NEP 2020 ALIGNED OBE CURRICULUM

PROGRAM: DIPLOMA IN PACKAGING TECHNOLOGY

by

Curriculum Development Cell,

Government Polytechnic, Nagpur

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TABLE OF CONTENTS

FOREWORD- CHAIRMAN GOVERNING BOARD XXVII

FOREWORD- PAST MEMBER SECRETARY GOVERNING BOARD XXIX

FOREWORD- MEMBER SECRETARY GOVERNING BOARD XXXI

FOREWORD- MEMBER SECRETARY, BOARD OF STUDIES XXXIII

PREAMBLE XXXV

LIST OF FIGURES XXXVII

LIST OF TABLES XXXIX

CHAPTER 1 INTRODUCTION 1

1.1 History 1

1.1.1 Autonomy 1

1.1.2 Awards 2

1.1.3 Geographical Location 2

1.1.4 Campus 4

1.2 Organizational Structure 4

1.3 Curriculum Development System 5

1.3.1 Governing Board (GB) 7

1.3.2 Board of Studies (BOS) 8

1.3.3 Program Wise Board of Studies (PBOS) 9

1.3.4 Advisory Board (AB) 10

1.4 Outline of Document 10

CHAPTER 2 NATIONAL EDUCATION POLICY 2020 12

2.1 NEP 2020: Reforms in Education System 12

2.1.1 Pillars of NEP 12

2.2 Features of NEP 2020 13

2.2.1 Holistic and Multidisciplinary Learning 13

2.2.2 Multiple Entry and Exit Options 13

2.2.3 Education in Mother Tongue/Local Language 14

2.2.4 Flexibility and Choice-Based Credit System (CBCS) 14

2.2.5 Vocational Education and Skill Development 14

2.2.6 Research and Innovation Ecosystem 14

2.2.7 Emphasis on Ethical and Sustainable Practices 15

2.2.8 Global Exposure and Collaboration 15

2.2.9 Gradual De-affiliation from Universities 15

2.3 Implementation of NEP 2020 in Engineering Institutes 15

2.3.1 Key Highlights of the GoM GR 16

2.4 Conclusion 17

CHAPTER 3 OBE APPROACH IN CURRICULUM DESIGN 18

3.1 Introduction to OBE 18

3.2 Why the OBE Approach? 19

3.3 Outcome-Based Education 19

3.3.1 Outcome-Based Curriculum (OBC) 20

3.3.2 Outcome-Based Learning and Teaching (OBLT) 20

3.3.3 Outcome-Based Assessment (OBA) 21

3.4 Benefits of Outcome-Based Education 21

3.5 Key Constituents of OBE 22

3.6 Role of Feedback in Curriculum Design 24

3.7 Conclusion 24

CHAPTER 4 BLOOM'S TAXONOMY 26

4.1 Introduction to Bloom's Taxonomy 26

4.2 Domains of Learning 27

4.2.1 Cognitive Domain 28

4.2.1 Psychomotor Domain 30

4.2.1 Affective Domain 32

4.3 Program Outcomes and Domains of Learning 33

4.4 Conclusion 34

CHAPTER 5 SWOT ANALYSIS FOR OBE CURRICULUM DEVELOPMENT 35

5.1 Stepwise Procedure for SWOT Analysis 35

5.1.1 Identify the Questionnaire for Conducting SWOT Analysis 35

5.1.2 Finalize the Questionnaire through Program-Level Brainstorming 36

5.1.3 Prepare Google Forms for Feedback Collection 36

5.1.4 Conduct Feedback Analysis at the Department Level 37

5.1.5 Conclude the SWOT Analysis 37

5.2 SWOT analysis of Packaging TechnologyProgram ..... **Error! Bookmark not defined.**

5.2.1 Strengths (S): ..... **Error! Bookmark not defined.**

5.2.2 Weaknesses (W): ..... **Error! Bookmark not defined.**

5.2.3 Opportunities (O): ..... **Error! Bookmark not defined.**

5.2.4 Threats (T): ..... **Error! Bookmark not defined.**

5.3 Conclusion 38

CHAPTER 6 CURRICULUM REVISION PROCESS 40

6.1 Change Management 40

6.1.1 ADKAR Model for Change Management 41

6.1.2 Results of ADKAR Model 42

6.2 Curriculum Development Process 42

6.2.1 Identify the Competencies and Skills 43

6.2.2 Finalize Competencies and Skills 44

6.2.3 Obtain Feedback Through Google Forms 44

6.2.4 Perform Feedback Analysis 46

Outcome: A clear understanding of stakeholder perspectives, which informs the validation process. 46

6.2.5 Validate Competencies and Skills in Search Conference 47

6.2.6 Preparation of Program Structure 50

6.2.7 Preparation of Course Curriculum 52

6.2.8 Approval from AB, PBOS, BOS and GB 52

6.3 Curriculum Development at a Glance 53

6.4 Conclusion 53

CHAPTER 7 FEATURES OF NEP ALIGNED CURRICULUM 55

7.1 Introduction 55

7.2 Initiatives by the CDC Cell 56

7.3 Features of NEP aligned curriculum 57

7.3.1 Seven Verticals 57

7.3.2 Outcome-Based Education (OBE) 62

7.3.3 Multiple Entry-Multiple Exit (MEME) 62

7.4 Lateral Entry (As per AICTE/State Govt. Guidelines) 63

7.5 Credit-based System 63

7.6 Industrial Training 64

7.7 Self-Study Learning & Its Assessment 64

7.8 Inclusion of Spoken Tutorials and NPTEL Courses 65

7.9 One Skill Enhancement Course (SEC) in Every Semester 66

7.10 One Value Education Course (VEC) in Every Semester 66

7.11 Generic Elective Courses 66

7.12 Introduction of Notional Hours 66

7.13 Award of Certificate/Diploma 67

7.14 Conclusion 67

CHAPTER 8 COURSE CURRICULUM 68

8.1 Basic Information 68

8.1.1 Program 68

8.1.2 Course Category 69

8.1.3 Course Code 69

8.1.4 Course Title 70

8.2 Rationale 70

8.3 Industry-identified competency 71

Figure 8.4. Industry-identified Competency 71

8.4 Course Outcomes (COs) 71

Figure 8.5. Course Outcomes 72

8.5 Learning Scheme 73

8.5.1 Classroom Learning (CL) 73

8.5.2 Laboratory Learning (LL) 73

8.5.3 Tutorial Learning (TL) 73

8.5.4 Self-Study Learning (SL) 74

Figure 8.6. Learning Scheme 74

8.6 Assessment Scheme 74

Figure 8.7. Assessment Scheme 74

8.6.1 Formative Assessment (FA) 74

8.6.2 Summative Assessment (SA) 75

8.7 Classroom Learning Content 75

8.7.1 Specific Learning Outcomes 75

Figure 8.8. Classroom Learning Content 76

8.8 Laboratory Learning Content 76

Figure 8.9. Laboratory Learning Content 77

8.9 Self-Study Learning (SLO in Cognitive / Psychomotor / Affective Domain) 77

Figure 8.10. Self-Study Learning Content 77

8.10 Specification Table for Classroom Learning Assessment 78

8.11 Question Paper Format for Summative Assessment (SA) 79

Figure 8.12. Question Paper Profile 79

8.12 Scheme of Laboratory Formative Assessment (FA) 79

Figure 8.13. Scheme of Laboratory Formative Assessment 80

8.13 Scheme of Self-Learning Summative Assessment (SA) 80

8.14 COs-POs/PSOs Mapping Matrix 81

8.15 Textbooks, BIS Codes References 82

Figure 8.16. Textbooks, BIS Codes References 82

8.16 e-References 82

Figure 8.17. e-References 82

8.17 List of Major Equipment/Machineries with Specification 83

Figure 8.18. List of Major Equipment/Machineries 83

8.18 List of Industry Experts and Faculties who contributed for this curriculum 83

Figure 8.19. List of Industry Experts and Faculties 84

CHAPTER 9 CURRICULUM DOCUMENT 85

9.1 Vision of Institute 85

9.2 Mission of Institute 85

9.3 Vision of Program 85

9.4 Mission of Program 85

9.5 Program Educational Objectives (PEOs) 86

9.6 Program Outcomes (POs) 86

9.7 Program Specific Outcomes (PSOs) 87

9.8 Mapping of Vision, Mission, PEOs, POs, PSOs 87

9.8.1 Mapping of Vision and Mission 88

9.8.2 Mapping of Mission and PEOs 88

9.8.3 Mapping of PEOs and POs- PSOs 88

9.9 Industry Identified Competencies in Search Conference 89

9.10 Courses Identification 93

9.11 Program Structure 101

APPENDIX A CURRICULUM 102

FOREWORD- Chairman Governing Board

Dr. Vinod Mohitkar
Chairman, Governing Board
&
Director, Technical Education, Mumbai

It is with immense pride and a deep sense of purpose that I present the *NEP aligned 2023 Curriculum for Diploma in Engineering*, a landmark step in advancing technical education. As Chairman of the Governing Board of Government Polytechnic, Nagpur and Director of Technical Education, Maharashtra State, I consider this curriculum a reflection of our collective commitment to the transformative vision laid out in the National Education Policy (NEP) 2020.

This curriculum embraces the core principles of Outcome-Based Education (OBE) and integrates the modern educational framework of Bloom's Taxonomy, focusing on equipping students with future-ready skills, practical knowledge, and professional competencies. Designed to foster innovation, critical thinking, and a hands-on learning approach, it addresses the rapidly evolving needs of industries and communities alike.

I wish to place on record my sincere appreciation for the Board of Studies Chairman and all Board of Studies members, whose leadership, insight, and dedication played a pivotal role in shaping this curriculum. Special thanks are also due to the Principal, Heads of Departments (HODs) and faculty members of various programs who actively contributed by

sharing ground-level teaching insights, refining course content, and ensuring alignment with real-world applications. Their collaborative efforts with the Program-wise Board of Studies academic and industry experts, who brought in valuable field experience, ensured that the curriculum remained dynamic, relevant, and future-oriented.

Through multiple rounds of consultations, workshops, and rigorous reviews, the curriculum has evolved to incorporate sector-specific innovations, practical implementation pathways, and learner-centric strategies. The collaboration between academia and industry—spearheaded by the Boards of Studies—has ensured that the curriculum is not only academically robust but also aligned with current industry standards and future demands.

This curriculum document, including chapters on NEP 2020, OBE philosophy, SWOT analysis, and curriculum development methodology, along with more than 50 carefully curated course curricula of each program, stands as a testimony to the vision and meticulous planning behind this academic reform.

I am confident that *Curriculum 2023* will serve as a cornerstone for excellence in technical education. It is our collective responsibility to implement it with the same spirit of dedication that guided its creation, as we work toward nurturing a generation of skilled, thoughtful, and responsible technocrats.

(Dr. Vinod Mohitkar)
Chairman, Governing Board, Government Polytechnic, Nagpur
and Director, Technical Education, Maharashtra State.

FOREWORD- Past Member Secretary Governing Board

Dr. Manoj Daigavane
Ex. Member Secretary, Governing Board,
Government Polytechnic, Nagpur &
Jt. Director, Technical Education, R.O. Nagpur

It is with immense pride and a deep sense of accomplishment that I pen this foreword for the revised NEP aligned curriculum document of Government Polytechnic, Nagpur. Having had the privilege to serve as the Member Secretary when the journey of aligning our educational framework with the transformative vision of the National Education Policy (NEP) was first initiated, I witnessed firsthand the dedication and foresight that has culminated in this comprehensive and forward-thinking curriculum.

The landscape of technical education is ever-evolving, and the NEP 2020 has provided a robust framework for fostering holistic, multidisciplinary, and skill-oriented learning. This curriculum document is a testament to our institution's commitment to embracing these progressive ideals. It meticulously integrates key NEP principles, ensuring that our students are not only academically proficient but also adaptable, innovative, and socially responsible citizens ready to contribute meaningfully to the nation's growth.

A cornerstone of this revision has been the unwavering focus on Outcome-Based Education (OBE), meticulously structured around the principles of Bloom's Taxonomy. This ensures that every learning experience is purposeful, with clearly defined outcomes that empower students to

acquire not just knowledge, but also critical thinking, problem-solving, and practical skills. The shift towards an outcome-centric approach will undoubtedly enhance the quality of learning and prepare our graduates for the complex demands of the 21st-century workforce.

The development of this curriculum has been a truly collaborative endeavor, embodying the spirit of collective expertise. The rigorous curriculum development process, involving extensive deliberations, workshops, and feedback sessions, has been instrumental in shaping this document. This curriculum is a testament to collaborative effort. My sincere gratitude goes to the distinguished experts and dedicated faculty, especially the In-charge of the Curriculum Development Cell, who spearheaded the writing of various chapters, ensuring their depth and relevance. Their tireless work has been instrumental.

As the Ex. Member Secretary of the Governing Board, Government Polytechnic, Nagpur, the supreme authority for curriculum approval, I can attest to the thorough scrutiny and thoughtful consideration given to every aspect of this revision. We are confident that this new curriculum will not only uphold the high standards of academic rigor that Govt. Polytechnic, Nagpur is known for, but also empower our students to become lifelong learners and leaders in their chosen fields.

I commend everyone involved in this monumental undertaking. This curriculum is a beacon guiding our students towards a brighter future, and I am confident it will contribute significantly to their personal and professional growth, and ultimately, to the progress of our nation.

[Dr. M. B. Daigavane]
Ex-Member Secretary, Governing Board,
Government Polytechnic, Nagpur

FOREWORD- Member Secretary Governing Board

(Dr. R.P.Mogre)
Member Secretary, Governing Board
&
Principal, Government Polytechnic, Nagpur

It gives me immense pleasure to present this comprehensive curriculum document developed by our autonomous polytechnic, a result of collaborative academic vision, pedagogical advancement, and policy alignment. This curriculum reflects a strategic response to the National Education Policy (NEP) 2020, integrating its transformative vision into technical education.

The document outlines the systematic curriculum development process, beginning with institutional introspection through SWOT analysis and guided by the principles of Outcome-Based Education (OBE). The integration of Bloom's Taxonomy ensures that the curriculum targets holistic cognitive development, fostering analytical, creative, and application-level competencies in students.

The curriculum has been developed by teams of experienced faculty members and subject experts under the guidance of the In-charge of the Curriculum Development Cell. Their efforts were directed toward making the curriculum learner-centric, industry-responsive, and future-ready. Notably,

the design process included inputs from domain specialists and industry professionals previously associated with our Program-wise Board of Studies and Board of Studies, ensuring both academic relevance and industrial applicability.

As the Member Secretary of the Governing Board—the apex academic authority for curriculum approval—I take pride in acknowledging the tireless dedication and academic integrity with which this document has been developed and approved. I am confident that this curriculum will serve as a robust foundation to produce competent, ethical, and innovative diploma professionals aligned with national aspirations.

(Dr. R.P. Mogre)
Member Secretary,
Governing Board, Government Polytechnic, Nagpur
&
Principal, Government Polytechnic, Nagpur

FOREWORD- Member Secretary, Board of Studies

Mr. Sudhir P. Pathak
Chairman, Board of Studies
Government Polytechnic, Nagpur

It gives me immense pleasure to present the NEP aligned 2023 Curriculum for the Diploma in Engineering, developed at Government Polytechnic, Nagpur.

As a Chairman of the Board of Studies and with the background of having served in Engineering and Auto industry for several decades, I deeply recognize the need for a dynamic, responsive, and industry-aligned technical education framework. This curriculum is a forward-looking document, inspired by the National Education Policy 2020 and built upon the principles of Outcome-Based Education (OBE).

The demands of the modern industrial landscape viz. digital transformation, sustainability, automation, global competitiveness, et al. requires diploma engineers who are not just technically competent but also, innovative, versatile, resourceful, and ethically grounded. This curriculum assuredly reflects those very values. It is designed with inter and intra institute deliberations and with careful consideration to the needs of students, industry, and society as well. It integrates modern pedagogical approaches such as Bloom's Taxonomy, continuous curriculum enhancement through SWOT analysis, and comprehensive assessment techniques. It also emphasizes skill development, entrepreneurship, and holistic learning

through internship and industry interaction and fosters a vibrant academic environment, ensuring that students graduate with the competencies required in the 21st-century workplace.

The Board of Studies has worked collaboratively with faculty, industry experts, alumni, and academic leaders to ensure that every course and learning outcome is relevant and robust.

I commend the entire curriculum development team for their assiduous efforts and dedication to excellence. Their work marks a significant step toward creating technically sound, socially responsible, and globally employable engineers. I am confident that this document will serve as a strong foundation for academic delivery and industry collaboration in the years to come.

Let us continue to inspire, evolve and, innovate building a stronger future for technical education in India.

[Sudhir P. Pathak]

Chairman, Board of Studies, Government Polytechnic, Nagpur

Preamble

The 2023 Curriculum of Government Polytechnic, Nagpur for the Diploma in Engineering reflects a transformative shift in technical education, firmly rooted in the Outcome-Based Education (OBE) framework, and aligned with the visionary directives of the National Education Policy (NEP) 2020. This curriculum has been thoughtfully designed to respond to the changing educational landscape, technological advancements, and evolving industry requirements, with a strong focus on practical skills, flexibility, and holistic development.

Our institute, renowned for its commitment to excellence in technical education, continues to play a vital role in shaping competent professionals who contribute meaningfully to national development. Through the modernization and continuous refinement of our academic offerings, we aim to empower students with the skills, attitudes, and knowledge necessary for lifelong success. Our focus has always remained on innovative, learner-centered curriculum development, emphasizing both technical competence and personal growth.

In line with NEP 2020 reforms, the revised curriculum embraces several key features: a choice-based credit system, multiple entry and exit options, skill-based education, soft skill and industry internship, and value-based education. These features not only support multidisciplinary learning but also foster creativity, critical thinking, and ethical responsibility among students.

The curriculum revision process was undertaken through a highly participative and structured approach. Valuable inputs were gathered from a wide spectrum of stakeholders, including industry experts, alumni, academic leaders, and students, ensuring the curriculum remains relevant, responsive, and forward-looking. Guided by the Governing Board (GB), Board of Studies (BOS), Program-wise Board of Studies (PBOS), and the Curriculum

Development Cell (CDC) of the institute, played integral roles in shaping this document. The contributions of faculty members, Heads of Departments (HODs), and domain experts further enriched the content and ensured alignment with the latest technological and pedagogical standards.

The implementation of OBE principles ensures clarity in learning outcomes, structured assessment strategies, and continuous improvement through feedback and evaluation. The integration of Bloom's Taxonomy, domain-specific learning objectives, and a clearly defined assessment framework supports differentiated learning across cognitive, affective, and psychomotor domains. A SWOT analysis methodology was employed to identify program-level strengths, gaps, opportunities, and challenges—laying the foundation for robust and future-ready program structures.

The NEP aligned 2023 curriculum offers a balanced and flexible learning scheme incorporating classroom instruction, laboratory experience, tutorials, and self-directed learning. Innovative elements such as skill enhancement courses, value education, NPTEL and Spoken Tutorial integration, and notional hour calculation reflect the comprehensive nature of the new academic structure.

Our institutional vision is to emerge as a Center of Excellence in technical education, committed to nurturing innovation, employability, and entrepreneurship. The NEP aligned 2023 Curriculum is a significant milestone in our academic journey, reinforcing our legacy of quality and our dedication to continuous educational advancement. It sets the stage for dynamic, student-centric learning environments that inspire students to contribute actively to society and industry.

[Dr. G. V. Gotmare]
Member Secretary, Board of Studies &
I/C, Curriculum Development Cell, Government Polytechnic, Nagpur

LIST OF FIGURES

Figure 1.1. Location of Nagpur City 3
Figure 1.2. Government Polytechnic, Nagpur Campus 4
Figure 1.3. Organizational Structure of GPN 5
Figure 1.4. Curriculum Development System 6
Figure 3.1. Outcome Based Education Framework 20
Figure 3.2. Key Constituents of OBE 22
Figure 4.1. Human Being and Domains of Learning 27
Figure 4.2. Revised cognitive hierarchy Levels 29
Figure 4.3. Psychomotor hierarchy Levels 31
Figure 4.4. Affective Domain hierarchy Levels 32
Figure 4.5. Program Outcomes and Domains of Learning 33
Figure 6.1. Mapping of change management tools with ADKAR 42
Figure 6.2. Identification of Competencies and Skills 43
Figure 6.3. Finalized List of Competencies and Skills 44
Figure 6.4. Feedback through Google Form 45
Figure 6.5. Feedback Analysis 46
Figure 6.6. Industry Survey Rating Report 49
Figure 6.7. Identified Courses List based on Industry Survey 49
Figure 6.8. Basic Program Structure 51
Figure 8.1. Basic Information 68
Figure 8.2. Course Code Details 69
Figure 8.3. Rationale 71
Figure 8.4. Industry-identified Competency 71
Figure 8.5. Course Outcomes 72

Figure 8.6. Learning Scheme 74

Figure 8.7. Assessment Scheme 74

Figure 8.8. Classroom Learning Content 76

Figure 8.9. Laboratory Learning Content 77

Figure 8.10. Self-Study Learning Content 77

Figure 8.11. Specification Table 78

Figure 8.12. Question Paper Profile 79

Figure 8.13. Scheme of Laboratory Formative Assessment 80

Figure 8.14. Scheme of Laboratory Formative Assessment 80

Figure 8.15. COs-POs/PSOs Mapping Matrix 81

Figure 8.16. Textbooks, BIS Codes References 82

Figure 8.17. e-References 82

Figure 8.18. List of Major Equipment/Machineries 83

Figure 8.19. List of Industry Experts and Faculties 84

LIST OF TABLES

Table 4.1. Cognitive Domain Levels Action Verbs.....29

Table 4.2. Psychomotor Domain Levels Action Verbs.....31

Table 4.3. Affective Domain Levels Action Verbs.....32

Table 6.1. Basic Program Structure 51

Table 7.1. UG Verticals 57

Table 7.2. Seven Verticals adopted by GPN 58

Table 7.2. Multiple Entry-Multiple Exit.....62

Table 9.1. Mapping of Vision-Mission 88

Table 9.2. Mapping Mission-PEOs 88

Table 9.3. Mapping PEOs-POs & PSOs.....88

Table 9.4. Courses Identification from Identified Competencies.....93

CHAPTER 1

Introduction

This chapter describes the history, organization structure, curriculum development system and the various bodies responsible for the development of curriculum of Government Polytechnic, Nagpur (GPN).

1.1 History

The Government Polytechnic, Nagpur, stands as one of the oldest technical institutions in central India. Established on July 14, 1914, it began as the Government Engineering School. Initially housed in the Victoria Science College (currently the Institute of Science), the institution started with just 16 students. In its inaugural year, it offered diploma-level courses in Civil and Mechanical Engineering. By 1915, an Automobile Engineering course was introduced, which later evolved into a Post Diploma program in Automobile Engineering. The institution played a pivotal role in the establishment of what is now the Visvesvaraya National Institute of Technology (VNIT), Nagpur. Over the years, the institution experienced significant growth, expanding from its modest beginnings to an enrollment of nearly 2,000 students today. The Government Engineering School was eventually renamed Government Polytechnic, Nagpur.

1.1.1 Autonomy

The Institute recently commemorated its centenary, celebrating 111 years of outstanding contribution to technical education. Government

Polytechnic, Nagpur has a rich history of evolving to meet the needs of industry and society. The institution remains committed to addressing the educational demands of an ever-changing world.

In 1995, the Government of Maharashtra granted the institute autonomous status under Government Resolution No. WBP-1093/(2640) (69)VE-5, dated March 31, 1994. This autonomy empowered the institute to independently introduce new programs, design curricula, implement self-developed academic plans, and oversee the assessment, evaluation, and certification of students.

1.1.2 Awards

Some of the prestigious awards received by Government Polytechnic, Nagpur are as follows:

- State Award "Best Overall Performance 1996" (ISTE Narsee Monjee Award)
- State Award "Best Polytechnic, 1997" , (Govt. of Maharashtra)
- National Awards "Best Polytechnic, Student Chapter 2002", (Institute of Engineers (India))
- National Awards "Best Polytechnic, Student's Project ,2002" (ISTE Narsee Monjee)
- State Award "Best Overall Performance 2016" (ISTE Narsee Monjee Award)
- National Education Award for "Best Technical Educational Institute in Maharashtra State-2016"

1.1.3 Geographical Location

Nagpur, located in India, lies at a latitude of 21.146633 and a longitude of 79.088860. Its geographical coordinates are 21° 8'

47.8788'' N and 79° 5' 19.8960'' E. The city sits at an elevation of 311 meters above sea level and is positioned at the very center of the Indian subcontinent. As shown in Figure 1.1, Nagpur is home to the Zero Mile Stone, a landmark that historically marked the geographical center of India and was used by the British to measure distances across the Indian subcontinent. The city's name is derived from the Nag River, which flows through it, originating from a village named Lavha. Nagpur is renowned for its oranges, often referred to as "Nagpur oranges," and has earned the title of the "Orange City" due to its prominence as a major trading hub for the region's orange cultivation.

Figure 1.1. Location of Nagpur City

1.1.4 Campus

Government Polytechnic, Nagpur is situated in heart of the Nagpur City at "Sadar" area, 2.1 km walking distance from zero-mile stone as well as Nagpur railway station.

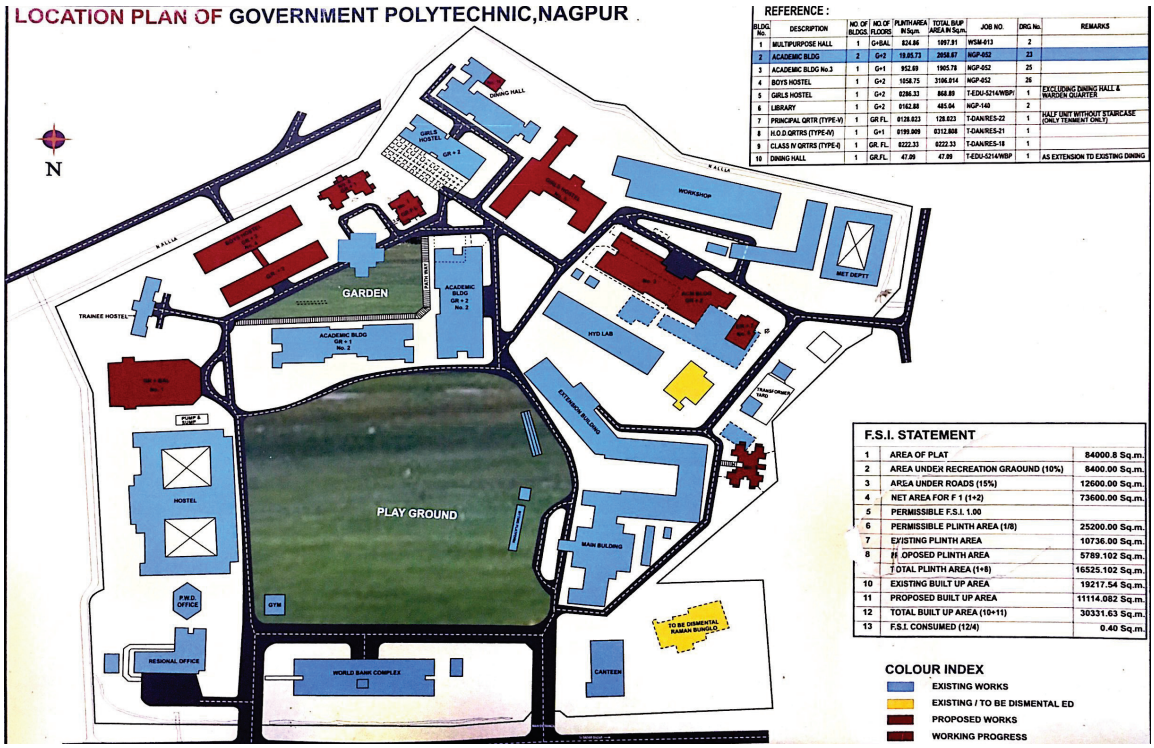

Figure 1.2. Government Polytechnic, Nagpur Campus

1.2 Organizational Structure

GPN, as a part of the Polytechnic Education System, has been addressing the needs of individuals, the community, society, and industry for over 111 years. Until 1995, its services operated under various affiliations, including the university, MP DTE, and MSBTE.

In 1995, the Government of Maharashtra granted GPN autonomous status. This autonomy empowered the institute to independently manage academic matters such as identifying the need for new

programs, designing requisite curricula, implementing self-designed curricula, and conducting student assessment, evaluation, and certification. In essence, the institute became fully accountable for these academic responsibilities, including facilitating student placements in the workforce.

To ensure effective and efficient operations under autonomous status, a functional organization was established alongside the institute's hierarchical structure, enabling streamlined management and governance.

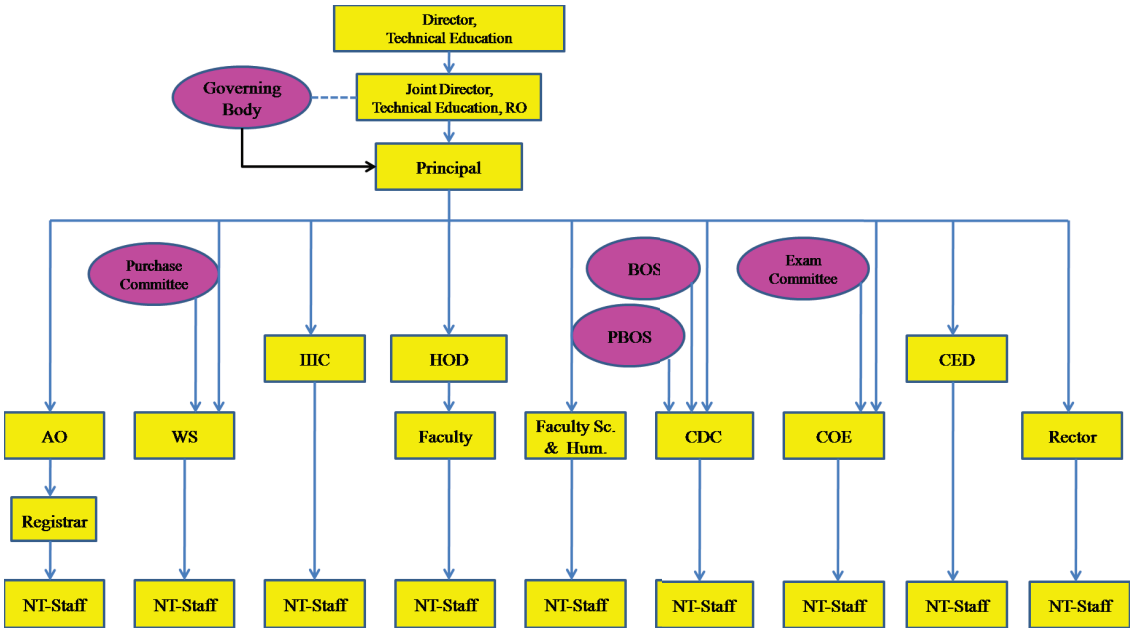

Figure 1.3. Organizational Structure of GPN

1.3 Curriculum Development System

Since 1995, the institute has been independently designing, revising, and implementing curricula for all programs under its autonomous status, except for Mining and Mine Surveying. This process is carried out using the Curriculum Development System illustrated in the accompanying figure 1.4.

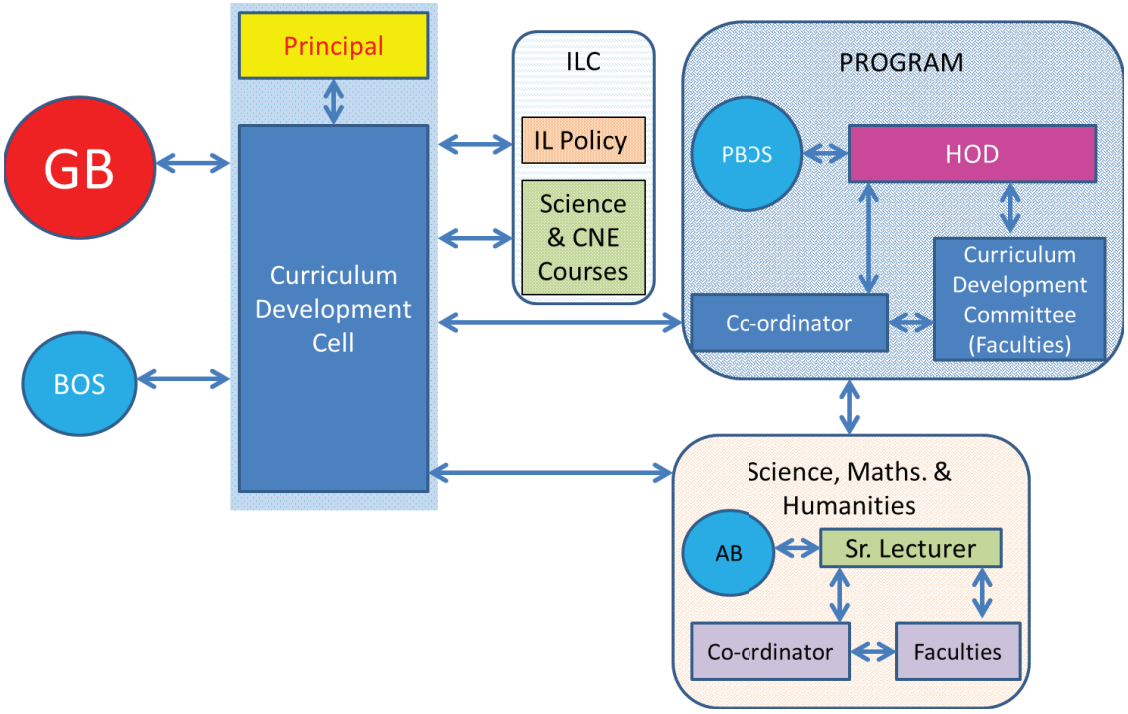

Figure 1.4. Curriculum Development System

The Curriculum Development System comprises various entities, including Program Departments (such as Civil, Mechanical, and Electrical), Non-Program Departments (such as Science, Mathematics, and Humanities), the Institute Level Committee (ILC), and the Curriculum Development Cell (CDC), which is headed by the Principal of the Institute. The institute follows a systematic process for designing, revising, developing, implementing curricula, and assessing and evaluating students to enhance their learning outcomes.

Constitutional bodies, such as the Governing Body (GB), Board of Studies (BOS), and Program-wise Board of Studies (PBOS) for specific programs, along with the non-constitutional Advisory Board (AB) for Non-Program Departments, are responsible for curriculum approval.

This section outlines the philosophy underpinning curriculum design, the mechanisms for its implementation, and the approach adopted for assessing student performance.

1.3.1 Governing Board (GB)

The Governing Body (GB) serves as the apex authority of GPN. Below is a detailed outline of its committee members, along with their roles and responsibilities.

- **Committee Members:**

1. Joint Director of Technical Education Maharashtra State, Bombay - Chairman
2. Nominee from Western Regional Committee Govt. of India - Member
3. Regional Officer, Human Resource Development or Co-ordinator, TTTI, Pune - Member
4. Representative from the Local Centre the I.E.(India) - Member
5. Representative from the Engineering Association - Member
6. Representative from the District Industries - Member
7. Project Director, State Project Implementation Unit (World Bank) – Member
8. Principal of the Polytechnic – Member Secretary

- **Functions and Responsibilities:**

1. To decide the policy of the institute and decide guidelines of the function of various committees.
2. To analyse all issues and provide policy directive for developing the scheme and implementing it at the institute level.

3. To appoint the various committees of Governance for smooth functioning of the Institute.
4. To institute scholarships fellowships studentships, Mudat prize and certificates on the recommendation of Board of Studies.
5. Approve new programmes of studies leading to Diploma/Post-Diploma.
6. Approve modifications in present curriculum in order to meet the changed demands of the industry society from time to time.
7. Approve Annual Reports of the Institute.
8. Approve Continuing Education Programmes or similar Activities Beneficial to the Students/Community Institute.
9. To approve the fees and other charges payable by the students of the Polytechnics on the recommendation of Board of Studies.

1.3.2 Board of Studies (BOS)

The Board of Studies (BOS) functions as an institute-level committee at GPN. The composition of its members, along with their roles and responsibilities, is detailed below.

- **Committee Members:**

1. Representative of the Industry - Chairman
2. Head of Department of 5 Programmes - Member
3. Local Experts of 5 Programmes- Member
4. Nominee of Board of Technical Examinations, M.S. Bombay- Member
5. In-charge of Curriculum Development Component– Member Secretary

- **Functions and Responsibilities:**

1. To prepare Syllabi for various courses and develop curriculum keeping in view the objectives of the Institute and the national requirement for consideration. Syllabi shall be equivalent to Syllabi of Board of Technical Examinations.
2. To suggest methodologies for innovative teaching and evaluation techniques.
3. To Co-ordinate research teaching, extension, and other academic activities in the various departments/ institute.
4. To recommend books including test books for various courses of studies.

1.3.3 Program Wise Board of Studies (PBOS)

The Program Board of Studies (PBOS) is a program-specific committee, with GPN comprising 13 PBOS committees. The composition of its members, along with their roles and responsibilities for each program, is outlined below.

- **Committee Members:**

1. Head of the Department concerned- Chairman
2. Two Senior Lecturers- Member
3. One expert in the programme from the neighbouring institution - Member
4. Nominee from the Board of Technical Examinations Bombay - Member
5. One Expert from the local industry in each Programme – Member
6. In-charge of Curriculum Development component - Member-Secretary

- **Functions and Responsibilities:**

1. To decide Philosophy of curriculum design course wise.
2. To analyse present needs and to identify desirable changes, additions, deletions course-wise.
3. Analyse of personnel development.
4. Formation of Programme objectives.
5. Selection of contents.
6. Design of student's evaluation.
7. To decide resources required and development thereof.
8. To decide strategy of implementation.
9. Recommend equivalence for granting exemptions.

1.3.4 Advisory Board (AB)

The Non-Program Departments (Science, Mathematics, and Humanities) do not have PBOS as per the Government Resolution. Instead, an Advisory Board (AB) has been constituted to function similarly to PBOS for these departments. There are four ABs, one each for the Physics, Chemistry, Mathematics, and English Departments.

1.4 Outline of Document

This document comprises nine chapters, each covering a key aspect of curriculum development at GPN:

Chapter 1 provides an overview of GPN, its organizational structure, and the curriculum development system.

The key provisions of NEP 2020 and relevant Government Resolutions (GR) issued by the Government of Maharashtra are examined in Chapter 2.

A detailed discussion on the principles and implementation of Outcome-Based Education (OBE) is presented in Chapter 3.

Chapter 4 focuses on Bloom's Taxonomy and its significance in designing effective learning outcomes.

A structured approach to conducting a SWOT analysis is outlined in Chapter 5.

The process for revising the 2023 curriculum is comprehensively detailed in Chapter 6.

Chapter 7 highlights the key features of an NEP 2020-aligned curriculum at GPN.

Detailed course curriculum content is presented in Chapter 8.

The complete curriculum document, along with comprehensive descriptions, is compiled in Chapter 9, while the appendix provides course-specific details.

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CHAPTER 2

National Education Policy 2020

The National Education Policy (NEP) 2020 aims to revolutionize India's education system for the 21st century by fostering holistic learning, inclusivity, and global competitiveness. Key reforms include flexible learning pathways, vocational integration, and a focus on research and sustainability. This chapter explores these features, highlighting their impact on engineering education and India's evolution into a vibrant knowledge society.

2.1 NEP 2020: Reforms in Education System

The National Education Policy (NEP) 2020 is a landmark reform in India's educational landscape, promising transformative changes to prepare students for the 21st century and beyond. Rooted in Indian ethos, NEP 2020 aspires to create a knowledge society by ensuring high-quality, inclusive, and equitable education for all. It emphasizes holistic development, employability, and international competitiveness while maintaining alignment with India's traditions, culture, and value system.

2.1.1 Pillars of NEP

NEP 2020 is built on five foundational pillars:

- **Access**: Ensuring education is available to all.
- **Equity**: Bridging disparities across regions and communities.
- **Quality**: Enhancing educational standards to global levels.

- **Affordability**: Making education economically accessible.
- **Accountability**: Promoting transparency and efficiency.

2.2 Features of NEP 2020

The NEP 2020 emphasizes holistic and multidisciplinary learning, flexible academic pathways with multiple entry and exit options, and the integration of vocational education for skill development. Following paragraph describes these features.

2.2.1 Holistic and Multidisciplinary Learning

NEP 2020 emphasizes a multidisciplinary approach, enabling students to explore diverse subjects beyond their core disciplines. For engineering students, this approach:

- Encourages creativity, critical thinking, problem-solving, and digital literacy.
- Allows for degree customization with minors in humanities, social sciences, or management, complementing technical expertise.
- Offers options for degrees with research, honors, or dual specializations.

2.2.2 Multiple Entry and Exit Options

The policy introduces flexibility in education:

- **Stages of Certification**: Students can receive certificates, diplomas, or degrees based on their level of completion, ensuring recognition at every stage.
- **Academic Bank of Credits (ABC)**: Facilitates credit accumulation and transfer across institutions.

- **Lifelong Learning**: Enables students to re-enter education at any stage for skill enhancement.

2.2.3 Education in Mother Tongue/Local Language

Promoting instruction in regional languages enhances comprehension, retention, and communication, fostering a deeper connection to cultural roots.

2.2.4 Flexibility and Choice-Based Credit System (CBCS)

NEP 2020 introduces CBCS to:

- Allow students to tailor their learning paths.
- Enable deeper exploration of specialized areas or interdisciplinary studies.
- Support internships and research projects for hands-on skill development.

2.2.5 Vocational Education and Skill Development

Integrating vocational education ensures:

- Alignment with industry needs.
- Access to skill-based courses, apprenticeships, and collaborations.
- Graduates are both academically proficient and industry-ready.

2.2.6 Research and Innovation Ecosystem

The policy fosters a culture of research and innovation by:

- Encouraging institutes to establish research parks, incubators, and technology transfer offices.
- Promoting collaboration between students and industry partners.

- Supporting commercialization of student innovations.

2.2.7 Emphasis on Ethical and Sustainable Practices

Engineering curricula under NEP 2020 incorporate ethics, environmental studies, and social responsibility. This equips students to:

- Tackle societal challenges like climate change and resource scarcity.
- Develop solutions that prioritize sustainability and equity.

2.2.8 Global Exposure and Collaboration

NEP 2020 encourages:

- Internationalization through partnerships, exchange programs, and joint research.
- Exposure to diverse cultures and advanced technologies, enhancing global competence.

2.2.9 Gradual De-affiliation from Universities

The policy advocates autonomous institutions, allowing them to develop independent academic frameworks and standards.

2.3 Implementation of NEP 2020 in Engineering Institutes

A flexible credit framework, detailed in Maharashtra Government's GRs dated July 4 and August 3, 2023, mandates NEP-aligned curricula from AY 2023-24 for autonomous institutions and AY 2024-25 for affiliating institutions.

2.3.1 Key Highlights of the GoM GR

1. **Multiple Entry and Exit Options**
    - Certificates, diplomas, and degrees are awarded at progressive stages.
    - Holistic and multidisciplinary education is facilitated, with major and minor subject combinations.
2. **Choice of Major and Minor Subjects**
    - Students must complete a minimum of 50% credits in core subjects.
    - Options for multidisciplinary minors and honors degrees are provided.
3. **Indian Knowledge Systems (IKS)**
    - Integration of IKS courses promotes interdisciplinary research and societal applications.
4. **Academic Bank of Credits (ABC)**
    - Enables credit transfer and mobility within the education system.
5. **Outcome-Based Curriculum**
    - Designed per international standards, focusing on learning outcomes and assessments.
6. **Strengthening Industry-Academia Linkages**
    - Emphasizes internships and apprenticeships, fostering collaboration with industries.
7. **Key Result Areas (KRAs)**
    - Institutions are advised to implement KRAs for the successful execution of NEP 2020.

2.4 Conclusion

The NEP 2020 is a transformative step toward reimagining India's education system. It not only addresses the present educational challenges but also paves the way for creating a globally competent, ethically grounded, and environmentally conscious workforce. For engineering students, it opens doors to multidisciplinary learning, research opportunities, and industry alignment, equipping them to meet the demands of a dynamic global landscape.

CHAPTER 3

OBE Approach in Curriculum Design

Outcome-Based Education (OBE) focuses on achieving specific learning outcomes to meet real-world demands. It emphasizes skill development through learner-centric methods, preparing students for modern challenges. OBE ensures quality education aligned with accreditation standards and societal needs, fostering holistic student growth. This chapter describes some aspect of OBE.

3.1 Introduction to OBE

Outcome-Based Education (OBE) is a transformative educational framework that prioritizes the attainment of specific outcomes or graduate attributes by students upon the completion of an academic program. Unlike traditional teacher-centric models, OBE is inherently learner-centric, emphasizing what students are expected to know, demonstrate, and achieve at the end of their learning journey. This paradigm shift ensures that educational programs align closely with the demands of industry, society, and other stakeholders.

The adoption of OBE has gained significant momentum globally due to its focus on measurable outcomes and its ability to produce graduates who are better equipped to meet real-world challenges. Recognizing its importance, the National Board of Accreditation (NBA) in India has mandated the implementation of OBE for all engineering programs seeking accreditation from 2013 onwards. By adopting the OBE model, educational institutions ensure that their programs meet international standards of quality and relevance.

3.2 Why the OBE Approach?

The NBA's emphasis on OBE stems from its fundamental focus on producing competent and industry-ready graduates. OBE shifts the focus from the teaching process to the learning outcomes, making it a student-focused model. This approach ensures that the curriculum, teaching methods, and assessments are designed to enable students to achieve predefined outcomes, thereby enhancing the overall educational experience.

Key reasons for adopting OBE include:

- **Learner-Centric Philosophy:** OBE places the student at the center of the educational process, focusing on their ability to apply knowledge and skills effectively in practical scenarios.
- **Alignment with Accreditation Standards:** As accreditation bodies like NBA prioritize OBE, its adoption is essential for programs aiming for national and international recognition.
- **Focus on Graduate Attributes:** OBE ensures that students develop specific attributes such as critical thinking, problem-solving, communication, teamwork, and ethical responsibility, which are crucial for success in their careers.

3.3 Outcome-Based Education

The framework required for implementation of OBE consists of the following as shown in Figure:

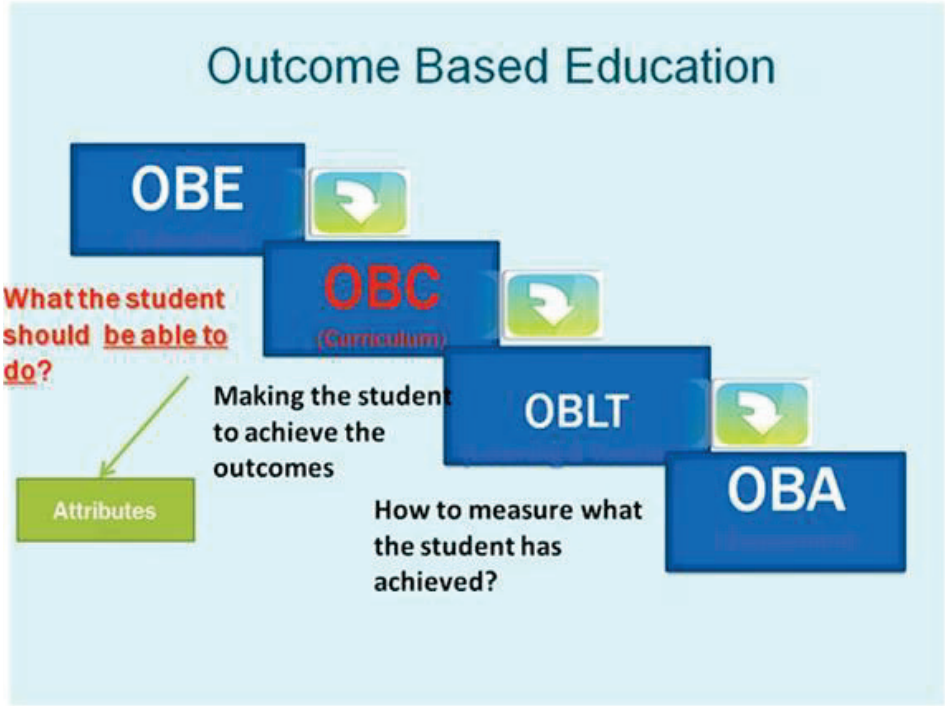

Figure 3.1. Outcome Based Education Framework

3.3.1 Outcome-Based Curriculum (OBC)

The curriculum forms the foundation of the OBE framework. An outcome-based curriculum is structured around the specific abilities and knowledge students should acquire by the end of the program. The design process begins by defining program educational objectives (PEOs), program outcomes (POs), and course outcomes (COs). These outcomes are tailored to meet the needs of stakeholders, including industries, employers, and society at large.

The key question driving an outcome-based curriculum is: **"What should students be able to do upon completing the program?"**

3.3.2 Outcome-Based Learning and Teaching (OBLT)

OBE extends beyond curriculum design to include teaching and learning practices. Outcome-based teaching and learning involve

adopting instructional strategies that actively engage students and help them achieve the desired outcomes. These methods include project-based learning, case studies, problem-solving exercises, and hands-on practical sessions.

The focus of OBLT is: **"How can we facilitate students in achieving the defined outcomes?"**

3.3.3 Outcome-Based Assessment (OBA)

Assessment plays a pivotal role in measuring whether students have achieved the intended outcomes. Outcome-based assessment uses various tools and methods, such as rubrics, assignments, projects, and exams, to evaluate student performance. These assessments are designed to provide feedback on students' mastery of skills, knowledge, and competencies.

The central question for outcome-based assessment is: **"How do we measure what students have achieved?"**

3.4 Benefits of Outcome-Based Education

The OBE approach offers several advantages that make it a preferred choice for curriculum design in engineering and technical education:

1. **Directed and Coherent Curriculum:** OBE ensures that the curriculum is well-structured and aligned with the desired outcomes, enabling a seamless progression of learning.
2. **Relevance to Industry and Stakeholders:** Graduates from OBE-aligned programs possess skills and knowledge that meet the needs of employers, industries, and society, making them more employable and impactful.
3. **Focus on Lifelong Learning:** By emphasizing critical thinking, problem-solving, and adaptability, OBE prepares students for

continuous learning and growth in their professional and personal lives.

4. **Improved Accountability:** With clear outcomes, institutions are better able to demonstrate the effectiveness of their programs to accreditation bodies and stakeholders.
5. **Enhanced Student Engagement:** The learner-centric nature of OBE encourages active participation, fostering a deeper understanding of concepts.

3.5 Key Constituents of OBE

Outcome-based education (OBE) focuses on clearly defined learning outcomes, ensuring students achieve specific knowledge, skills, and attitudes by the end of their educational experience. The following are the key constituents of OBE, which are shown in following figure:

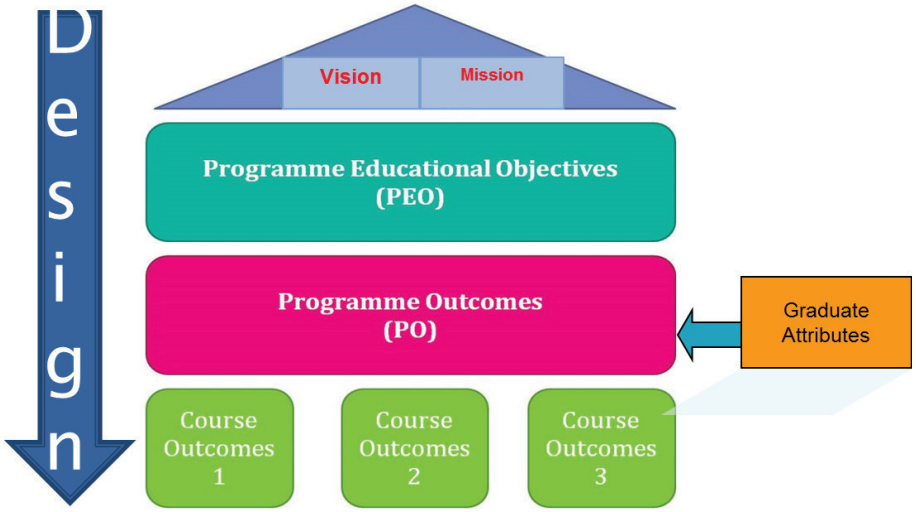

Figure 3.2. Key Constituents of OBE

1. **Vision:** Vision is a picture of the future you seek to create, described in the present tense, as if it were happening now. It

shows where we want to go, and what we will be like when we get there.

2. **Mission:** Mission statement defines what an institution is, why the institution exists, and its reason for being. It defines what we are here to do together.
3. **Graduate Attributes (GAs):** Graduate attributes are the qualities, skills and understandings a university community agrees its students should develop during their time with the institution. These attributes include but go beyond the disciplinary expertise or technical knowledge that has traditionally formed the core of most university courses. WA (Washington Accord) defines 12 GA's for Engineering Graduates.
4. **Program Outcomes (POs):** Programme Outcomes (POs) describe what students should know and be able to do at the end of the programme. They are to be in line with the graduate attributes (GAs). PO's are to be specific, measurable and achievable. POs transform the PEOs into specific student performance and behaviors that demonstrate student learning and skill development.
5. **Program Specific Outcomes (PSOs):** PSOs focus on equipping students with specialized knowledge, skills, and competencies required for industry, research, or higher education, ensuring they are ready to contribute effectively in their chosen field.
6. **Program Educational Objectives (PEOs):** The Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that the programme is preparing graduates to accomplish. PEOs should

be measurable, appropriate, realistic, time bound and achievable.

7. **Course Outcomes (COs):** Course Outcomes (COs) are specific, measurable statements that describe the knowledge, skills, and attitudes students are expected to acquire upon completing a particular course.
8. **Specific Learning Outcomes (SLOs):** Specific Learning Outcomes (SLOs) are precise, actionable statements that define the intended achievements of students for each topic or unit within a course, focusing on knowledge, skills, or attitudes.

3.6 Role of Feedback in Curriculum Design

Feedback from stakeholders plays a crucial role in designing and refining an OBE-based curriculum. Insights from industry experts ensure that the curriculum remains aligned with current trends and demands. Alumni feedback provides valuable information on the relevance of the program in real-world applications, while academic experts offer guidance on integrating innovative pedagogical practices. This collaborative approach ensures that the curriculum remains dynamic, relevant, and effective.

3.7 Conclusion

The adoption of Outcome-Based Education in curriculum design marks a significant step forward in aligning technical education with the evolving needs of the 21st century. By focusing on clearly defined outcomes and employing a structured framework, OBE ensures that students are equipped with the skills and knowledge required to thrive in their professional and personal lives. As the NBA continues to emphasize the importance of OBE for accreditation, institutions must

embrace this learner-centric approach to deliver quality education and contribute meaningfully to society.

CHAPTER 4

Bloom’s Taxonomy

Outcome-Based Education (OBE) is a learning-centered educational model where the curriculum, teaching methods, and assessments are designed to achieve specific student learning outcomes. Learning is defined as a relatively permanent change in behavior or abilities resulting from reinforced practice or experience. Educational taxonomies, such as Bloom's Taxonomy, play a crucial role in developing an OBE curriculum. Benjamin Bloom and a group of educational psychologists created this classification system to categorize learning objectives. Key aspects of Bloom's Taxonomy are foundational to designing effective learning outcomes in OBE which are outlined below.

4.1 Introduction to Bloom’s Taxonomy

In 1948, Benjamin Bloom developed a framework for classifying intellectual behavior and learning to identify and measure progressively advanced learning levels. Bloom's Taxonomy is particularly significant in higher education, where outcomes must assess students' ability to apply information rather than simply recall and repeat concepts. While lower levels of learning are easier to evaluate, they fail to fully demonstrate students' ability to utilize their knowledge. Additionally, learning extends beyond cognitive processes; it varies when it involves performing a skill or re-evaluating behavior. This approach is rooted in the biological structure of human beings, as illustrated in the figure 4.1.

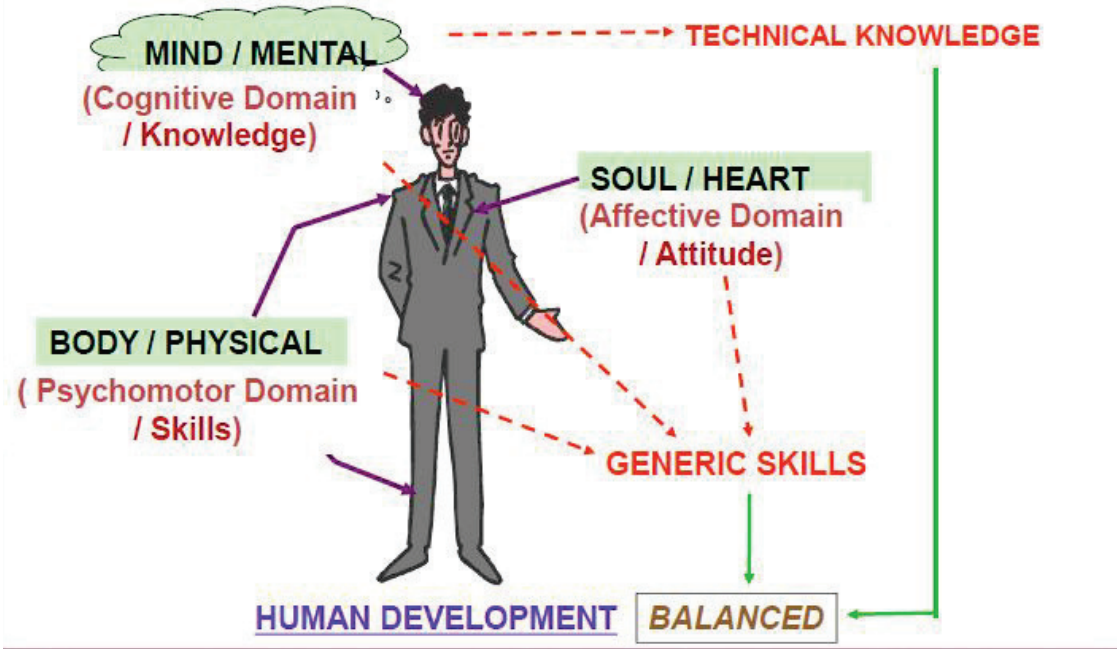

Figure 4.1. Human Being and Domains of Learning

The key elements of this approach, which form the foundation of learning, are outlined below.

4.2 Domains of Learning

Learning is the process through which students achieve a relatively permanent change in mental associations through experience, as defined by cognitive psychologists. Behavioral psychologists, on the other hand, define learning as a relatively permanent change in behavior. However, learning is not solely a cognitive function; it varies when it involves performing skills or re-evaluating behavior.

Learning encompasses the following three domains:

- **Cognitive Domain:** Focuses on intellectual skills and abilities.
- **Affective Domain:** Relates to emotions, attitudes, preferences, and values.

- **Psychomotor Domain:** Involves physical skills, such as hand-eye coordination and manipulative abilities.

In Engineering and Technology courses, the curriculum is designed to emphasize the development of cognitive skills through classroom teaching. Psychomotor skills are cultivated in workshops, laboratories, and seminars where students engage in individual or group activities. Affective skills, including attitudes and values, are nurtured through projects, co-curricular activities, and the institution's work culture.

Student progress in cognitive and psychomotor domains is evaluated through classroom learning and laboratory learning assessments respectively. Additionally, self-study learning plays a vital role by encouraging independent exploration, critical thinking, and problem-solving skills, enabling students to deepen their understanding and apply knowledge effectively.

4.2.1 Cognitive Domain

In 1956, Dr. Benjamin Bloom analyzed examination questions in the American education system and proposed a hierarchical structure of instructional objectives based on the intellectual abilities these questions assessed.

At the most basic level of cognitive learning, students demonstrate their ability to recall information directly from long-term memory. This includes retrieving facts, concepts, principles, laws, definitions, properties, and procedures. Objectives focused on memory recall were classified as knowledge-level objectives, representing the lowest tier in Bloom’s hierarchy of intellectual abilities. Questions testing memory were considered the simplest form of assessment.

The higher levels of the hierarchy introduced by Dr. Bloom in 1956, and later revised in 2001, involve progressively more complex

cognitive processes required to answer questions. These levels reflect increasing demands on the brain's ability to process and use information. The complete hierarchy, including its revised version, is depicted in the accompanying figure 4.2.

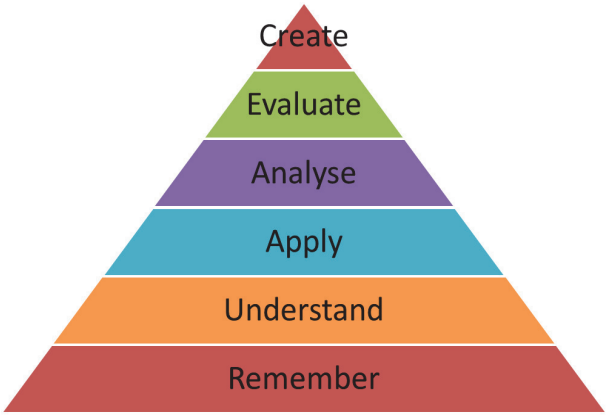

Figure 4.2. Revised cognitive hierarchy Levels

Table 4.1. Cognitive Domain Levels Action Verbs

Cognitive Domain Levels	Behavior descriptions	Action Verbs
Remember	Recall or recognize information	Define, Duplicate, List, Name, Identify, Recall, Reproduce, Recognize, Retrieve
Understand	Understand meaning, re-state data in one's own words, interpret, extrapolate, translate	Calculate, Categorize, Clarify, Classify, Compare, Conclude, Contrast, Describe, Exemplify, Expand, Illustrate, Infer, Interpret, Locate, Paraphrase, Predict, Report, Restate, Summarize, Translate

Apply	Use or apply knowledge, put theory into practice, use knowledge in response to real circumstances	Carry out, Classify, Demonstrate, Execute, Illustrate, Implement, Practice, Solve, Use, Utilize
Analyse	Interpret elements, organizational principles, structure, construction, internal relationships; quality, reliability of individual components	Appraise, Attribute, Compare, Contrast, Deconstruct, Detect, Differentiate, Discriminate, Distinguish, Examine, Formulate, Infer, Integrate, Organize, Parse, Relate, Select, Sequence, Structure, Test
Evaluate	Assess effectiveness of whole concepts, in relation to values, outputs, efficacy, viability; critical thinking, strategic comparison and review; judgment relating to external criteria	Appraise, Check, Coordinate, Critique, Defend, Detect, Dispute, Judge, Monitor, Prioritize, Rate, Reconstruct, Select, Support, Verify
Create	Develop new unique structures, systems, models, approaches, ideas; creative thinking, operations	Change, Combine, Compile, Compose, Construct, Create, Design, Formulate, Generate, Hypothesize, Improve, Invent, Plan, Predict, Produce

4.2.1 Psychomotor Domain

The Psychomotor Domain, as defined by R.H. Dave in 1970, was introduced to focus on the development of skills related to the physical aspects of performing tasks. Since 'motor' skills go beyond the traditional notion of manual and physical abilities, it is important to incorporate this domain, even if the Cognitive and Affective Domains appear sufficient in your context. Regardless of the scenario, the Psychomotor Domain is likely to play a significant role.

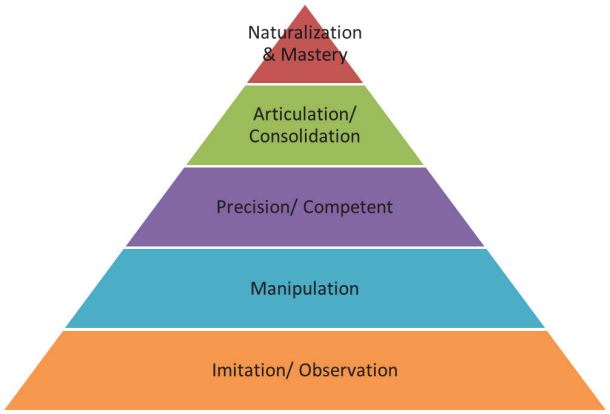

Figure 4.3. Psychomotor hierarchy Levels

Table 4.2. Psychomotor Domain Levels Action Verbs

Psychomotor Domain Levels	Behavior descriptions	Action Verbs
Imitation/ observation	Copy action of another; observe and replicate	Copy, follow, replicate, repeat, adhere, attempt, reproduce, organize, sketch, duplicate
Manipulation	Reproduce activity from instruction or memory	Re-create, build, perform, execute, implement, acquire, conduct, operate
Precision/ competent	Execute skill reliably, independent of help, activity is quick, smooth, and accurate	Demonstrate, complete, show, perfect, calibrate, control, achieve, accomplish, master, refine
Articulation/ consolidation	Adapt and integrate expertise to satisfy a new context or task	Solve, adapt, combine, coordinate, revise, integrate, adapt, develop, formulate, modify, master
Naturalization & Mastery	Instinctive, effortless, unconscious mastery of activity and related skills at strategic level	Construct, compose, create, design, specify, manage, invent, project-manage, originate

4.2.1 Affective Domain

The Affective Domain, as outlined by Bloom, Krathwohl, and Masia in *Taxonomy of Educational Objectives: Vol. II* (1964)*, The Affective Domain*, emphasizes the development of attitudes, which are now often referred to as 'beliefs' in personal development. Bloom's theory proposes a structure and sequence for cultivating attitudes, providing a framework for teaching, training, and evaluating the effectiveness of instruction. This framework also helps assess the impact on learners, including how well the training is retained and its influence on the individual.

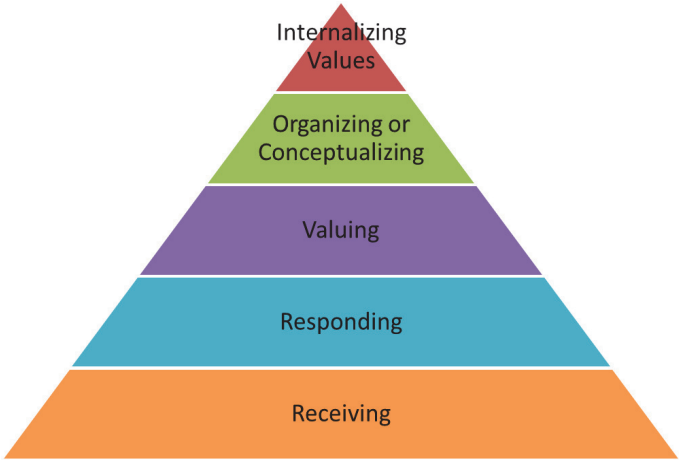

Figure 4.4. Affective Domain hierarchy Levels

Table 4.3. Affective Domain Levels Action Verbs

Affective Domain Levels	Behavior descriptions	Action Verbs
Receiving	Open to experience, willing to hear	Ask, listen, focus, attend, take part, acknowledge, hear, be open to, retain, follow, concentrate, read, do, feel
Responding	React and participate actively	React, respond, interpret, clarify, contribute, question, present, cite, write, perform

Valuing	Attach values and express personal opinions	Argue, challenge, debate, refute, confront, justify, persuade, criticize,
Organizing or Conceptualizing	Reconcile internal conflicts; develop value system	Build, develop, formulate, defend, modify, relate, prioritize, reconcile, contrast, arrange, compare
Internalizing Values	Adopt belief system and philosophy	Act, display, influence, solve, practice,

4.3 Program Outcomes and Domains of Learning

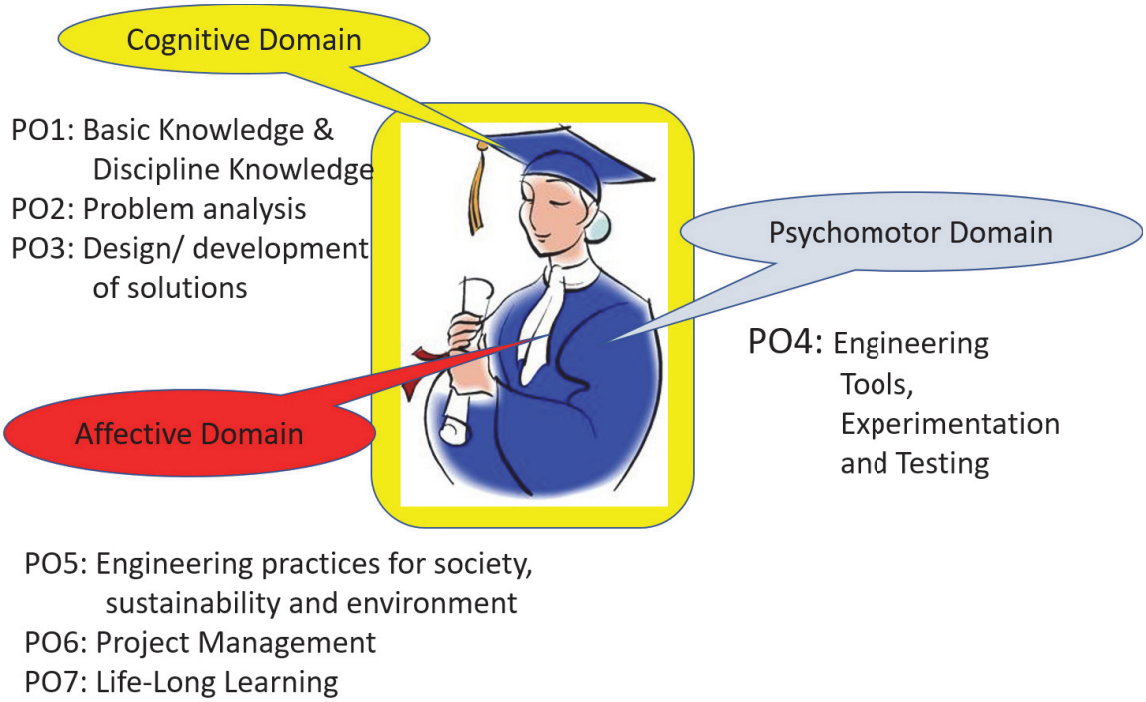

Figure 4.5. Program Outcomes and Domains of Learning

Program Outcomes (POs) defined by the NBA for diploma students represent the specific skills and characteristics expected by stakeholders from the students. These outcomes are closely linked to the three domains of learning, as illustrated in the figure. This classification plays a key role in shaping the curriculum.

4.4 Conclusion

Outcome-Based Education (OBE) provides a structured framework for aligning curriculum, teaching methodologies, and assessments with clearly defined learning outcomes. Rooted in the OBE philosophy, this approach ensures that the curriculum of GPN is designed to develop competencies that meet academic and professional expectations. By leveraging educational taxonomies, educators can systematically define and assess learning objectives across cognitive, affective, and psychomotor domains. A well-implemented OBE model enhances student learning by focusing on measurable outcomes and continuous improvement.

CHAPTER 5

SWOT Analysis for OBE Curriculum Development

SWOT analysis, a strategic planning tool, plays a vital role in developing an effective Outcome-Based Education (OBE) curriculum. By systematically identifying Strengths, Weaknesses, Opportunities, and Threats (SWOT), institutions can align their educational programs with stakeholders' needs and expectations. This chapter outlines a stepwise approach for conducting a SWOT analysis as part of the curriculum development process.

5.1 Stepwise Procedure for SWOT Analysis

The stepwise procedure for SWOT analysis involves preparing a questionnaire, gathering feedback via digital forms, and analyzing responses at the department level. This systematic approach concludes with actionable insights to refine the curriculum and align it with stakeholder needs.

5.1.1 Identify the Questionnaire for Conducting SWOT Analysis

The first step involves formulating a questionnaire that will serve as a foundation for gathering feedback. The Curriculum Development Cell (CDC) collaborates with stakeholders to create questions targeting key areas such as academic quality, infrastructure, teaching methodologies, industry relevance, and overall program effectiveness. These questions must be:

- Clear and concise.
- Relevant to the program’s objectives and outcomes.
- Designed to elicit actionable insights.

Example Questions:

- What are the program's key strengths that contribute to achieving its objectives?
- What challenges or weaknesses hinder program effectiveness?
- What opportunities can be leveraged to enhance the curriculum?
- What external threats could impact the program’s success?

5.1.2 Finalize the Questionnaire through Program-Level Brainstorming

The draft questionnaire is reviewed and refined through brainstorming sessions at the program level. Faculty members, department heads, and other relevant stakeholders participate in this collaborative process to ensure:

- Comprehensive coverage of all critical aspects.
- Inclusion of diverse perspectives.
- Alignment with the program’s vision and mission.

The finalized questionnaire should be validated for clarity and relevance before proceeding to the next step.

5.1.3 Prepare Google Forms for Feedback Collection

Each program uses the finalized questionnaire to create digital feedback forms, such as Google Forms, to ensure ease of access and convenience for respondents. The forms are designed to:

- Include multiple-choice, Likert scale, and open-ended questions.
- Ensure anonymity to encourage honest feedback.
- Be mobile-friendly to maximize response rates.

Feedback is solicited from key stakeholders:

- **Faculty**: Insights on academic and administrative challenges.
- **Students**: Perspectives on learning experiences and outcomes.
- **Alumni**: Reflections on the program’s impact in their professional lives.

5.1.4 Conduct Feedback Analysis at the Department Level

The collected data is analyzed at the departmental level to derive meaningful insights. The analysis process includes:

- **Quantitative Analysis**: Statistical methods to summarize responses and identify trends.
- **Qualitative Analysis**: Thematic analysis of open-ended responses to uncover nuanced insights.

Departments categorize the findings under the four SWOT components:

- **Strengths**: Areas of excellence and key program differentiators.
- **Weaknesses**: Areas needing improvement.
- **Opportunities**: Emerging trends and potential areas for growth.
- **Threats**: External factors that may pose challenges.

5.1.5 Conclude the SWOT Analysis

The final step is to summarize and document the findings of the SWOT analysis. This involves:

- Preparing a comprehensive report highlighting key observations and actionable recommendations.
- Sharing the report with stakeholders, including the CDC and institutional leadership.
- Using the findings to inform curriculum revisions, resource allocation, and strategic planning.

Example Outcome:

- Strength: Strong industry tie-ups for internships and placements.
- Weakness: Limited access to advanced laboratory equipment.
- Opportunity: Growing demand for skill-based courses in emerging technologies.

- Threat: Increasing competition from online education platforms.

5.2 SWOT Analysis of Packaging Technology Program

5.2.1 Strengths (S):

1. Government Recognition & Support – Offered by Government Polytechnic, Nagpur, an autonomous institute under the Government of Maharashtra, ensuring credibility and academic autonomy.
2. Exclusive Program in the State – The only institute in Maharashtra running this specialized and job-oriented diploma program, giving it a unique position in technical education.
3. Industry-Aligned Curriculum – Syllabus updated every five years to reflect industry trends, technological advancements, and market demands.
4. Outcome-Based Education – Credit system ensuring graduates possess industry-relevant skills.
5. Qualified Teaching Faculty – Experienced and knowledgeable staff providing academic and practical expertise.
6. Strong Infrastructure – Laboratories, classrooms, cafeteria, playground, and separate boys' and girls' hostels.
7. Strategic Location – Situated in Sadar(heart of the city), Nagpur, offering accessibility and industry connectivity.
8. Affordable Fees – Nominal tuition costs enabling access for students from diverse socio-economic backgrounds.

5.2.2 Weaknesses (W):

1. Limited number of updated computer systems for running advanced packaging design software.
2. Procedural delays in procurement of new equipment and laboratory upgrades.
3. Shortage of regular faculty members in certain core subject areas.

5.2.3 Opportunities (O):

1. Expanding national and international demand for skilled packaging professionals in manufacturing, FMCG, e-commerce, pharmaceuticals, and export sectors.

2. Potential for strong industry linkages for internships, placements, and collaborative research projects.
3. Ability to attract students from across the country and overseas due to program exclusivity and industry relevance.
4. Scope for developing expertise in emerging domains like sustainable packaging, biodegradable materials, and smart packaging technologies.

5.2.4 Threats (T):

1. Rapid technological advancements in packaging requiring frequent upgrades to equipment, software, and teaching practices.
2. Low public awareness of packaging as a specialized profession, with misconceptions that it is limited to simple carton or box manufacturing.
3. Industry's increasing preference for multi-disciplinary professionals, necessitating regular curriculum enhancement to integrate allied skills

5.3 Conclusion

SWOT analysis is a critical step in the OBE curriculum development process, enabling institutions to align their programs with stakeholder needs and industry trends. By following the stepwise procedure outlined in this chapter, programs can ensure a systematic, inclusive, and data-driven approach to curriculum improvement, fostering academic excellence and long-term success.

CHAPTER 6

Curriculum Revision Process

Since attaining autonomous status, GPN has revised its curriculum every five years, with the 2023 revision marking the seventh iteration. While the concept of Bloom's Taxonomy has been part of the GPN curriculum from the start, the comprehensive Outcome-Based Education (OBE) model was first implemented in the 2016 curriculum and has been carried forward to the 2023 curriculum. The 2023 curriculum is also aligned with the National Education Policy 2020. The detailed process of revising the 2023 curriculum is outlined below.

6.1 Change Management

GPN, a diploma-level educational institute, offers 14 diploma programs, 13 of which operate under autonomous status. Revising the curriculum for these programs within a short timeframe, while adopting a new and unfamiliar model, posed a significant challenge for the Curriculum Development Committee (CDC). It is natural for individuals to resist change, even under the best circumstances.

To address this, GPN implemented the ADKAR model for change management. This diagnostic tool enabled the institution and its staff to understand their position in the change process. It also helped identify gaps in the change management process and provided effective coaching for faculty members.

The ADKAR model was instrumental in:

- Managing faculty resistance.
- Guiding faculty through the transition process.

- Creating a successful action plan for curriculum development.
- Developing an effective strategy for curriculum design and implementation.

6.1.1 ADKAR Model for Change Management

The ADKAR model has gained significant popularity among managers and project teams due to its simplicity and ease of application. It is also effective in educating others, including executive sponsors of change. ADKAR represents five key building blocks for successful change:

- **Awareness**: Understanding the need for change.
- **Desire**: Willingness to participate in and support the change.
- **Knowledge**: Learning how to implement the change.
- **Ability**: Developing the skills and behaviours required for the change.
- **Reinforcement**: Ensuring the change is sustained over time.

In the curriculum revision process, the following change management tools are utilized:

1. Communication
2. Motivation
3. Workshops
4. Resistance Management
5. Training

Figure 6.1 illustrates the mapping of these tools with the ADKAR framework.

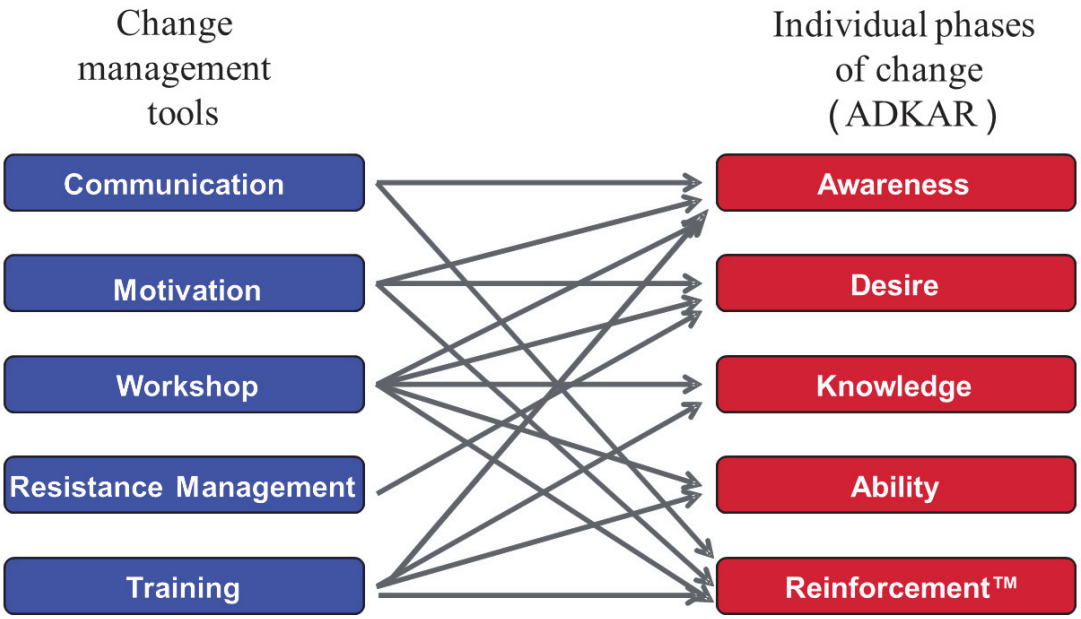

Figure 6.1. Mapping of change management tools with ADKAR

6.1.2 Results of ADKAR Model

The application of the ADKAR model in the curriculum revision process achieved the following results:

- Start Date of Curriculum Revision Process: **16/08/2023**
- Completion Date of Curriculum Revision Process: **31/12/2024**
- Duration to Complete Curriculum Revision: **16 ½ months**
- Number of Programs: **13**
- Number of Course curriculum Developed: **383**
- Implementation of NEP aligned OBE curriculum from for First Semester: **September 2023**

6.2 Curriculum Development Process

Curriculum development is a systematic process aimed at designing and refining educational programs to meet the needs of learners and

stakeholders. The steps outlined below describe an effective approach for developing a curriculum based on identified competencies and skills

6.2.1 Identify the Competencies and Skills

The first step in curriculum development involves identifying the key competencies and skills that students must acquire. This stage requires a thorough understanding of industry demands, technological advancements, and stakeholder expectations. Input from subject matter experts, educators, and industry professionals is crucial to ensure the relevance of the competencies and skills being identified.

Key Activities:

- Conduct surveys through internet.
- Review current trends and advancements in the field.
- Analyze job descriptions and roles to pinpoint essential skills.

Outcome: A comprehensive list of competencies and skills required by learners to succeed in their field. List of competencies and skills for various diploma programs prepared by Curriculum Development Cell is shown in Figure 6.2 (Screen Shot).

S.N.	Diploma in Electrical Engineering Students will be able to:
1	Apply principles of physics to solve broad based relevant engineering problems.
2	Apply principles of chemistry to solve broad based relevant engineering problems.
3	Use computers for documentation, presentation, analyse data and Internet services.
4	Prepare engineering drawing using prevailing drawing instruments.
5	Apply the concept of Mathematics to solve industry-based technology problems.
6	Use different engineering tools for performing shop floor activities.
7	Use basic principles in electrical engineering for different applications
8	Use electronic components and circuits for electrical applications.
9	Apply principles of mechanical engineering to solve broad based engineering problems
10	Analyze electrical circuits to determine voltage, current, and power relationships.
11	Conduct electrical tests and measurements accurately and interpret the results.
12	Operate and maintain various electrical machines, ensuring optimal performance.
13	Operate and maintain transformers for electrical systems.
14	Operate and maintain generators for power generation.
15	Apply the principles of power distribution systems and effectively manage electrical distribution.
16	Apply the principles of power transmission systems and effectively manage electrical transmissio
17	Proficient in using electrical instrumentation for data collection and analysis.

Civil | Mechanical | Electrical | Electronics | Packaging | Automobile | Metallurgy | Computer

Figure 6.2. Identification of Competencies and Skills

6.2.2 Finalize Competencies and Skills

Once the competencies and skills have been identified, they are refined and finalized to ensure alignment with the program's objectives. This involves collaboration with key stakeholders to validate the findings and incorporate their feedback.

Key Activities:

- Organize meetings with curriculum development cell.
- Prioritize competencies and skills based on their importance and applicability.
- Document finalized competencies and skills for further use.

Outcome: A finalized and well-documented list of competencies and skills, forming the foundation of the curriculum.

Score	Hands on Skills
3.7	Conduct electrical tests using instruments such as multimeters, and other testing equipment to evaluate the performance of electrical system.
3.5	Wire and install electrical components, switches, outlets, and lighting fixtures.
3.5	Diagnose and troubleshoot electrical faults and problems in electrical equipment and domestic appliances.
3.4	Assemble and solder electronic components onto circuit boards.
3	Repair and modify electronic devices and PCBs.
3.3	Calibrate and maintain electrical instrumentation devices for measurement and control.
3.2	Install and maintain solar panels, wind turbines, and other renewable energy systems.
3	Install and maintain EV charging stations and systems.
3.3	Create and interpret electrical schematics and drawings using CAD software.
3.4	Conduct safety audits and inspections to ensure compliance with electrical safety standards.
3.2	Build and wire electrical panels and control cabinets.
2.8	Develop digital control systems for motors, power converters and battery stems using MATLAB and Simulink

Figure 6.3. Finalized List of Competencies and Skills

6.2.3 Obtain Feedback Through Google Forms

To ensure the relevance and quality of the identified competencies and skills, feedback is gathered from a broader audience. Google Forms is an effective tool for collecting responses from various stakeholders, including faculty members, industry representatives, and alumni.

Key Activities:

- Design a structured feedback form.
- Share the Google Form with relevant stakeholders through email and social media.
- Encourage stakeholders to provide honest and constructive feedback.

Outcome: A diverse set of feedback data that highlights the strengths and areas for improvement in the proposed competencies and skills.

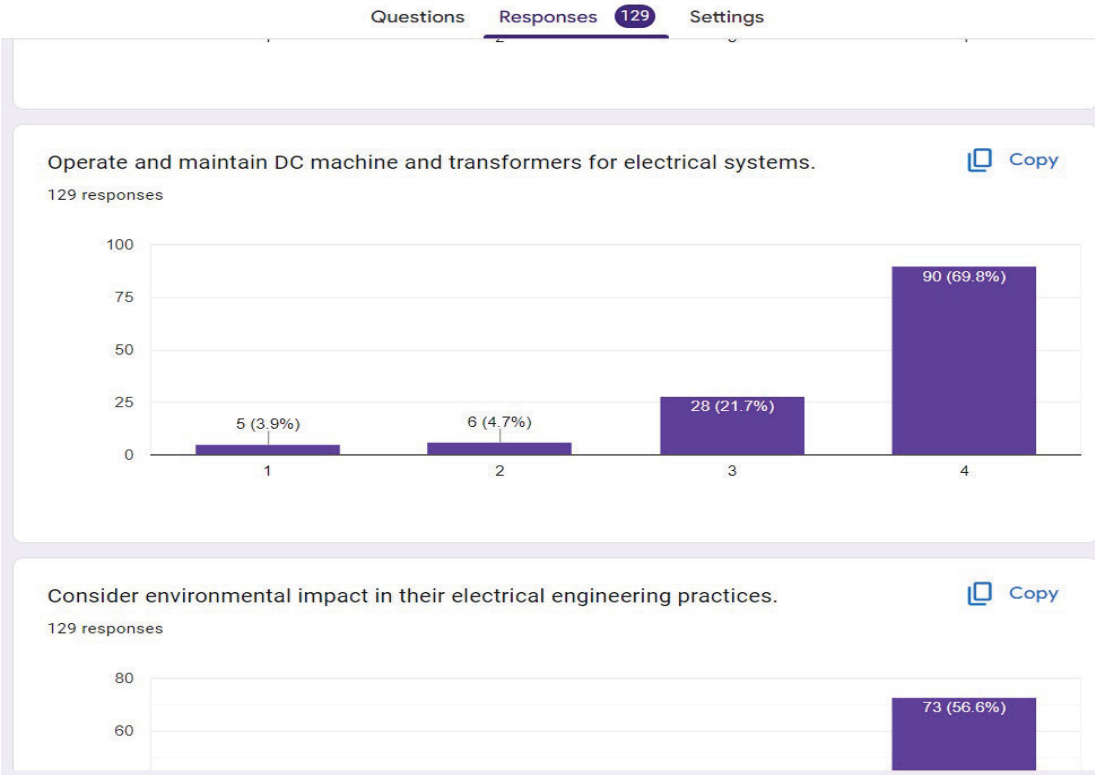

Figure 6.4. Feedback through Google Form

6.2.4 Perform Feedback Analysis

The feedback collected is analyzed to identify patterns, trends, and actionable insights. This step ensures that the curriculum aligns with stakeholder expectations and meets industry requirements.

Key Activities:

- Categorize feedback based on common themes and suggestions.
- Use data analysis tools to interpret quantitative and qualitative responses.
- Summarize findings and identify key takeaways.

Outcome: A clear understanding of stakeholder perspectives, which informs the validation process.

	A	B	C	D	E	F	G
1	Competencies	ME	E	D	NR	Total	Score
2	Communicate technical information clearly and effectively.	105	16	4	4	105	3.72093
3	Create and interpret electrical drawings and diagrams accurately.	95	26	3	5	95	3.635659
4	Prioritize safety in electrical engineering practices and adhere to established safety protocols.	97	21	7	4	97	3.635659
5	Identify, select, and use appropriate electrical materials and components.	90	30	6	3	90	3.604651
6	Use computers for documentation, presentation, analyze data and Internet services.	93	24	7	5	93	3.589147
7	Operate and maintain DC machine and transformers for electrical systems.	90	28	6	5	90	3.573643
8	Maintain electrical switchgears and protection systems to safeguard equipment and personnel.	88	29	9	3	88	3.565891
9	Optimize energy usage and promote energy efficiency in electrical systems.	87	30	8	4	87	3.550388
10	Use basic principles in electrical engineering for different applications.	89	25	12	3	89	3.550388
11	Exhibit leadership qualities and Manage time efficiently to meet project deadlines and goals.	84	35	6	4	84	3.542636
12	Implement renewable energy systems.	84	34	8	3	84	3.542636
13	Demonstrate a commitment to lifelong learning and professional development.	85	29	12	3	85	3.51938
14	Use electronic components and circuits for electrical applications.	86	30	6	7	86	3.511628
15	Use electrical instrumentation for data collection and analysis.	83	32	11	3	83	3.511628

Form Responses 1 | Analysis | Sheet2 | +

Figure 6.5. Feedback Analysis

6.2.5 Validate Competencies and Skills in Search Conference

The search conference is a structured event aimed at fostering dialogue among key stakeholders in education and industry. It serves as a forum for validating existing skills, identifying new competencies, and refining curriculum frameworks to ensure that graduates are equipped to meet industry demands. By involving a diverse array of participants, including industry professionals, academic experts, and alumni, the search conference creates a comprehensive feedback loop essential for continuous improvement in education.

The search conference is organized after systematically gathering feedback from stakeholders, ensuring that their insights and suggestions form the foundation of discussions and decisions. This preparatory step ensures that the conference discussions are relevant, targeted, and actionable, paving the way for meaningful outcomes.

During the Search Conference, additional suggestions are gathered from participants to further refine the curriculum. This step ensures inclusivity and leverages the expertise of diverse participants.

Objectives of the Search Conference

The primary objectives of organizing a search conference are as follows:

1. **Validation of Skills**: The search conference provides an opportunity to validate the competencies and skills outlined by the academic program. Industry experts assess whether these competencies and skills align with current workplace requirements, ensuring graduates possess competencies relevant to their fields.

2. **Identification of New Skills**: With rapid technological advancements and changing job roles, new skill sets are continually emerging. Industry and field experts suggest additional competencies that technicians need to excel in their specific work areas.
3. **Feedback Collection**: Feedback on the existing curriculum is gathered to identify strengths and areas for improvement. This includes reviewing suggestions from prior conferences or feedback sessions, creating a continuous cycle of curriculum enhancement.
4. **Curriculum Enhancement**: The conference serves as a brainstorming platform to propose new course content that reflects industry trends and innovations. This ensures the curriculum remains dynamic and forward-looking.
5. **Program Structure Analysis**: Stakeholders provide insights and suggestions on broader aspects of the program structure, such as course sequencing, interdisciplinary integration, and practical training components.
6. **Skills Analysis and Course Formation**: The validated and newly identified competencies and skills are analyzed to prepare a final list. This serves as a foundation for designing or revising courses that align with these skills, ensuring a targeted and effective educational approach.

Key Activities:

- Organize the Search Conference with representatives from academia, industry, and alumni.
- Present the identified competencies and skills for discussion.

- Facilitate group discussions to ensure active participation and consensus-building.

Outcome: The courses are designed based on competencies and skills validated during the Search Conference, ensuring alignment with industry needs. Inputs from the conference were systematically incorporated to create an industry-relevant, practical, and dynamic curriculum.

Industry Survey Rating Report for Diploma in Electrical Engineering

Competencies Required for Diploma in Electrical Engineering

S.N.	Competencies (What diploma holders will be able to do in the industry at entry level) Legends: ME-Most Essential, E-Essential, D-Desirable, NR-Not Required	ME	E	D	NR	Total	Score	Rank
1	Communicate technical information clearly and effectively.	105	16	4	4	129	3.72093	1
2	Create and interpret electrical drawings and diagrams accurately.	95	26	3	5	129	3.635659	2
3	Prioritize safety in electrical engineering practices and adhere to established safety protocols.	97	21	7	4	129	3.635659	3
4	Identify, select, and use appropriate electrical materials and components	90	30	6	3	129	3.604651	4

ty: Investigate

Figure 6.6. Industry Survey Rating Report

Diploma in Electrical Engineering

Formation of Courses according to Industry Feedback

S.N.	Competencies (What diploma holders will be able to do in the industry at entry level)	Rank based on Industry Feedback	Name of Course to be introduced in Curriculum	Remarks (if any)	Course Category DSC/DSE/SEC/AEC/VEC/INP etc.	Semester of the course
1	Communicate technical information clearly and effectively.	1	Communication Skill		AEC	First
2	Create and interpret electrical drawings and diagrams accurately.	2	Electrical Software and Computer Aided Drawing		SEC	
3	Prioritize safety in electrical engineering practices and adhere to established safety protocols.	3	Testing and Maintenance of Electrical Machines		DSC	Sixth
4	Identify, select, and use appropriate electrical materials and components.	4	Electrical Wiring		SEC	Third

Figure 6.7. Identified Courses List based on Industry Survey

6.2.6 Preparation of Program Structure

After analyzing the NEP 2020 guidelines, Government of Maharashtra GRs for NEP implementation, and conducting brainstorming sessions, the program structure is designed to align with NEP 2020 policies and industry standards. This step ensures a balanced curriculum that fosters holistic development and interdisciplinary learning.

Key Activities:

- Map courses to the seven verticals defined in NEP 2020 guidelines.
- Identify core, elective, skill-enhancement, value education, and internship courses for comprehensive coverage.
- Define semester-wise and course-wise credit distribution.
- Ensure interdisciplinary and multidisciplinary integration as per NEP requirements.

Outcome:

A well-structured program framework that reflects NEP 2020 principles, integrates stakeholder inputs, and supports the achievement of desired learning outcomes.

Table 6.1 presents the basic program structure common to all diploma programs in engineering. Figure 6.5 provides a visual representation of the program structure, including the exit options for a Certificate in Vocation after the first year and a Diploma in Vocation after the second year.

Table 6.1. Basic Program Structure

SN	Semester	DSC	DSE	GE	AEC	SEC	VEC	INP	Total Courses (Credits)
1	Sem I	DSC 1 (4) DSC 2 (4) DSC 3 (3)			AEC 1 (3)	SEC 1 (2) SEC 2 (2)	VEC 1 (2)		7 (20)
2	Sem II	DSC 4 (4) DSC 5 (4) DSC 6 (3) DSC 7 (3)			AEC 2 (2)	SEC3 (2)	VEC 2 (2)		7 (20)
3	Sem III	DSC 8 (3) DSC 9 (3) DSC10(3) DSC11(3)		GE 1 (2)		SEC 4 (2)	VEC 3 (2)	INP (4)	8 (22)
4	Sem IV	DSC12(3) DSC13(5) DSC14(4)	DSE 1 (3)	GE 2 (2)		SEC 5 (3)	VEC 4 (2)		7 (22)
5	Sem V	DSC15(3) DSC16(4)	DSE 2 (3)	GE 3 (2)		SEC 6 (2)	VEC 5 (1)	INP 1 (1) INP 2 (6)	8 (22)
6	Sem VI	DSC17(3) DSC18(3) DSC19(3)	DSE 3 (3)			SEC 7 (2)	VEC 6 (1)	INP 3 (1) INP 4 (6)	8 (22)
	Total Courses (Credits) Percentage Credits	19 (65) 50.78%	3 (9) 7.03%	3 (6) 4.68%	2 (5) 3.90%	7 (15) 11.71%	6 (10) 7.81%	5 (18) 14.06%	45 (128)

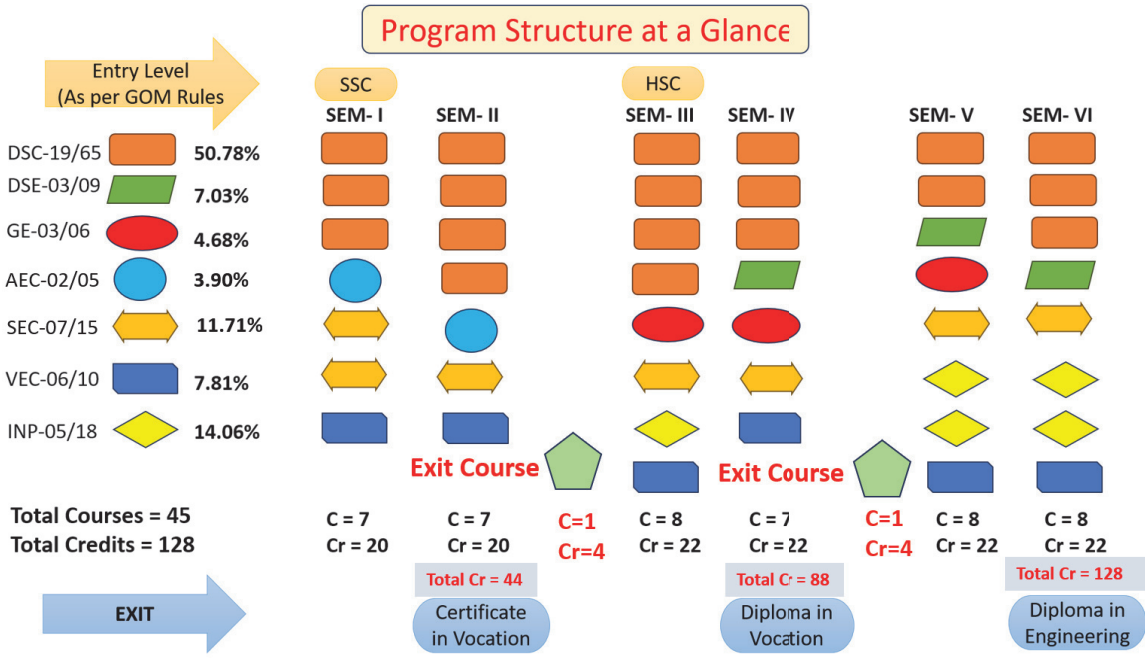

Figure 6.8. Basic Program Structure

6.2.7 Preparation of Course Curriculum

The course curriculum is developed based on industry-identified competencies, ensuring alignment with real-world demands and enhancing employability. Faculty members play a key role in integrating these competencies into the course design, focusing on practical and theoretical balance.

Key Activities:

- Align identified competencies with course outcomes (COs) and specific learning outcomes (SLOs).
- Develop course content that integrates classroom learning, laboratory learning, and self-study learning.
- Design assessment strategies to effectively measure the attainment of industry identified competencies.
- Identify essential textbooks, e-references, and major equipment required for course delivery.
- Establish a mapping framework to correlate course outcomes (COs) with program outcomes (POs) and program-specific outcomes (PSOs).

Outcome:

A NEP 2020 aligned competency-based OBE course curriculum that addresses industry requirements, promotes skill development, and ensures students are job-ready upon completion of diploma program.

6.2.8 Approval from AB, PBOS, BOS and GB

The program structure for all programs and the course curricula are approved by their respective PBOS, while the curricula for Science, Mathematics, and Humanities departments are approved by the Academic Board (AB). Science, Mathematics, and Humanities courses are also presented to the PBOS of each program for review and

approval. Suggestions received during PBOS meetings are incorporated before submission to the Board of Studies (BOS). All approved curricula are then forwarded to the Governing Body (GB) for final approval, incorporating the suggestions obtained from BOS.

6.3 Curriculum Development at a Glance

- No. of Programs : 13
- No. of Courses : 383
- No. of GB Meetings : 04
- No. of BOS Meetings : 04
- No. of PBOS Meetings : 52
- No. of AB Meetings : 04
- No. of ILC Meetings : 02
- No. of Coordinators Meetings : 09
- Trainings Workshops : 04
- Search Conference : 01
- No. of Industry Experts in Search Conference : 39
- No. of Faculties Involved : 101
- No. of outside Experts Involved : 39
- Curriculum Editing Workshops : 52
- Industries Feedback (for each Program) :100+

6.4 Conclusion

The detailed process of revising the 2023 curriculum has been comprehensively outlined in this chapter, covering the key methodologies, considerations, and steps involved in the revision. This structured approach ensures alignment with industry requirements, technological advancements, and educational best practices. While this

chapter focuses on the process of curriculum revision, the subsequent chapter delves into the distinctive features of the revised curriculum, highlighting its key components.

CHAPTER 7

Features of NEP Aligned Curriculum

The National Education Policy (NEP) 2020 marks a transformative shift in the Indian education system, emphasizing holistic, multidisciplinary, and flexible learning. Its curriculum framework is designed to foster critical thinking, creativity, and global competencies while rooted in India's cultural ethos. Below are the key features of an NEP 2020-aligned curriculum of GPN.

7.1 Introduction

The National Education Policy (NEP) 2020 has introduced significant reforms in India's education system, emphasizing a holistic, flexible, multidisciplinary, and skill-based approach to learning. To align with these objectives, the Government of Maharashtra issued guidelines for implementing NEP 2020 in undergraduate (UG) engineering courses. The Board of Studies (BOS) deliberated on these developments, highlighting the need to align diploma-level curricula with NEP principles.

Although specific guidelines for diploma institutions were initially unavailable, the BOS decided to implement the NEP-aligned curriculum from the 2024 academic session. Consequently, the Curriculum Development Cell (CDC) was tasked with formulating an action plan for program structure and first-semester curriculum development by December 2023. Meanwhile, the Maharashtra State Board of Technical Education (MSBTE) had already initiated curriculum restructuring four months earlier and announced the implementation of an NEP-aligned curriculum for diploma institutions. Subsequently, MSBTE mandated

that all autonomous diploma institutions adopt the NEP-aligned curriculum from the 2023-24 academic year.

In light of these developments, the restructuring of the 2021 curriculum to comply with NEP 2020 guidelines has become essential. A final decision has been made to implement the NEP-aligned curriculum from the 2023-24 academic year.

7.2 Initiatives by the CDC Cell

Before MSBTE's Decision

1. **Institute-Level Committee Meeting**: Conducted on 24th July 2023 to plan curriculum alignment with NEP 2020.
2. **NEP 2020 Workshop**: Organized on 7th and 8th August 2023 for Heads of Departments (HODs) and faculty members.
3. **Formation of Program-Wise Board of Studies (PBOS)**: PBOS committees were constituted to oversee curriculum development.

After MSBTE's Decision

1. **Development of Tentative Program Structure and Curriculum Format**: Drafted between 15th and 16th August 2023, adhering to NEP, UG, and MSBTE guidelines.
2. **Institute-Level Committee Meetings**: Conducted on 17th and 29th August 2023 to review progress.
3. **Curriculum Development Workshop**: Held on 19th August 2023 for curriculum drafting and refinement.
4. **PBOS Meetings**: Held between 22nd to 29th August 2023 for detailed discussions on program structure.

7.3 Features of NEP aligned curriculum

The features of NEP aligned curriculum of GPN are mentioned below.

7.3.1 Seven Verticals

The Curriculum Development Cell (CDC) conducted a comparative analysis of the verticals and found that all verticals proposed for the undergraduate (UG) program by the Government of Maharashtra (GoM) are already included in the Maharashtra State Board of Technical Education (MSBTE) framework, with only differences in nomenclature. The detailed nomenclature of UG program proposed by GOM and their percentage are mentioned in table.

Table 7.1. UG Verticals

UG Verticals as per GOM GR	Percentage
Basic Science Course & Engineering Science Course	43
Program Courses (PCC & PEC)	17
Multidisciplinary Courses (MDM & OE)	12
Skill Courses (VSEC)	4.5
Humanities Social Science and Management (AEC, EDP, IKS, VEC)	8.5
Experiential Learning Courses (FP, IN, OJT)	12.5
Liberal Learning Courses (CC)	2.5

To ensure equivalence with MSBTE, the NEP-aligned curriculum of the institute adopts MSBTE's nomenclature, as detailed below. Since diploma graduates require a higher level of skill development compared to undergraduates, the proportion of Skill Enhancement and Generic Elective (MDM) courses has been adjusted, prioritizing skill components. The proposed percentage distribution for these

components before finalization of program structure and the actual percentage adopted after finalizing program structure in the NEP-aligned curriculum across various verticals is outlined in the following table.

Table 7.2. Seven Verticals adopted by GPN

GPN Verticals equivalent to MSBTE	Proposed	Actual
DSC = Discipline Specific Courses Core	50%	50.78%
DSE = Discipline Specific Elective	8%	7.03%
GE = Generic Elective	5%	4.68%
AEC = Ability Enhancement Course	5%	3.90%
SEC = Skill Enhancement Course	12%	11.71%
VEC = Value Education Course	8%	7.81%
INP = Internship/Apprentice/Community	12%	14.06%

The curriculum is structured into seven verticals as explained below.

1. Discipline Specific Courses Core (DSC)

These are mandatory courses fundamental to a student's discipline. The aim is to build a strong foundation by covering essential concepts and principles specific to the chosen field of study. DSC courses ensure that students acquire the requisite core competencies for their professional journey.

A total of 19 Discipline Specific Courses Core (DSC) courses has been incorporated into the curriculum to provide in-depth knowledge and hands-on skills in diploma engineering. These courses cover fundamental, applied, and emerging topics essential for diploma students.

2. Discipline Specific Elective (DSE)

DSE courses allow students to explore advanced and specialized areas within their discipline. Offered in the fourth, fifth and sixth semesters, these electives provide deeper insights into specific topics, enabling students to tailor their learning experience based on interests and career goals.

A total of 3 Discipline-Specific Elective (DSE) courses have been incorporated into the curriculum to enhance specialized knowledge and practical skills in diploma engineering. These courses cover advanced, industry-relevant, and emerging topics, allowing students to explore specific areas of interest and improve their employability.

3. Generic Elective (GE)

GE courses promote interdisciplinary and multidisciplinary education and offered in the third, fourth, and fifth semesters. These courses offer students the flexibility to choose subjects beyond their core specialization, fostering broad-based knowledge and skills. The objective is to enhance personal and professional development while encouraging intellectual curiosity. Minor diploma in based on these courses.

A total of 3 Generic Elective (GE) courses has been incorporated into the curriculum, offered in the third, fourth, and fifth semesters for awarding a Minor Diploma. To earn a Minor Diploma alongside their Major Diploma, students must select all three courses from the same discipline. These courses provide interdisciplinary knowledge, industry-oriented skills, and a broader understanding of specialized domains, enhancing career opportunities and academic progression.

4. Ability Enhancement Courses (AEC)

AEC courses aim to strengthen social, communication, and leadership skills essential for personal and professional success. These courses

focus on areas such as language, and communication, empowering students to navigate diverse challenges effectively.

A total of 2 Ability Enhancement Courses (AEC) have been incorporated into the curriculum in the first and second semesters, focusing on Communication Skills and Business Communication. These courses aim to develop students' proficiency in verbal and written communication, workplace etiquette, and professional interaction, enhancing their confidence and employability in technical and business environments.

5. Skill Enhancement Courses (SEC)

Skill Enhancement Courses (SEC) are designed to equip diploma engineering students with practical, hands-on skills in their specialization, combining theoretical knowledge with lab work, training, and fieldwork to meet industry demands.

A total of 7 SEC courses has been incorporated into the curriculum, with at least one course in each semester, ensuring vocational and technical proficiency. These courses emphasize hands-on training, technical expertise, problem-solving, and industry-relevant competencies, preparing students to work effectively as technicians (supervisors). By bridging the gap between theory and practice, SEC courses ensure graduates are job-ready and capable of handling real-world engineering challenges.

6. Value Education Courses (VEC)

VEC courses focus on holistic personality development and instilling ethical, cultural, and constitutional values. These courses encourage critical thinking, teamwork, sportsmanship, and scientific temperament. Topics such as Indian Knowledge Systems, Personality

development, human rights, and Sustainability Development are integral to these courses, ensuring well-rounded growth.

A total of 6 Value Education Courses has been incorporated into the curriculum, with one course in each semester, common to all diploma engineering programs. These courses include Integrated Personality Development, Advanced Personality Development, Yog and Meditation, Environmental Sustainability, Indian Constitution, and Indian Knowledge System. They aim to foster holistic development, ethical values, environmental responsibility, constitutional awareness, and a deeper understanding of India’s rich knowledge traditions, ensuring well-rounded personal and professional growth.

7. Internship/Apprenticeship/Community (INP)

Internship (INP) courses offer experiential learning through professional work environments, providing students with meaningful, practical exposure aligned with their field of study or career aspirations. These structured and credit-bearing internships help students develop industry-relevant skills, build professional networks, and gain real-world experience, effectively bridging the gap between academic knowledge and practical application. By integrating domain-specific expertise, multidisciplinary exposure, skill-building, and values-based education, INP courses ensure holistic learning, aligning with NEP 2020's vision for well-rounded professional and personal development.

Internship courses include summer internships after the second and fourth semesters, along with courses on Industrial Management, Entrepreneurship, and Startups. These courses provide students with practical industry exposure, managerial insights, and entrepreneurial

skills, preparing them for technical roles, leadership positions, and startup ventures.

7.3.2 Outcome-Based Education (OBE)

OBE ensures that the curriculum is designed to achieve predefined outcomes such as skills, competencies, and knowledge levels. This approach shifts the focus from traditional teaching to measurable learning outcomes, preparing students for industry needs and societal contributions. It aligns with NEP's emphasis on learner-centric education and continuous assessment for mastery of concepts. OBE philosophy is explained in details in chapter 3.

7.3.3 Multiple Entry-Multiple Exit (MEME)

The MEME framework allows students to join and exit academic programs at different stages, earning appropriate certification, diploma, or degree based on their completion level. This flexibility caters to diverse learner needs, supports lifelong learning, and provides resilience in adapting to changing career paths or personal circumstances. The details of MEME adopted by GPN is mentioned in table 7.3.

Table 7.3. Multiple Entry-Multiple Exit

Academic Level	Entry Qualification	Exit Qualification	National Credit Level (NCrF)
I Year Diploma Engineering	10 Grade (SSC)	Certificate of Vocation	3.5
II Year Diploma Engineering	I Yr. Diploma / As prescribed by AICTE/State Govt.	Diploma in Vocation	4.0

III Year Diploma Engineering	II Yr. Diploma Engineering	Diploma in Engineering	4.5

The National Credit Framework (NCrF) categorizes education into eight levels, with school education spanning levels 0 to 4. Students who complete Class 5 are placed at Level 1, those passing Class 8 at Level 2, and Class 10 at Level 3. Hence, upon completing three-year diploma in engineering, students reach Level 4.5 as mentioned in table 7.2.

7.4 Lateral Entry (As per AICTE/State Govt. Guidelines)

Lateral entry provisions enable diploma holders and other eligible candidates to enter higher semesters of degree programs, promoting vertical mobility in education. This feature, guided by AICTE and state policies, aligns technical education pathways, recognizing prior learning and practical experience as integral to academic progression.

7.5 Credit-based System

A credit-based system quantifies learning achievements, making the academic workload transparent and transferable. It supports flexible learning pathways, aids in credit accumulation and transfer, and aligns Indian education with global standards, thereby fostering student mobility and lifelong learning.

In the credit system, credits serve as formal recognition of a student's completion of prior learning that aligns with a specific qualification level. Under the NCrF framework, one credit corresponds to 30 notional learning hours.

Each semester, a student must earn a minimum of 20 credits, amounting to at least 40 credits per year, corresponding to 1,200

notional learning hours. However, students have the flexibility to earn more than the minimum required credits within a year as per NCrF framework.

To complete the Diploma in Engineering at GPN, students must earn a total of 128 credits. The credit distribution across semesters is as follows: Semester I – 20 credits, Semester II – 20 credits, Semester III – 22 credits, Semester IV – 22 credits, Semester V – 22 credits, and Semester VI – 22 credits, as detailed in the table 6.1 and the detailed program structure mentioned later on.

7.6 Industrial Training

Mandatory industrial training for 15 weeks bridges the gap between academic learning and real-world application. It immerses students in industry practices, enhances employability skills, and provides practical insights into their disciplines, aligning with NEP's focus on experiential and vocational learning.

As per the directives of the Directorate of Technical Education (DTE), industrial training as internship must have a duration of 16 weeks. In accordance with the AICTE internship policy, the proposed schedule is as follows:

i) 4 weeks during the summer vacation after the completion of the Second Semester Examination.

ii) 12 weeks from 16th May to 15th August following the Fourth Semester Examination.

7.7 Self-Study Learning & Its Assessment

Incorporating self-study components encourages independent learning, critical thinking, and time management skills. Structured

assessments ensure accountability and validate the knowledge gained, promoting a culture of self-driven education and lifelong learning as envisioned in NEP 2020.

Self-study learning hours are included in the credit calculation; however, they do not contribute to the faculty's workload. Nevertheless, faculty members should guide students during their self-study and conduct a summative assessment to evaluate their learning progress.

7.8 Inclusion of Spoken Tutorials and NPTEL Courses

The integration of Spoken Tutorials by IIT Mumbai and NPTEL courses provides access to high-quality, standardized online learning resources. These platforms enhance conceptual understanding and technical skills, supporting NEP's vision of leveraging technology for inclusive and equitable education.

Every student must register for the **"**Basics of Computer**"** course under IIT Bombay's Spoken Tutorial program during their course of study, as specified in the program structure. The course must be completed under the mentorship of department faculty. The related guidelines are mentioned elsewhere in this document.

A student may register for an NPTEL course with a minimum duration of 8 weeks as a generic elective course from any discipline. However, they must submit the completion certificate to acquire the credits specified in the program structure. For obtaining a minor diploma, students are required to complete three NPTEL courses from the same discipline.

7.9 One Skill Enhancement Course (SEC) in Every Semester

Including at least one SEC per semester ensures continuous skill development, making students industry-ready. These courses focus on technical, vocational, and soft skills, bridging the gap between theoretical knowledge and practical application. (Explained in 7.3.1 (5))

7.10 One Value Education Course (VEC) in Every Semester

VECs foster ethical awareness, social responsibility, and personal development. By embedding value-based education in every semester, the curriculum nurtures compassionate and socially conscious individuals, in line with NEP's holistic education goals. (Explained in 7.3.1 (6))

7.11 Generic Elective Courses

Offering multidisciplinary Generic Elective courses in the middle semesters allows students to explore interests beyond their core discipline. This flexibility fosters innovation, broadens perspectives, and supports the concept of a Minor Diploma, enriching the academic experience. (Explained in 7.3.1 (3))

7.12 Introduction of Notional Hours

Notional hours represent the total estimated time a student spends on all academic activities, including lectures, practical, assignments, and self-study. Establishing a minimum of 600 notional hours per semester ensures a well-rounded academic workload, fostering deeper engagement and comprehensive learning.

7.13 Award of Certificate/Diploma

As the Multiple-Entry Multiple-Exit (MEME) system is implemented at GPN, the awarding of certificates and diplomas is based on the percentage of marks obtained by students upon completing the total credits outlined in the program structure, as follows:

1. **Certificate in Vocation** – Based on the percentage of marks obtained in the first and second semesters, including the exit course.
2. **Diploma in Vocation** – Based on the percentage of marks secured in the third and fourth semesters, including the exit course.
3. **Diploma in Engineering** – Based on the percentage of marks achieved in the fifth and sixth semesters.

7.14 Conclusion

NEP 2020-aligned curriculum represents a paradigm shift in education, focusing on fostering critical thinking, practical skills, and holistic development. By incorporating flexibility, technology, and diverse learning opportunities, it empowers students to thrive in a rapidly changing world. Through its innovative features, this curriculum ensures that learners are equipped with the knowledge, skills, and values needed for personal growth, professional success, and societal contributions, fulfilling the vision of NEP 2020.

CHAPTER 8

Course Curriculum

The Model Course Curriculum for one course, developed by the CDC of GPN, is circulated among various programs for curriculum development. A workshop is organized to explain the contents of the curriculum, providing further insights into its structure and implementation for academic enhancement. The details are described below.

8.1 Basic Information

EE204H **2023 CURRICULUM**

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in Electrical Engineering
Course Category	:	DSC
Course Code	:	EE204H
Course Title	:	DC Machines and Transformers

Figure 8.1. Basic Information

8.1.1 Program

Government Polytechnic, Nagpur offers thirteen diploma engineering programs, with their respective abbreviations listed below.

Civil Engineering- CE

Mechanical Engineering- ME

Electical Engineering - EE

Electronics and Telecommunication Engineering- EC

Packaging Technology- PK

Metallurgical Engineering- MT

Information Technology- IT

Automobile Engineering- AE

Computer Engineering- CM

Travel and Tourism- TR

Textile Manufacture- TX

Mechatronics Engineering- MK

Artificial Intelligence & Machine Learning- AI

8.1.2 Course Category

As per the National Education Policy 2020, the institute has adopted seven verticals as course categories, mentioned in 7.3.1.

8.1.3 Course Code

A unique method has been developed for assigning course codes to various courses, as illustrated in the figure 8.2.

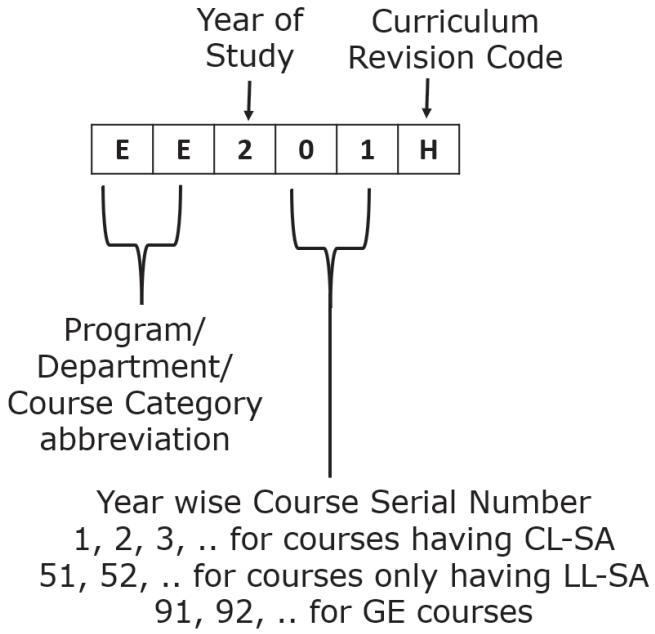

Figure 8.2. Course Code Details

Program codes are mentioned above, however department and other codes for common courses are as follows:

Departments:

English- EN

Mathematics- MH

Physics-PH

Chemistry-CH

Workshop-WS

Applied Mechanics-AM

Hotel Management- HM

Other Codes:

Value Education- VE

Internship/Management- IN

8.1.4 Course Title

The course title provides a concise and descriptive name that reflects the primary focus and objectives of the course. It serves as an identifier for students and educators, ensuring clarity and alignment with the course content and learning outcomes. A course is designed based on an industry-identified competency.

8.2 Rationale

The rationale of a curriculum explains the purpose and importance of the course or program. It outlines how the curriculum aligns with educational goals, addresses the needs of students, industry, and society, and supports the development of skills and knowledge. It serves as a foundation for curriculum design and implementation.

I Rationale:

This course deals with basics of DC machines and transformers. Students will learn to choose the right machines and transformers for different needs. They'll able to differentiate between special and conventional transformers. These are crucial in power systems for generating, transmitting, and distributing electricity. Students will apply this knowledge in studying courses like power system management, equipment operation, and maintenance. They'll use these skills in roles like supervisors, controllers, and technicians..

Figure 8.3. Rationale

8.3 Industry-identified competency

Industry-identified competencies in a curriculum refer to the specific skills, knowledge, and abilities that are recognized as essential by industry professionals. These competencies ensure that students are equipped with practical, relevant expertise to meet the demands of the workforce, fostering employability and bridging the gap between academic learning and real-world applications.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Operate and maintain DC machine and transformers for electrical systems.

Figure 8.4. Industry-identified Competency

8.4 Course Outcomes (COs)

Course Outcomes (COs) are considered the "building blocks" of the Outcome-Based Education (OBE) system. They are measurable statements that define the knowledge, skills, and abilities students are expected to achieve by the end of the course. COs are aligned with Program Outcomes (POs) and are linked to assessments that evaluate

student performance. Typically, every course has six COs, and these outcomes are closely related to the desired graduate attributes.

In OBE, Bloom's Taxonomy plays a significant role in shaping COs, focusing on higher-order thinking skills rather than just recalling facts. COs are written at higher levels of learning, ensuring that students can apply, analyze, and synthesize information. They are based on all domains of learning—cognitive, psychomotor, and affective—to achieve a comprehensive set of POs. Each CO begins with an action verb, emphasizing active learning.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** the suitable DC generator as per requirement.

CO2: **Suggest** the suitable D.C motor on the basis of applications.

CO3: **Analyse** different parameters obtained from various tests on transformer.

CO4: **Recommand** special transformer for perticular application.

CO5: **Suggest** the suitable three-phase transformer for various applications.

CO6: **Operate** single-phase and three-phase transformers in parallel for load sharing.

Figure 8.5. Course Outcomes

Course Outcomes (COs) are designed based on industry-identified competencies and are specified for each unit.

Example COs:

- "Analyze electrical circuits to identify faults" (Cognitive Domain).

- "Design and build a simple electrical prototype" (Psychomotor Domain).
- "Practice electrical circuits for lighting" (Affective Domain).

8.5 Learning Scheme

Each curriculum is designed for 15 weeks, and for calculations under the National Credit Framework (NCrF), 30 notional learning hours are equivalent to one credit. For instance, if a course involves a total of 6 learning hours per week, this translates to 90 notional hours over the duration of the course, resulting in a total of 3 credits.

As per National Education Policy 2020, the total outcome-based learning hours for credits shall, subject to assessment, include: Classroom Learning (CL), Tutorial Learning (TL)/Laboratory Learning (LL), and Self-study Learning (SL).

8.5.1 Classroom Learning (CL)

Classroom learning is a structured educational process that occurs in a formal setting, typically led by an instructor or teacher. It focuses on the delivery of theoretical knowledge and conceptual understanding.

8.5.2 Laboratory Learning (LL)

Laboratory learning provides hands-on experience to reinforce theoretical concepts through practical application. It is essential for technical and engineering education.

8.5.3 Tutorial Learning (TL)

Tutorial Learning (TL) emphasizes interactive sessions, allowing students to clarify concepts, engage in discussions, and solve problems with personalized guidance.

8.5.4 Self-Study Learning (SL)

Self-study is a personalized learning process where students take initiative to acquire knowledge independently. It complements classroom and laboratory learning.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

Figure 8.6. Learning Scheme

8.6 Assessment Scheme

Assessment scheme consists of formative and summative assessment as specified in respective curriculum.

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

Figure 8.7. Assessment Scheme

8.6.1 Formative Assessment (FA)

Formative assessment is a continuous evaluation process aimed at monitoring student learning and providing ongoing feedback to improve teaching and learning.

8.6.2 Summative Assessment (SA)

Summative assessment evaluates student learning at the end of a course, unit, or academic period. It focuses on measuring outcomes against predefined standards.

8.7 Classroom Learning Content

Classroom learning content is structured into five or six units, each comprising topics and subtopics. Specific Learning Outcomes (SLOs) in the cognitive domain are defined based on the Course Outcomes (COs) and learning content. Action verbs from higher levels of the cognitive domain—Apply, Analyze, Evaluate, and Create—are utilized to align the SLOs with the Course Outcomes (COs).

8.7.1 Specific Learning Outcomes

Specific Learning Outcomes (SLOs) are defined as "statements describing what students are expected to achieve as a result of a learning activity," such as at the end of a unit, chapter, or practical session. SLOs should represent assessable and measurable knowledge, skills, abilities, or attitudes that students acquire by the conclusion of the sub-topic or practical.

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: DC Generator	1a	Select the laws suitable for dc machines operation	1.1	Introduction to DC and AC.Machines, types of DC and AC machines, Principle of DC motor and DC Generator,Fleming's Right hand rule, Flemings Left hand rule.	CO1
	1b	Suggest the materials used for given parts of dc machines with justification	1.2	Construction of DC machines,Different parts of D.C.Machines and their functions, Different materials used for the parts of DC machines.	
	1c	Calculate EMF induced in DC generator on the given data.	1.3	Types of Armature windingLap and Wave windings, EMF equation.Calculate the emf induced in the generator	
	1d	Select the suitable DC generator as per given requirement	1.4	Symbolic representation of a generator,Types of DC generator and Load characteristics of separetly excited and self excited DC generators, Various losses inDC generator. efficiency of generator (No Numericals) and their applications.	

Figure 8.8. Classroom Learning Content

8.8 Laboratory Learning Content

Laboratory learning content is organized into five or six units, with all Specific Learning Outcomes (SLOs) focused on the psychomotor domain at higher levels. These SLOs are aligned with the Course Outcomes (COs) to develop practical skills as per industry-identified

competency. Each SLO will be assessed formatively, and summative assessment will be conducted using rubrics.

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify different parts and windings of DC machine.	2	CO1
I	2	Find the value of critical resistance of DC shunt generator by plotting OCC	2#	CO1
I	3	Perform load test on DC shunt generator.Plot internal and external characteristics of DC shunt generator	2#	CO1

Figure 8.9. Laboratory Learning Content

8.9 Self-Study Learning (SLO in Cognitive / Psychomotor / Affective Domain)

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare a microproject on small dc generatorand prepare report.
2. Draw the constructional diagram of DC machine showing various parts and write their functions along with materials used for the different parts.prepare report.

Figure 8.10. Self-Study Learning Content

Self-study learning content is structured into 10 to 15 activities, with all Specific Learning Outcomes (SLOs) targeting higher levels of the Cognitive, Psychomotor, or Affective domains. Learners will select and complete one activity under the guidance of a faculty mentor. Summative assessment will be conducted by the faculty using rubrics.

8.10 Specification Table for Classroom Learning Assessment

The specification table serves as a blueprint for designing a valid question paper. In the curriculum, it is included to guide both question paper setting and student preparation. The table highlights level-wise cognitive process dimensions across three levels: Remember (R), Understand (U), and Apply/Higher Level (A).

The suggested distribution of levels is as follows: Remember (R) – 20%, Understand (U) – 30%, and Apply/Higher Level (A) – 50%.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	DC Generator	5	C	02	04	00	06
			O	00	00	06	06
2	D.C. Motor	10	C	02	04	06	12
			O	02	04	04	10
3	Single phase transformer	8	C	06	04	06	16
			O	04	04	00	8
4	Special transformer	6	C	00	08	00	08
			O	02	04	00	06
5	Three phase transformer	10	C	02	04	10	16
			O	00	04	00	04
6	Parallel operation of transformers	6	C	02	04	06	12
			O	00	00	06	06
Total		45	C	14	28	28	70
			O	8	16	16	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

Figure 8.11. Specification Table

8.11 Question Paper Format for Summative Assessment (SA)

The Question Paper Profile (QPP) is a tool that facilitates the implementation of e-governance in the question paper-setting process. By using QPP along with a question bank for each component, a question paper can be generated through a computer program. QPP serves as a ready reckoner for setters, enabling them to create questions across different cognitive domain levels and topics. It significantly reduces the time required to prepare printed question papers for classroom learning summative assessments.

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	5R2	6R2	2R2	4R2	5	7
2	2U4	1U4	3R4	4U4	3R4			3	5
3	3U4	4U4	5U4	5U4	2A4			3	5
4	4U4	6U4	5A4	2U4	3U4			3	5
5	3A6	2A6	1A6					2	3
6	5A6	6A6	6A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

Figure 8.12. Question Paper Profile

8.12 Scheme of Laboratory Formative Assessment (FA)

A maximum of four criteria are defined in the curriculum for the formative assessment of laboratory learning. Each SLO will be

assessed by faculty using rubrics, which are based on the criteria outlined in the curriculum.

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

Figure 8.13. Scheme of Laboratory Formative Assessment

8.13 Scheme of Self-Learning Summative Assessment (SA)

A maximum of four criteria are defined in the curriculum for the summative assessment of self-study learning. The activity performed by the learner will be evaluated by the faculty using rubrics, based on the criteria specified in the curriculum.

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment, survey	5
2	Performance, collection of literature	10
3	fabrication, Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

Figure 8.14. Scheme of Laboratory Formative Assessment

8.14 COs-POs/PSOs Mapping Matrix

A curriculum map helps identify the program's strengths (attributes widely addressed) and gaps (attributes addressed by only a few learning experiences). The simplest form of a curriculum map is a matrix, where the rows represent learning experiences (Course Outcomes), and the columns represent Program Outcomes (or Graduate Attributes). The seven Program Outcomes for diploma engineering courses, as defined by the National Board of Accreditation, serve as the columns. The strength of mapping is categorized into three levels: Low (1), Medium (2), and Strong (3).

CO-PO mapping is conducted by a group of faculty members using the method established by the Curriculum Development Cell.

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	2	3	-	-
CO2	3	-	-	3	-	2	3	-	-
CO3	3	-	-	3	-	2	3	-	-
CO4	3	-	-	3	-	-	3	-	-
CO5	3	-	-	3	-	-	3	-	-
CO6	3	-	-	3	-	-	3	-	-

Figure 8.15. COs-POs/PSOs Mapping Matrix

8.15 Textbooks, BIS Codes References

The reference books, textbooks, and standards needed for the curriculum content are provided as resources for both students and faculty. Only standard books with ISBN numbers are given priority in the curriculum document.

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Electrical Machines	S.K. Bhattacharya, The McGraw Hill companies, Seventh Reprint, 2011.	13:978-007-0669215 10:0-07-066921-X
2	Principle of Electrical Machines	V K Mehta, Rohit Mehta, S. Chand Publishing, 2nd Edition,2002	9788121921916

Figure 8.16. Textbooks, BIS Codes References

8.16 e-References

E-references are included in the curriculum to serve as valuable resources for both students and faculty. Priority is given to standard and credible e-references to ensure quality and reliability. These references are carefully selected to enhance students' learning experience and support their academic growth.

XV e-References:

1. http://nptel.ac.in/courses/108108076/1 , accessed on 29th April 2024
2. https://www.youtube.com/watch?v=-xebh8wU8gY accessed on 29th April 2024

Figure 8.17. e-References

8.17 List of Major Equipment/Machineries with Specification

The document includes a detailed list of major equipment and instruments necessary for conducting practical exercises aimed at developing psychomotor skills. The listed equipment and instruments are integral to facilitating effective practical sessions, enabling students to gain proficiency and confidence in applying theoretical concepts to real-world scenarios.

XVI List of Major Equipment/Machineries with Specification:

1. Auto transformer (Dimmerstat), single-phase, Input-240 V, Output 0-270 V,
2. Auto transformer (Dimmerstat), three-phase, Input-440 V, Output 0-440 V
3. D.C. Shunt, Series and Compound Generators, Voltage rating 220 Volts,
4. D.C. Shunt and Series Motors, Voltage rating 220 Volts, Power rating 2 KW

Figure 8.18. List of Major Equipment/Machineries

8.18 List of Industry Experts and Faculties who contributed for this curriculum

The document includes a list of experts and faculty members who contributed to the development of the curriculum. Their valuable inputs and expertise have ensured the curriculum's relevance and quality. The document is authenticated with the signatures of the Chairman and Member Secretary of the Program Board of Studies (PBOS), underscoring its credibility and approval.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M.B.Daigavane	Principal	Government Polytechnic, Nagpur
2	Dr.P. M.Daigavane	H.O.D. Electrical Engineering, Academic Expert.	G.H.Raisoni College of Engineering, Nagpur
3	Mrs. Divya Piprode	Sr. Engineer, Industry Expert	PGCIL, Nagpur
4	Mr. M.N. Gawande	Lecturer in Electrical Engineering, MSBTE Nominee.	Government Polytechnic, Gondia
5	Dr G.V.Gotmare	I/C HoD, Electrical Engineering	Government Polytechnic, Nagpur
6	Mrs. A. A. Alegaonkar	Lecturer in Electrical Engineering, Course Incharge	Government Polytechnic, Nagpur

(Dr.G.V.Gotmare)
HOD & Chairman PBOS,

(Dr. G. V. Gotmare)
Member Sectretary PBOS,

Figure 8.19. List of Industry Experts and Faculties

CHAPTER 9

Curriculum Document

Detailed curriculum document of Diploma in **Packaging Technology** is given below.

9.1 Vision of Institute

To become a Center of Excellence, providing quality technical education and training

9.2 Mission of Institute

The mission of Government Polytechnic, Nagpur is-

1. To frame institutional policies for effective implementation of teaching learning process
2. To inculcate values and ethics for life-long learning through curricular, co-curricular and extra-curricular activities
3. To develop facilities and services for academic excellence
4. To enhance the skills of faculties and staff through industry institute collaboration.

9.3 Vision of Program

Vision of Packaging Technology Program:

"To Promote Professional Standards and Competency through Education and Training to Create a World Class Packaging Diploma Engineer."

9.4 Mission of Program

Mission of Packaging Technology Program:

Mission of the Packaging Technology Program:

M1: To develop competent packaging professionals for the industry and society by providing world class teaching learning facilities.

M2: To provide Educo-healthy environment that help developing lifelong learning attitude within the student and the staff.

M3: To produce environmentally conscious entrepreneurs by imparting quality education.

M4: To develop soft skills and inculcate ethics to make a versatile personality.

9.5 Program Educational Objectives (PEOs)

The Program Educational Objectives of (PEOs) Packaging Technology Program are:

PEO 1: To create the technical manpower for Packaging and allied industries enriched with basic technical knowledge and skills of packaging materials & methods, package conversion, testing, designing and decoration.

PEO 2: To serve the society and the nation by developing technocrats with reasonable understanding and inclination to environmental aspects & sustainability.

PEO 3: Develop the attitude for life-long learning and professional advancement through self-study and continuing education or professional studies in Packaging Technology.

PEO 4: To produce entrepreneurs who will be able to start his own enterprise on at least small-scale basis this will enable him not only to earn his livelihood but also to provide job opportunities to others; hence contributing towards nation building.

PEO 5: To communicate effectively, encourage colleagues and subordinates, maintain values, positive attitude, interpersonal relations and deal effectively with people to achieve personal and organizational goals.

9.6 Program Outcomes (POs)

PO1: Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

PO2: Problem analysis: Identify and analyse well-defined engineering problems using codified standard methods.

PO3: Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

PO4: Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

PO5: Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

PO6: Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

PO7: Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

9.7 Program Specific Outcomes (PSOs)

PSO1: Supervise packaging processes.
PSO2: Test and evaluate package and its applied parts.

9.8 Mapping of Vision, Mission, PEOs, POs, PSOs

9.8.1 Mapping of Vision and Mission

Table 9.1. Mapping of Vision-Mission

	Mission Statements			
	M1	M2	M3	M4
Vision Statement	✓	✓	✓	✓

9.8.2 Mapping of Mission and PEOs

Table 9.2. Mapping Mission-PEOs

Mission Statements	**Program Educational Objectives (PEOs)**				
	PEO1	**PEO2**	**PEO3**	**PEO4**	**PEO5**
M 1	✓	✓	✓	✓	✓
M 2	✓	✓	✓	--	✓
M 3	✓	✓	--	✓	--
M 4	--	✓	--	--	✓

9.8.3 Mapping of PEOs and POs- PSOs

Table 9.3. Mapping PEOs-POs & PSOs

PEOs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
PEO1	✓	✓	✓	✓	✓	✓	✓	✓	✓

PEO2	✓	✓	✓	–	✓	–	✓	✓	✓
PEO3	–	–	–	✓	–	✓	✓	–	–
PEO4	✓	–	✓	✓	✓	✓	✓	✓	✓
PEO5	–	–	–	–	✓	✓	✓	–	–

9.9 Industry Identified Competencies in Search Conference

Sr. No.	Competencies (What diploma holders will be able to do in the industry at entry level) Legends: ME-Most Essential, E-Essential, D-Desirable, NR-Not Required	ME	E	D	NR	Total	Rank
1	Apply the knowledge of fundamentals of packaging in various packaging applications.	58	8	1	0	67	1
2	Use computers for documentation, presentation, data analysis and availing internet services.	56	8	2	1	67	2
3	Apply the knowledge of aesthetics and different printing processes for package printing and label designing & printing.	53	12	2	0	67	3
4	Apply the knowledge of printing and graphics techniques for packaging applications.	52	14	0	1	67	4
5	Comprehend the knowledge of different plastic package manufacturing and conversion processes for packaging applications.	51	10	6	0	67	5
6	Design paper based packages / containers and test their performance.	51	11	5	0	67	6
7	Apply the environmental ethics and sustainability concern in packaging applications.	51	13	3	0	67	7
8	Comprehend the knowledge of different filling & packaging processes for packaging applications.	50	15	2	0	67	8
9	Comprehend the knowledge of papers and their conversion processes for packaging applications.	50	15	1	1	67	9
10	Design labels for various types of containers using designing software.	49	10	7	1	67	10
11	Comprehend the knowledge of properties of plastics/polymers for various packaging applications.	49	14	4	0	67	11
12	Comprehend the knowledge of polymers used in packaging for different packaging applications.	49	13	5	0	67	12

13	Plan and execute packaging projects effectively and create technical documentation for the same.	48	13	6	0	67	13
14	Design and develop economic packages for different products.	48	17	2	0	67	14
15	Design and develop economic and environmental friendly packaging prototypes and conduct tests for evaluation of the same.	48	15	4	0	67	15
16	Comprehend the knowledge of different aspects of pharmaceuticals for different packaging applications.	48	13	6	0	67	16
17	Suggest proper packaging solutions for various engineering goods.	47	14	6	0	67	17
18	Select the suitable packaging systems for medicines, cosmetic and personal care products.	47	14	6	0	67	18
19	Commit to lifelong learning and professional development.	46	13	7	1	67	19
20	Select appropriate types of traditional packaging materials for packaging applications.	45	17	4	1	67	20
21	Apply the knowledge of characteristics of food preservation methods, shelf life studies and modern methods of packaging in developing packaging systems for food products and beverages.	44	20	3	0	67	21
22	Record observations, identify problems, write reports and give presentation on the findings in Industrial Training.	43	19	5	0	67	22
23	Comprehend the knowledge of entrepreneurship & start up ideas for business setup.	43	17	7	0	67	23
24	Comprehend and apply the knowledge of labelling and coding techniques and legalities of labelling for different packages.	43	19	5	0	67	24
25	Analyze data and draw meaningful conclusions with the help of different tools like xls.	42	18	7	0	67	25
26	Apply the basic knowledge of principles of production management, productivity studies and different aspects of quality and quality control and Implement a few quality control tools in production management.	42	20	4	1	67	26
27	Suggest proper packaging solutions for various chemicals, garments and handicrafts.	42	17	7	1	67	27
28	Design optimum cushioning for a product being packed.	41	21	4	1	67	28
29	Apply the knowledge of managing warehousing, distribution and logistics operations.	41	16	7	3	67	29
30	Operate a few plastic package-manufacturing machines on its basic settings.	41	17	6	3	67	30
31	Comprehend the knowledge of relative motions and the functional aspect of mechanism for maintaining packaging machines & other	39	22	6	0	67	31

	packaging applications.						
32	Present the work done effectively using PPT.	38	21	8	0	67	32
33	Apply the knowledge of mechanics in Packaging Development.	37	25	5	0	67	33
34	Apply the knowledge of basics of Industrial Management& tools for efficient working.	36	23	7	1	67	34
35	Conduct preventive maintenance with basics on packaging machinery.	36	22	8	1	67	35
36	Operate and maintain packaging machinery for its basics.	36	22	6	3	67	36
37	Comprehend the Industrial Ethics/code of conduct during Industrial Training.	35	24	8	0	67	37
38	Prepare engineering drawing using prevailing drawing instruments.	35	19	11	2	67	38
39	Suggest suitable refrigeration system & cold storage for different product.	34	22	9	2	67	39
40	Communicate in English language effectively to express ideas and views in front of people concerned.	34	22	8	3	67	40
41	Use different engineering tools for performing shop floor activities.	32	26	8	1	67	41
42	Apply principles of physics to solve broad based relevant engineering problems.	31	23	10	3	67	42
43	Identify the simple troubles in a refrigerator and air conditioning system and give remedies.	29	16	18	4	67	43
44	Apply the concept of Mathematics to solve industry-based technology problems. *	28	27	7	5	67	44
45	Use basic principles of electrical and electronics engineering for packaging applications.	23	19	18	7	67	45
46	Apply principles of chemistry to solve broad based relevant engineering problems.	21	23	16	7	67	46
	Average (Total 67 Participant)	**42.2**	**17.4**	**6.2**	**1.2**	**67**	
	Percentage	**63.0**	**25.9**	**9.3**	**1.8**	**100**	

Technical Skills Required for Diploma in PACKAGING TECHNOLOGY

S.N.	Technical Skills (What diploma holders will be able to do	ME	E	D	NR	Total	Rank

	in the industry at entry level) **Legends: ME-Most Essential, E-Essential, D-Desirable, NR-Not Required**						
1	Apply the knowledge of fundamentals of packaging in various packaging applications.	58	8	1	0	67	1
2	Use computers for documentation, presentation, data analysis and availing internet services.	56	8	2	1	67	2
3	Apply the knowledge of aesthetics and different printing processes for package printing and label designing & printing.	53	12	2	0	67	3
4	Apply the environmental ethics and sustainability concern in packaging applications.	51	13	3	0	67	4
5	Design labels for various types of containers using designing software.	49	10	7	1	67	5
6	Plan and execute packaging projects effectively and create technical documentation for the same.	48	13	6	0	67	6
7	Design and develop economic packages for different products.	48	17	2	0	67	7
8	Design and develop economic and environmental friendly packaging prototypes and conduct tests for evaluation of the same.	48	15	4	0	67	8
9	"Select the suitable packaging systems for medicines, cosmetic and personal care products.	47	14	6	0	67	9
10	Select appropriate types of traditional packaging materials for packaging applications.	45	17	4	0	67	10
11	Apply the knowledge of characteristics of food preservation methods, shelf life studies and modern methods of packaging in developing packaging systems for food products and beverages.	44	20	3	0	67	11
12	Comprehend and apply the knowledge of labelling and coding techniques and legalities of labelling for different packages.	43	19	5	0	67	12
13	Design optimum cushioning for a product being packed.	41	21	4	1	67	13

14	Apply the knowledge of managing warehousing, distribution and logistics operations.	41	16	7	3	67	14
15	Operate a few plastic package-manufacturing machines on its basic settings.	41	17	6	3	67	15

9.10 Courses Identification

Courses are formed based on feedback obtained from alumni and industries, industry identified competencies finalized in search conference, and identified gaps previous curriculum, NEP and AICTE guidelines and institute policy framed by ILC. The following table shows various courses formed based on identified competencies.

Table 9.4. Courses Identification from Identified Competencies.

S.N.	Competencies (What diploma holders will be able to do in the industry at entry level)	Rank based on Industry Feedback	Name of Course to be introduced in Curriculum	Remarks (if any)	Course Category DSC/DSE /SEC/AEC /VEC/INP etc.	Semester of the course
1	Apply the knowledge of fundamentals of packaging in various packaging applications.	1	Fundamentals of Packaging		DSC	I
2	Use computers for documentation, presentation, data analysis and availing internet services.	2	Basics of Computers		SEC	I
3	Apply the knowledge of aesthetics and different printing processes for package printing and label designing & printing.	3	Package Printing & Aesthetics (Letterpress, Offset and Digital)		DSC	IV
4	Apply the knowledge of printing and graphics	4	Package Printing & Aesthetics (Gravure &		DSC	VI

	techniques for packaging applications.		Flexography)			
5	Comprehend the knowledge of different plastic package manufacturing and conversion processes for packaging applications.	5	Plastic Package Manufacturing		DSC	IV
6	Design paper based packages / containers and test their performance.	6	Paper & Board in Packaging - I		DSC	III
7	Apply the environmental ethics and sustainability concern in packaging applications.	7	Environmental Science / Sustainability Packaging Development		VEC SEC	III V
8	Comprehend the knowledge of different filling & packaging processes for packaging applications.	8	Packaging Processes		SEC	III
9	Comprehend the knowledge of papers and their conversion processes for packaging applications.	9	Paper & Board in Packaging – II / Folding Cartons & Corrugated Boxes		DSC	IV
10	Design labels for various types of containers using designing software.	10	Packaging & Labelling Design Software		SEC	IV
11	Comprehend the knowledge of properties of plastics/polymers for various packaging applications.	11	Plastic Materials in Packaging		DSC	III
12	Comprehend the knowledge of polymers used in packaging for different packaging applications.	12	Plastic Materials in Packaging		DSC	III
13	Plan and execute packaging projects effectively and create	13	Project Internship		SEC	VI

	technical documentation for the same.		(Vocational Skills)		INP	IV
14	Design and develop economic packages for different products.	14	Packaging Development		SEC	V
15	Design and develop economic and environmental friendly packaging prototypes and conduct tests for evaluation of the same.	15	Packaging Development Environmental Science		SEC	V
16	Comprehend the knowledge of different aspects of pharmaceuticals for different packaging applications.	16	Packaging of Pharmaceuticals		DSC	VI
17	Suggest proper packaging solutions for various engineering goods.	17	Packaging of Engineering Goods		DSE	V
18	Select the suitable packaging systems for medicines, cosmetic and personal care products.	18	Packaging of Pharmaceuticals		DSC	VI
19	Commit to lifelong learning and professional development.	19	Integrated Personality Development Advanced Personality Development Generic Electives Indian Constitution		VEC VEC GE VEC	I II III, IV, V v
20	Select appropriate types of traditional packaging materials for packaging applications.	20	Traditional Packaging Materials		DSC	III
21	Apply the knowledge of characteristics of food	21	Packaging of Food &		DSC	V

	preservation methods, shelf life studies and modern methods of packaging in developing packaging systems for food products and beverages.		Beverages			
22	Record observations, identify problems, write reports and give presentation on the findings in Industrial Training.	22	Internship (Report Writing) Capstone Project		INP SEC	VI VI
23	Comprehend the knowledge of entrepreneurship & start up ideas for business setup.	23	Entrepreneurship & Start up Indian Constitution		INP VEC	VI V
24	Comprehend and apply the knowledge of labelling and coding techniques and legalities of labelling for different packages.	24	Packaging & Labelling Design Software Packaging of Pharmaceuticals		SEC DSC	IV VI
25	Analyse data and draw meaningful conclusions with the help of different tools like xls.	25	Basics of Computers		SEC	I
26	Apply the basic knowledge of principles of production management, productivity studies and different aspects of quality and quality control and Implement a few quality control tools in production management.	26	Production Management & Q.A.		DSE	IV
27	Suggest proper packaging solutions for various chemicals, garments and handicrafts.	27	Packaging of Chemicals, Garments & Handicrafts		DSE	V
28	Design optimum cushioning for a product	28	Package Design Engineering		DSC	V

	being packed.					
29	Apply the knowledge of managing warehousing, distribution and logistics operations.	29	Logistics & Supply Chain Management		DSE	VI
30	Operate a few plastic package-manufacturing machines on its basic settings.	30	Plastic Package Manufacturing		DSC	IV
31	Comprehend the knowledge of relative motions and the functional aspect of mechanism for maintaining packaging machines & other packaging applications.	31	Theory of Machines	Course Deleted and required points taken in PDE		
32	Present the work done effectively using PPT.	32	Internship Capstone Project Business Communication		INP SEC AEC	IV VI II
33	Apply the knowledge of mechanics in Packaging Development.	33	Engineering Mechanics Package Design Engineering		DSC DSC	II V
34	Apply the knowledge of basics of Industrial Management& tools for efficient working.	34	Industrial Management		INP	V
35	Conduct preventive maintenance with basics on packaging machinery.	35	Maintenance in Packaging		DSE	IV
36	Operate and maintain packaging machinery for its basics.	36	Plastic Package Manufacturing Folding Cartons & Corrugated Boxes Maintenance in Packaging		DSC DSC DSE	IV IV IV

37	Comprehend the Industrial Ethics/code of conduct during Industrial Training.	37	Internship (Basic Skills)		INP	II
38	Prepare engineering drawing using prevailing drawing instruments.	38	Engineering Drawing		SEC	II
39	Suggest suitable refrigeration system & cold storage for different product.	39	Refrigeration in Packaging		DSE	VI
40	Communicate in English language effectively to express ideas and views in front of people concerned.	40	Communication Skills Business Communication Internship (Seminar) Project		AEC AEC INP SEC	I II V VI
41	Use different engineering tools for performing shop floor activities.	41	Engg. Workshop Practice		SEC	I
42	Apply principles of physics to solve broad based relevant engineering problems.	42	Applied Physics		DSC	I
43	Identify the simple troubles in a refrigerator and air conditioning system and give remedies.	43	Refrigeration in Packaging		DSE	VI
44	Apply the concept of Mathematics to solve industry-based technology problems. *	44	Basic Mathematics Applied Mathematics		DSC DSC	I II
45	Use basic principles of electrical and electronics engineering for packaging applications.	45	Basics of EC & EE		DSC	II
46	Apply principles of chemistry to solve broad based relevant	46	Applied Chemistry		DSC	II

	engineering problems.					

Technical Skills Required for Diploma in Packaging Technology

S.N.	Technical Skills (What diploma holders will be able to do in the industry at entry level)	Rank based on Industry Feedback	Name of Course to be introduced in Curriculum	Remarks (if any)	Course Category DSC/DSE/ SEC/AEC/ VEC/INP etc.	Semester of the course
1	Apply the knowledge of fundamentals of packaging in various packaging applications.	1	Fundamentals of Packaging		DSC	I
2	Use computers for documentation, presentation, data analysis and availing internet services.	2	Basics of Computers		SEC	I
3	Apply the knowledge of aesthetics and different printing processes for package printing and label designing & printing.	3	Packaging Printing: Offset, Screen, and Digital Technology Packaging Printing: Gravure and Flexography		DSC DSC	IV VI
4	Apply the environmental ethics and sustainability concern in packaging applications.	4	Packaging Development Environmental Science / Sustainability		SEC VEC	V III
5	Design labels for various types of containers using designing software.	5	Packaging & Labelling Design Software		SEC	IV
6	Plan and execute packaging projects effectively and create technical	6	Project Internship (Vocational		SEC INP	VI IV

	documentation for the same.		Skills)			
7	Design and develop economic packages for different products.	7	Packaging Development			
8	Design and develop economic and environmental friendly packaging prototypes and conduct tests for evaluation of the same.	8	Packaging Development Environmental Science / Sustainability		SEC VEC	V III
9	Select the suitable packaging systems for medicines, cosmetic and personal care products.	9	Packaging of Pharmaceuticals		DSC	VI
10	Select appropriate types of traditional packaging materials for packaging applications.	10	Traditional Packaging Materials		DSC	III
11	Apply the knowledge of characteristics of food preservation methods, shelf life studies and modern methods of packaging in developing packaging systems for food products and beverages.	11	Packaging of Food & Beverages		DSC	V
12	Comprehend and apply the knowledge of labelling and coding techniques and legalities of labelling for different packages.	13	Packaging & Labelling Design Software Packaging of Pharmaceuticals		SEC DSC	IV VI
13	Design optimum cushioning for a product being packed.	14	Package Design Engineering		DSC	V
14	Apply the knowledge of managing warehousing, distribution and logistics operations.	15	Logistics & Supply Chain Management		DSE	VI
15	Operate a few plastic package-manufacturing machines on its basic settings.	16	Plastic Package Manufacturing		DSC	IV

9.11 Program Structure

The program structure of the Packaging Technology program is developed as described previously and is given in appendix.

APPENDIX A Curriculum

Appendix I

Curriculum

Program Structure

Government Polytechnic, Nagpur

Diploma in Packaging Technology

NEP 2020 Align Curriculum 2023 Program Structure

Semester: First

SN	Course Code	Course Title	Course Category	Learning Scheme (Hours/Week)				Notional Hours/ Week (Total Notional Hours)		Credits	Assessment Scheme (Marks)					Total Marks
											CL		TL/LL		SL	
				CL	TL	LL	SL	NLH		Cr	SA	FA	SA	FA	SA	
1	MH101H	Basic Mathematics	DSC	4	2	-	2	8	(120)	4	70	30	-	25	25	150
2	PH101H	Applied Physics	DSC	4	-	2	2	8	(120)	4	70	30	25	25	25	175
3	ME151H	Engineering Graphics	DSC	2	-	4	-	6	(90)	3	-	-	50	50	-	100
4	EN101H	Communication Skills	AEC	2	-	2	2	6	(90)	3	70	30	25	25	25	175
5	WS151H	Engineering Workshop Practice	SEC	-	-	4	-	4	(60)	2	-	-	50	50	-	100
6	CM151H	Basics of Computer	SEC	-	-	2	2	4	(60)	2	-	-	25	25	25	75
7	VE151H	Integrated Personality Development	VEC	-	-	2	2	4	(60)	2	-	-	25	25	25	75
			Total	**12**	**2**	**16**	**10**	**40**	**(600)**	**20**	**210**	**90**	**200**	**225**	**125**	**850**

Abbreviations:
CL= Classroom Learning, TL= Tutorial Learning, LL= Laboratory Learning, SL=Self-Study Learning, NLH=Notional Learning Hours SA=Summative Assessment (At the End of Semester), FA=Formative Assessment (At the end of Unit(s) / Each LL/TL Activity) Classroom Learning FA= Average (CL_FA1,CL_FA2), Laboratory/Tutorial Learning FA= Average (LL_FA1, LL_FAn)
40% Combined passing for Classroom Learning (FA+SA), 40% individual passing for other Heads.
Symbols: ** Classroom Learning Summative Assessment usimg Objective Type Online Examination, + Laboratory Learning Summative Assessment by External Examiner.

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Diploma in Packaging Technology

NEP 2020 Align Curriculum 2023 Program Structure

Semester: Second

SN	Course Code	Course Title	Course Category	Learning Scheme (Hours/Week)				Notional Hours/ Week (Total Notional Hours)		Credits	Assessment Scheme (Marks)					Total Marks
											CL		TL/LL		SL	
				CL	TL	LL	SL	NLH		Cr	SA	FA	SA	FA	SA	
1	MH102H	Applied Mathematics	DSC	4	2	-	2	8	(120)	4	70	30	-	25	25	150
2	CH101H	Applied Chemistry	DSC	4	-	2	2	8	(120)	4	70	30	25	25	25	175
3	EE103H	Basic Electrical and Electronics	DSC	3	-	2	1	6	(90)	3	70 **	30	25	25	25	175
4	AM101H	Engineering Mechanics	DSC	3	-	2	1	6	(90)	3	70	30	25	25	25	175
5	EN151H	Business Communication	AEC	2	-	2	-	4	(60)	2	-	-	25	25	-	50
6	ME157H	Engineering Drawing	SEC	-	-	4	-	4	(60)	2	-	-	50	50	-	100
7	VE152H	Advanced Personality Development	VEC	-	-	2	2	4	(60)	2	-	-	25	25	25	75
			Total	**16**	**2**	**14**	**8**	**40**	**(600)**	**20**	**280**	**120**	**175**	**200**	**125**	**900**

Exit Course for "Certificate in Vocation"

8	IN151H	Internship (Basic Skills)	INP	-	-	-	8	8	(120)	4	-	-	-	-	50	50
			Total	**16**	**2**	**14**	**16**	**48**	**(720)**	**24**	**280**	**120**	**175**	**200**	**175**	**950**

Abbreviations:
CL= Classroom Learning, TL= Tutorial Learning, LL= Laboratory Learning, SL=Self-Study Learning, NLH=Notional Learning Hours SA=Summative Assessment (At the End of Semester), FA=Formative Assessment (At the end of Unit(s) / Each LL/TL Activity) Classroom Learning FA= Average (CL_FA1,CL_FA2), Laboratory/Tutorial Learning FA= Average (LL_FA1, LL_FAn)
40% Combined passing for Classroom Learning (FA+SA), 40% individual passing for other Heads.
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Diploma in Packaging Technology

NEP 2020 Align Curriculum 2023 Program Structure

Semester: Third

SN	Course Code	Course Title	Course Category	Learning Scheme (Hours/Week)				Notional Hours/ Week (Total Notional Hours)		Credits	Assessment Scheme (Marks)					Total Marks
											CL		TL/LL		SL	
				CL	TL	LL	SL	NLH		Cr	SA	FA	SA	FA	SA	
1	PK201H	Fundamentals of Packaging	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25	175
2	PK202H	Traditional Packaging Materials	DSC	3	-	2	1	6	(90)	3	70	30	25	25	25	175
3	PK203H	Plastic Materials in Packaging	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25	175
4	PK204H	Packaging Papers & Products	DSC	3	-	2	1	6	(90)	3	70	30	25	25	25	175
5	PK251H	Packaging Processes	SEC	-	-	4	-	4	(60)	2	-	-	50 +	50	-	100
6	##291H	Generic Elective	GE	2	-	2	-	4	(60)	2	70 **	30	25	25	-	150
7	VE251H	Environmental Sustainability	VEC	-	-	2	2	4	(60)	2	-	-	25	25	25	75
8	IN251H	Basic Internship	INP	-	-	2	6	8	(120)	4	-	-	-	-	50	50
			Total	**14**	**0**	**18**	**12**	**44**	**(660)**	**22**	**350**	**150**	**200**	**200**	**175**	**1075**

Abbreviations:
CL= Classroom Learning, TL= Tutorial Learning, LL= Laboratory Learning, SL=Self-Study Learning, NLH=Notional Learning Hours SA=Summative Assessment (At the End of Semester), FA=Formative Assessment (At the end of Unit(s) / Each LL/TL Activity) Classroom Learning FA= Average (CL_FA1,CL_FA2), Laboratory/Tutorial Learning FA= Average (LL_FA1, LL_FAn)
40% Combined passing for Classroom Learning (FA+SA), 40% individual passing for other Heads.
Symbols: ****** Classroom Learning Summative Assessment usimg Objective Type Online Examination, **+** Laboratory Learning Summative Assessment by External Examiner.

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Diploma in Packaging Technology

NEP 2020 Align Curriculum 2023 Program Structure

Semester: Third

List of Generic Elective Courses MDM (Multidisciplinary Minor)

SN	Course Code	Course Title
1	CE291H	Civil Engineering Practice
2	ME291H	Elements of Mechanical Engineering
3	EE291H	Electrical Generation, Transmission and Distribution
4	EC291H	Analog and Digital Electronics
5	IT291H	Applied Multimedia Techniques
6	MT291H	Foundry Technology
7	TX291H	General Textile Technology
8	AE291H	Basics of Automobile
9	CM291H	Open-Source Technologies
10	MK291H	Basic Mechatronics
11	AI291H	Python Programming
12	TR291H	Agro & Rural Tourism
13	NP291H	Any one NPTEL Course of more than 8 week duration

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Diploma in Packaging Technology

NEP 2020 Align Curriculum 2023 Program Structure

Semester: Fourth

SN	Course Code	Course Title	Course Category	Learning Scheme (Hours/Week)				Notional Hours/ Week (Total Notional Hours)		Credits	Assessment Scheme (Marks)					Total Marks
											CL		TL/LL		SL	
				CL	TL	LL	SL	NLH		Cr	SA	FA	SA	FA	SA	
1	PK205H	Packaging Printing: Offset, Screen, and Digital Technology	DSC	3		2	1	6	(90)	3	70	30	25 +	25	25	175
2	PK206H	Folding Cartons & Corrugated Boxes	DSC	4	-	4	2	10	(150)	5	70	30	25 +	25	25	175
3	PK207H	Plastic Package Manufacturing	DSC	4	-	2	2	8	(120)	4	70	30	25	25	25	175
4	PKXXXH	Discipline Specific Elective	DSE	3	-	2	1	6	(90)	3	70	30	25	25	25	175
5	PK252H	Packaging Label Design Software	SEC	2	-	4	-	6	(90)	3	-	-	50 +	50	-	100
6	##292H	Generic Elective	GE	2	-	2	-	4	(60)	2	70 **	30	25	25	-	150
7	VE252H	Yog & Meditation	VEC	-	-	2	2	4	(60)	2	-	-	25	25	25	75
			Total	**18**	**0**	**18**	**8**	**44**	**(660)**	**22**	**350**	**150**	**200**	**200**	**125**	**1025**

List of Discipline Specific Elective

1	PK208H	Production Management and Q.A.
2	PK209H	Maintenance in Packaging

Exit Course for "Diploma in Vocation"

8	IN252H	Internship (Vocational Skills)	INP	-	-	-	8	8	(120)	4	-	-	-	-	50	50
			Total	**18**	**0**	**18**	**16**	**52**	**(780)**	**26**	**350**	**150**	**200**	**200**	**175**	**1075**

Abbreviations:
CL= Classroom Learning, TL= Tutorial Learning, LL= Laboratory Learning, SL=Self-Study Learning, NLH=Notional Learning Hours SA=Summative Assessment (At the End of Semester), FA=Formative Assessment (At the end of Unit(s) / Each LL/TL Activity) Classroom Learning FA= Average (CL_FA1,CL_FA2), Laboratory/Tutorial Learning FA= Average (LL_FA1, LL_FAn)
40% Combined passing for Classroom Learning (FA+SA), 40% individual passing for other Heads.
Symbols: ****** Classroom Learning Summative Assessment usimg Objective Type Online Examination, **+** Laboratory Learning Summative Assessment by External Examiner.

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Diploma in Packaging Technology

NEP 2020 Align Curriculum 2023 Program Structure

Semester: Fourth

List of Generic Elective Courses MDM (Multidisciplinary Minor)

SN	Course Code	Course Title
1	CE292H	Basic Surveying
2	ME292H	Workshop Technology
3	EE292H	Electrical Machines
4	EC292H	Principles of Communication Engineering
5	IT292H	Web Designing
6	MT292H	Testing of Materials
7	TX292H	Dyeing and Printing
8	AE292H	Two-Wheeler Technology
9	CM292H	Web Development
10	MK292H	Computer Aided Design
11	AI292H	Basics of Artificial Intelligence
12	TR292H	Wildlife Tourist Guide/ Naturalist
13	NP292H	Any one NPTEL Course of more than 8 week duration

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Diploma in Packaging Technology

NEP 2020 Align Curriculum 2023 Program Structure

Semester: Fifth

SN	Course Code	Course Title	Course Category	Learning Scheme (Hours/Week)				Notional Hours/ Week (Total Notional Hours)		Credits	Assessment Scheme (Marks)					Total Marks
											CL		TL/LL		SL	
				CL	TL	LL	SL	NLH		Cr	SA	FA	SA	FA	SA	
1	PK301H	Packaging of Food & Beverages	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25	175
2	PK302H	Package Design Engineering	DSC	3	-	4	1	8	(120)	4	70	30	25 +	25	25	175
3	PKXXXH	Discipline Specific Elective	DSE	3	-	2	1	6	(90)	3	70	30	25 +	25	25	175
4	PK351H	Packaging Development	SEC	-	-	4	-	4	(60)	2	-	-	50 +	50	-	100
5	##391H	Generic Elective	GE	2	-	2	-	4	(60)	2	70 **	30	25	25	-	150
6	IN301H	Industrial Management	INP	2	-	-	-	2	(30)	1	70 **	30	-	-	-	100
7	VE351H	Indian Constitution	VEC	-	-	2	-	2	(30)	1	-	-	25	25	-	50
8	IN351H	Internship (Seminar)	INP	-	-	2	10	12	(180)	6	-	-	25	-	50	75
			Total	**13**	**0**	**18**	**13**	**44**	**(660)**	**22**	**350**	**150**	**200**	**175**	**125**	**1000**

List of Discipline Specific Elective

1	PK303H	Packaging of Engineering Goods
2	PK304H	Packaging of Chemicals, Garments & Handicrafts

Abbreviations:
CL= Classroom Learning, TL= Tutorial Learning, LL= Laboratory Learning, SL=Self-Study Learning, NLH=Notional Learning Hours SA=Summative Assessment (At the End of Semester), FA=Formative Assessment (At the end of Unit(s) / Each LL/TL Activity) Classroom Learning FA= Average (CL_FA1,CL_FA2), Laboratory/Tutorial Learning FA= Average (LL_FA1, LL_FAn)
40% Combined passing for Classroom Learning (FA+SA), 40% individual passing for other Heads.
Symbols: **** Classroom Learning Summative Assessment usimg Objective Type Online Examination, **+** Laboratory Learning Summative Assessment by External Examiner.

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Diploma in Packaging Technology

NEP 2020 Align Curriculum 2023 Program Structure

Semester: Fifth

List of Generic Elective Courses MDM (Multidisciplinary Minor)

SN	Course Code	Course Title
1	CE391H	Building Services
2	ME391H	Heat Engine Technology
3	EE391H	Electrical Wiring and Estimation
4	EC391H	Microcontroller and Applications
5	IT391H	Cyber Security and Privacy
6	MT391H	Heat Treatment
7	TX391H	Garment and fashion Technology
8	AE391H	Four-Wheeler Technology
9	CM391H	Digital Marketing
10	MK391H	Automotive Mechatronics
11	AI391H	Machine Learning
12	TR391H	Tourism Resources of India
13	NP391H	Any one NPTEL Course of more than 8 week duration

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Government Polytechnic, Nagpur

Diploma in Packaging Technology

NEP 2020 Align Curriculum 2023 Program Structure

Semester: Sixth

SN	Course Code	Course Title	Course Category	Learning Scheme (Hours/Week)				Notional Hours/ Week (Total Notional Hours)		Credits	Assessment Scheme (Marks)					Total Marks
											CL		TL/LL		SL	
				CL	TL	LL	SL	NLH		Cr	SA	FA	SA	FA	SA	
1	PK305H	Packaging of Pharmaceuticals	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25	175
2	PK306H	Packaging Printing: Gravure and Flexography	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25	175
3	PK307H	Logistics & Supply Chain Management	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25	175
4	PKXXXH	Discipline Specific Elective	DSE	3	-	2	1	6	(90)	3	70	30	25 +	25	25	175
5	PK352H	Capstone Project	SEC	-	-	4	-	4	(60)	2	-	-	50 +	50	-	100
6	IN352H	Internship (Report Writing)	INP	-	-	2	10	12	(180)	6	-	-	25	-	50	75
7	VE352H	Indian Knowledge System	VEC	-	-	2	-	2	(30)	1	-	-	25	25	-	50
8	IN353H	Entrepreneurship & Startup	INP	1	-	-	1	2	(30)	1	-	-	-	-	75	75
			Total	**13**	**0**	**16**	**15**	**44**	**(660)**	**22**	**280**	**120**	**200**	**175**	**225**	**1000**

List of Discipline Specific Elective

1	PK308H	Green Packaging
2	PK309H	Refrigeration in Packaging

Abbreviations:
CL= Classroom Learning, TL= Tutorial Learning, LL= Laboratory Learning, SL=Self-Study Learning, NLH=Notional Learning Hours SA=Summative Assessment (At the End of Semester), FA=Formative Assessment (At the end of Unit(s) / Each LL/TL Activity) Classroom Learning FA= Average (CL_FA1,CL_FA2), Laboratory/Tutorial Learning FA= Average (LL_FA1, LL_FAn)
40% Combined passing for Classroom Learning (FA+SA), 40% individual passing for other Heads.
Symbols: ** Classroom Learning Summative Assessment usimg Objective Type Online Examination, + Laboratory Learning Summative Assessment by External Examiner.

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Semester

I

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/AI/PK/MT/MK/TX
Course Category	:	DSC
Course Code	:	MH101H
Course Title	:	Basic Mathematics

I Rationale:

Mathematics is the core course and plays a crucial role in diploma programme. This Basic course of mathematics is a foundations of Engineering which will help in developing compitency, logical thinking, enhance qualitative literacy analytical thinking which are valuable for lifelong learning and professional growth. Also Basic course of mathematics is being develop the requisite course outcomes in most of the engineering programme and thereby enhance employability. It will help to apply the principles of basic mathematics to solve related technological problems. Hence the course provides the insight to analyse engineering problems scientifically using logarithm, partial fraction, determinant, matrices, trigonometry and statistics.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the concept of Mathematics to solve industry-based technological problems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** Algebra, Laws of Logarithm, and change of base of logarithm to solve engineering problems.

CO2: **Resolve** proper fraction improper fraction into partial fraction.

CO3: **Apply** matrix method to solve simultaneous equation of Two and three variables in engineering problems.

CO4: **Use** concept of Allied Angles, Compound angles, Multiple and sub-multiples Angles to solve engineering problems.

CO5: **Use** the principle values of inverse trigonometric function, properties to solve the examples of inverse Trigonometric function.

CO6: **Use** the measures of central tendencies and measures of dispersion in decision making.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
4	2	-	2	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	-	-	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Logarithm	1a	Evaluate the value of given Logarithm without using calculator.	1.1	Logarithm:-Concept of Logarithm	CO1
	1b	Solve the given logarithm by Using Laws of Logarithm.	1.2	Rules And Laws of Logarithm; Addition, Subtraction, Multiplication, Division And Change of Base Formula.	
	1c	Identify natural and common Logarithm.	1.3	Concept of natural & common Logarithm.	
UNIT II: Partial Fraction	2a	Identify the given rational fraction is proper or improper fraction.	2.1	Concept of rational fraction, proper, improper fraction and partial fraction.	CO2
	2b	Resolve the given proper fraction into partial fraction.	2.2	Resolving proper fraction into partial fraction. Denominator containing non- repeated linear factors, Denominator containing repeated linear factors, Denominator containing irreducible non repeated quadratic factors	
	2c	Resolve the given improper Fraction into partial fraction.	2.3	Resolving improper fraction into partial fraction.	

UNIT III: Determinant & Matrix	3a	Find the value of given determinant of order 2 and 3.	3.1	Concept of determinant ,order of determinant, Expansion& Evaluation of determinant of order 2 and 3.	CO3
	3b	Find inverse of given matrix.	3.2	Concept of matrix, Types of matrices, Algebra of matrices Transpose of matrix , ad-joint, singularity of matrix and inverse of matrix	
	3c	Solve the given simultaneous equation in two and three variables.	3.3	Solution of system of linear equations two and three variables by inverse matrix method	
UNIT IV: Trigonometry	4a	Use fundamental identities to solve the given Trigonometric relation.	4.1	Fundamental identities, Trigonometric ratios of any angle.	CO4
	4b	Apply the concept of allied angle , compound angle, multiple angle (2θand 3θ) sub-multiple angle (θ/2),to solve the given trigonometric relation	4.2	Trigonometric ratios of allied angles, compound angles, multiple and sub-multiple angles (without proof)	
	4c	Apply Factorization, De-Factorization formulae to solve the given trigonometric relations.	4.3	Factorization and de-factorization formulae (without proof).	
UNIT V: Inverse Trigonometric Function	5a	Find the principle value the given Inverse trigonometric functions.	5.1	Concept of inverse trigonometric functions, Principle values of inverse Trigonometric functions.	CO5
	5b	Solve the given inverse	5.2	Properties of inverse Trigonometric functions.	
	5c	Evaluate the value of given Inverse-trigonometric functions.	5.3	Relation between inverse trigonometric functions	
	6a	Find mean or Combined Mean of given Statistical data.	6.1	Measures of central tendency Mean (only), & Combined mean.	

UNIT VI: Statistics	6b	Find the Range, Co-efficient of Range, Mean Deviation, Standard Deviation of given Statistical data.	6.2	Measures of dispersion:- Range , mean deviation , standard deviation of Discrete, Grouped & Ungrouped Data.	CO6
	6c	Find variances, co-efficient of variation of given Statistical data.	6.3	Variance and coefficient of variation, of Discrete, Grouped & Ungrouped Data.	
	6d	Check the Consistency & Reliability of given sets of data.	6.4	Comparison of two sets of observations, Consistency & Reliability.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Evaluate the value of given logarithm without using calculator	2#	CO1
I	2	Solve simple problems of Logarithm based on laws of logarithm, change base Formulas. Identify the given logarithm is Common Logarithm Or Natural Logarithm.	2#	CO1
II	3	Identify the given Rational Fraction is proper fraction or improper fraction. Resolve improper fraction into Partial fraction.	2#	CO2
II	4	Resolve into partial fraction using linear non-repeated, repeated, and irreducible quadratic factors.	2#	CO2
III	5	Evaluate the given Determinant of order 2 and 3 by expansion method.	2#	CO3
III	6	Solve elementary problems on Algebra of matrix for branch specific related with engineering application.	2#	CO3
III	7	Verify the given properties of transpose of matrix.	2#	CO3
III	8	Find adjoint of matrix and inverse of matrix.	2#	CO3
III	9	Solve the given simultaneous equation of order 2 and 3.	2#	CO3
IV	10	Verify the given trigonometric Identities, Relations by using Trigonometric Ratios.	2#	CO4
IV	11	Verify the given trigonometric Identities, Relations by using allied angle and compound angle formulas.	2#	CO4
IV	12	Verify the given trigonometric Identities, Relations by using multiples angle and sub-multiples angle formulas.	2#	CO4
IV	13	Verify the given trigonometric Relations by using factorization and De-factorization formulas.	2#	CO4
V	14	Find the principle values of inverse trigonometric function.	2#	CO5
V	15	Verify the given inverse trigonometric Relations by using properties of inverse trigonometric function.	2#	CO5
VI	16	Find the mean of any given data, and find the combined mean given two sets of data.	2#	CO6

VI	17	Find the range, co-efficient of range of the given grouped and un-grouped data.	2#	CO6
VI	18	Calculate the mean, standard deviation of grouped and un-grouped data related to the engineering problems.	2#	CO6
VI	19	Calculate the variance, co-efficient of variances grouped and un-grouped data related to the engineering problems.	2#	CO6
VI	20	Justify the consistency and Reliability of two given sets.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Verify the complicated calculation by logarithm and calculator.
2. Prepare a chart of Rules, Laws of Logarithm.
3. Convert the given improper fraction into proper fraction and resolve into partial fraction.
4. Solve simultaneous equation in two variables by matrix inversion method and write mathematical programming related with engineering field.
5. Prepare the list of Trigonometric formulas and inverse trigonometric formulas.
6. Represent trigonometric ratios, logarithmic function graphically and interpret the Result.
7. Collect the data from market, class test marks in your class or from two groups then find the mean.
8. Compare the any two cricket players by using consistency and reliability.
9. Calculate mean Deviation, standard deviation, co-efficient of variance of any given data.
10. Find the number of unknown variables in two groups if the combined mean is given.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Logarithm	5	C	02	04	00	6
			O	00	00	04	4
2	Partial Fraction	8	C	02	04	04	10
			O	00	00	06	6
3	Determinant & Matrix	14	C	02	04	10	16
			O	00	04	04	8
4	Trigonometry	14	C	02	04	12	18
			O	02	04	04	10
5	Inverse Trigonometric Function	5	C	02	04	00	6
			O	00	04	00	4
6	Statistics	14	C	02	00	12	14
			O	00	04	04	8
Total		60	C	12	20	38	70
			O	2	16	22	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	4R2	5R2	6R2	5	7
2	1U4	1A4	2U4	2A4	3U4			3	5
3	3U4	3A4	3A4	4U4	6U4			3	5
4	4U4	4A4	5U4	5U4	6A4			3	5
5	2A6	4A6	6A6					2	3
6	3A6	4A6	6A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance (Regularity And Awareness About Performing Assignment)	5
2	Assignment Contents (20-25 examples is compulsory on each unit)	10
3	Completion of Assignment, Neatness And cleanliness of maintaining Assignment Copy.	10
4		
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Interest And Awareness About Performing Assignment	5
2	Assignment Contents	10
3	Completion of Assignment, Neatness And cleanliness of maintaining Assignment Copy.	10
4		
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	1	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Higher Algebra	Hall & Knight, Publisher: Arihant, 6thEdition 2021	9789351762539
2	Plane Trigonometry	S.L. Loney, Publisher: Arihant, 5thEdition 2015	9352030540
3	Basic Statistics	B.L. Agarwal, Publisher: Anshan	1848290675
4	Basic Mathematics	G. V. Kumbhojkar,P. Jamnadas LLP.,21st Edition 2017	978-81-934573-5-1
5	Fundamental of Statistics	S.C.Gupta, Himalaya Publishing House, 7th Edition 2015	9789350517697
6	Higher Engineering Mathematics	Khanna Publication New Delhi, B.S.Grewal	8174091955

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1. https://econtent.msbte.ac.in/econtent/econtent_home.php assessed on 20th August 2023
2. https://www.khanacademy.org assessed on 20th August 2023
3. https://www.youtube.com/watch?v=5_TuK1yCPD4 assessed on 20th August 2023
4. http://nptl.ac.in/course/106102064 (online Learning Initiatives By IITs and IISc) assessed on 20th August 2023
5. https://www.khannacademy.org/mathq gelid=CnqHuabCys4CFdOJaddHoPig assessed on 20th August 2023

XVI List of Major Equipment/Machineries with Specification:

1. Nil
2. --
3. --

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. P.T. Khobaragade	I/C Mathematics Dept.	Govt. Polytechnic Nagpur
2	Mr. S.M. Sayyed	Ex-Lecturer	Govt. Polytechnic Nagpur
3	Mr. G.R. Dewalkar	Lecturer	Govt. Polytechnic Sakoli
4	Dr. P. B. Bahatkar	Professor	Y. C. C. E. Nagpur
5	Mr. V.M.Meshram	Ex-Lecturer	Govt. Polytechnic Nagpur

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/MK/IT/CM/MT/PK/AE/TX/MK/AIML
Course Category	:	DSC
Course Code	:	PH101H
Course Title	:	Applied Physics

I Rationale:

Physics is the foundation of engineering and technology which help to develope the ability of technical skills for those students who wish to pursue higher study in engineering field. Without the concept and application of physics there cannot be technology development. Study of physics develops the ability of problem solving, logical thinking and also the ability to think intellectually. Fundamental principle and scientific knowledge of physics is used for technology innovation to develop new surrounding that benefits new mankind which is important to society and nature, making everything easier around us.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply principles of physics to solve broad based relevant engineering problems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Determine** physical quantities using proper measuring instruments.

CO2: **Solve** fundamental engineering problems using law of electricity and magnetism.

CO3: **Apply** the fundamental principles of heat and optics for engineering applications.

CO4: **Apply** principles of wave motion, acoustics and radioactivity for engineering applications.

CO5: **Use** LASER, X-rays and photoelectric cell for industry applications.

CO6: **Use** nanotechnology and Non-Destructive Testing (NDT) for various applications in engineering field.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
4	-	2	2	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: General Properties of Matter	1a	Estimate the error in the measurement for a given data.	1.1	Errors, Type of error, instrumental, systematic, and random error, Estimation of error, Absolute, Relative and Percentage error.	CO1
	1b	Calculate Least Count (LC) and range of given instruments.	1.2	Ancient Indian Astronomical Instrument: water clock (Ghati Yantra), Gnomon (Shanku), Crossed Staff (Yasti Yantra). Modern measuring instruments: Least count and range of Vernier caliper, outside micrometer screw gauge and travelling microscope.	
	1c	Compare deformation in given bodies by the action of external deforming force.	1.3	Elasticity, Plasticity, Rigidity. Stress and Strain with their types, Elastic Limit, Hook's Law, Types of modulus of Elasticity, Stress-Strain curve, Applications of elasticity, Numerical based on above.	

	1d	Determine the coefficient of viscosity of the given fluid using the law of viscosity for given data.	1.4	Viscous force, Definition of viscosity, Newton's law of viscosity, Stoke's law, (Statement and formula only), Coefficient of viscosity and S.I. unit. Types of flow of liquid, Reynold's number, Terminal velocity and Application of viscosity.	
UNIT II: Basic Electricity	2a	Calculate the force of attraction or repulson between two charges for a given data.	2.1	Concept of charge, Coulomb's inverse square law, Electric field, Electric field intensity, potential and potential difference, Numerical based on Coulomb's inverse square law, Electric field intensity.	CO2
	2b	Solve problems based on Magnetic field intensity and Magnetic flux.	2.2	Magnetic field and magnetic field intensity and its units, magnetic lines of force, magnetic flux.	
	2c	Apply the law of series and parallel combination to the given electrical circuit.	2.3	Ohm's law, specific resistance, laws of series and parallel combination of resistance, calculation of resultant resistance of given resistances in series and parallel combination, Heating effect of electric current, Joule's Law, Numerical based on above.	
	2d	Differentiate materials on the basis of given energy band diagram.	2.4	Conductors, Insulators and Semiconductors, Energy bands, intrinsic and extrinsic semiconductors	
d Fiber Optics	3a	Select the modes of transmission of heat for given materials.	3.1	Heat and Temperature: Heat, temperature, Absolute zero temperature, different temperature scale, Three modes of transmission of heat. Good and bad conductor of heat with examples, Law of thermal conductivity and S.I. units.	

UNIT III: Thermometry an	3b	Determine given parameters of gas by applying gas laws.	3.2	Boyle's law, Charle's law, Gay Lussac's law, General gas equation, Applications of gas laws and calculation of pressure, volume or temperature using gas laws.	CO3
	3c	Differentiate different type of optical fibre with their application.	3.3	Reflection, Refraction, Snell's law, Optical fiber, Structure of optical fiber, Principle of Optical fiber-Total Internal Reflection, Type of optical fibre and applications of Optical Fiber.	
UNIT IV: Wave Motion and Radioactivity	4a	Classify the given types of waves by their characteristics.	4.1	Definition of wave motion, amplitude, period, frequency & wavelength, relation between velocity, frequency & wavelength. Progressive wave, Stationary waves, longitudinal and transverse wave. Node, Antinode. Ultrasonic wave, Properties, and application.	CO4
	4b	Calculate velocity of sound with end correction on given data.	4.2	Definition of resonance with example. Formula for velocity of sound with end correction, calculation of velocity of sound with the help of resonance tube.	
	4c	Compare the properties of radioactive rays on the basis of given parameters.	4.3	Radioactivity, α, β and γ rays and their Properties, Advantages, and disadvantages of Radioactivity.	

UNIT V: Modern Physics (Photoelectricity, LASER, X-Rays)	5a	Calculate work function, energy, threshold frequency and threshold wavelength for a given data.	5.1	Photon, properties of photons, Planck's hypothesis, Threshold frequency, threshold wavelength and Stopping potential. Work function, Photoelectric effect with characteristics properties. Principle, Construction and working of Photoelectric cell with applications. Einstein's photoelectric equation. (Numerical based on above)	CO5
	5b	Apply the fundamental concepts of LASER in given engineering fields.	5.2	Properties of laser, Types of laser, absorption, spontaneous and stimulated emission. Definition of Pumping and its type, Population inversion, Metastable state. Applications of LASER in Engineering and biomedical field.	
	5c	Describe the production of X-rays of the given materials with properties and applications.	5.3	Introduction to X-rays, Properties of X -rays, production of X-ray using Coolidge tube. Applications of X-rays in Engineering, medical and scientific field.	
UNIT VI: Nanotech-nology and Non Destructive Testing.	6a	Calculate surface area per volume ratio of given objects.	6.1	Definition of nanoscale, nano-meter, nanoparticle, determination of surface area per volume ratio of objects, application of nanotechnology in Engineering and Technology, medical, cosmetics, environmental, space and defence.	CO6
	6b	Compare DT and NDT methods on the basis of given points.	6.2	Non-Destructive Testing (NDT), comparison of DT and NDT, Various NDT methods used, Criteria for the selection of NDT method, Merits and Demerits of NDT.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the various instruments used in Physics laboratory and follow precautionary measures.	2#	CO1
I	2	Measure the outer diameter of a cylindrical body by Vernier Calliper.	2#	CO1
I	3	Calculate the diameter of a small spherical body by Outside micrometer screw gauge.	2#	CO1
I	4	Calculate the value of Young's modulus of elasticity of given wire.	2#	CO1
I	5	Determine the coefficient of viscosity of given fluids by Stoke's method.	2	CO1
II	6	Calculate mechanical equivalent of heat, J by electrical method.	2#	CO2
II	7	Use magnetic compass to draw the magnetic lines of forces of bar magnet.	2#	CO2
II	8	Calculate the resultant resistance of given resistances in series combination.	2#	CO2
II	9	Calculate the resultant resistance of given resistances in parallel combination.	2#	CO2
III	10	Analyze the effect of volume on pressure at constant temperature.	2#	CO3
III	11	Calculate critical angle of incidence for a given glass slab to verify total internal reflection phenomenon.	2	CO3
IV	12	Determine inner diameter of resonance tube using Vernier Calliper.	2#	CO4
IV	13	Find the velocity of sound with the help of resonance tube.	2#	CO4
V	14	Find the angle of divergence of Laser beam.	2	CO5
VI	15	Calculate the surface area (SA), volume (V) and SA/V of an object and measure dimensions required for it.	2#	CO6

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Collect different solid materials. Classify them into elastic, plastic and rigid bodies on the basis of Hooke's law and prepare a report on it.
2. Collect viscous liquids and prepare a working model to differentiate the liquids on the basis of viscosity.
3. Prepare a prototype vernier caliper of desire least count using card sheet.
4. Prepare model of heating effect of electric current on aluminium and nichrome wire.
5. Prepare model of series and parallel resistances using household materials.
6. Perform comparative analysis of series and parallel combination of resistances using LED, resistor and connecting wires.
7. Prepare demonstrative model of simple electromagnet by using law of electricity and magnetism.
8. Plot the magnetic lines of forces for U-shaped magnet using magnetic compass.
9. Construct a simple ON-OFF Circuit on breadboard using semiconducting devices.
10. Prepare model to demonstrate magnetic lines of forces of different types of magnets.
11. Prepare a report on conducting and non-conducting material and differentiate good conductor and bad conductor among the collected material such as metal and plastic etc.
12. Collect different conducting and non-conducting materials and construct ON OFF circuit using resistors, LED, connecting wires to differentiate good and bad conductors within the collected materials.
13. Prepare a working model to demonstrate Total Internal Reflection (TIR) by using water and diode laser.
14. Prepare a simple model of projector using fundamental principle of optics.
15. Use diode LASER to differentiate LASER with ordinary source of light.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	General Properties of Matter	8	C	02	02	04	8
			O	00	00	04	4
2	Basic Electricity	8	C	02	04	06	12
			O	00	04	04	8
3	Thermometry and Fiber Optics	12	C	04	06	04	14
			O	02	06	00	8
4	Wave Motion and Radioactivity	12	C	04	06	04	14
			O	04	04	00	8
5	Modern Physics (Photoelectricity, LASER, X-Rays)	14	C	02	04	10	16
			O	02	00	06	8
6	Nanotech-nology and Non Destructive Testing.	6	C	02	04	00	6
			O	00	00	04	4
Total		60	C	16	26	28	70
			O	8	14	18	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	1U2	5R2	6R2	3R2	5R2	5	7
2	3R4	2U4	1A4	2U4	1A4			3	5
3	3A4	4R4	4A4	2A4	4R4			3	5
4	5A4	5U4	6A4	6U4	4U4			3	5
5	3U6	2A6	3U6					2	3
6	4U6	5A6	5A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Sources of information	5
2	Scientific Approach	10
3	Timely submission	5
4	Conclusion / Interpretation	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	2	-	-	3	-	-
CO2	3	-	-	2	-	-	3	-	-
CO3	3	-	-	-	-	-	3	-	-
CO4	3	-	-	2	2	-	3	-	-
CO5	3	-	-	2	2	-	3	-	-
CO6	3	-	-	-	2	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Modern Physics	B.L.Thereja, S. Chand & Company Ltd 5th Edition, 2014	13:978-8-12-190163-5
2	Engineering Physics	V.Rajendran, The McGraw Hill Education Pvt. Ltd,1st Edition, 2010	13: 978-0-07-107014-0
3	Conceptual Physics	P.G.Hewitt, San Francisco Addison Wesley- 10th Edition, 2006	13: 9780321909107
4	Engineering Physics	R.K.Gaur And S.L.Gupta, Dhanpatrai Publication New Delhi, 1987	97-8-18-992822-3
5	A Textbook of Engineering Physics	M N Auadhanulu, S Chand Publication, 2008	8121908175, 9788121908177
6	Fundamental of Physics	Dvid Halliday, Robert Resnick, Jearl Walker	13:978-0471524618, 10:0471524611

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2. https://www.livescience.com/58816-photoelectric-effect.html, assessed on 19th Aug 2023.
3. https://www2.lbl.gov/abc/wallchart/chapters/03/4.html, assessed on 18th Aug 2023.
4. https://www.sanskritimagazine.com/ancient-indian-astronomical-instruments-of-bhaskaracharya/ assessed on 24th Aug 2023.
5. https://easyelectronics.co.in/ultrasonic-waves/ assessed on 24th Aug 2023.
6. https://www.keyence.co.in/ss/products/measure-sys/measurement-selection/basic/error.jsp assessed on 23rd Aug 2023.

XVI List of Major Equipment/Machineries with Specification:

1. Vernier Caliper (Least count= 0.01 cm and range= 0 to 12 cm)
2. Screw gauge (Least count= 0.001 cm and range= 0 to 2.5 cm)
3. Young' Modulus- Searle's apparatus with micrometer reading 0.001 cm.
4. Travelling microscope (vertical and horizontal scales with range 0- 15 cm with least count 0.001 cm)
5. Resonance apparatus with glass tube and metal reservoir (L= 0- 100 cm)
6. Tunning fork -256, 320, 384, 428, 480, 512 Hz.
7. Boyle's apparatus iron base double steel rod, 25 ml fitted with leveling screw on base
8. Stoke's apparatus with glass tube 50 cm.
9. Joule's calorimeter with mass 198 cal/gms.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mrs. S. B. Adulkar	Lecturer	Government Polytechnic, Nagpur
2	Dr. A. R. Karule	Lecturer	Government Polytechnic, Nagpur
3	Mr. A. J. Khobragade	Lecturer	Government Polytechnic, Nagpur
4	Mr. D. D. Bodele	Lecturer	Government Polytechnic, Nagpur
5	Dr. S. B. Raut	Lecturer	Government Polytechnic, Gondia
6	Dr. A. M. Dabhade	Lecturer	Government Polytechnic, Bramhapuri.
7	Mr. A. D. Ningurkar	Lecturer	Government Polytechnic, Bramhapuri.

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in ME/PK
Course Category	:	DSC
Course Code	:	ME151H
Course Title	:	Engineering Graphics

I Rationale:

Engineering graphics is a non-verbal and graphical language to communicate ideas, instructions and facts with each other clearly and without ambiguity while carrying out engineering jobs on the sites, shop floor etc. It describes the fundamentals, facts, concepts, principles and techniques of Engineering Graphics. The course illustrates techniques of drawing in an engineering field. It helps to develop the idea of visualizing the actual object or part on the basis of drawings and blue prints. This course is useful in developing drafting and sketching skills of the student. This preliminary course aims at building a foundation for the further course in drawing and other allied courses.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Prepare engineering drawings using prevailing drawing standards and instruments.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** and construct appropriate drawing scales and use drawing instruments & Apply IS SP-46 2011 for engineering drawing.

CO2: **Draw** various engineering curves.

CO3: **Covert** isometric projections into orthographic projections.

CO4: **Visualize** three dimensional objects and draw isometric projections.

CO5: **Apply** knowledge of projections of points and solve the problems on projection of straight lines.

CO6: **Draw** freehand sketches of an engineering elements.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	4	-	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	50	20	50	20	-	-

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Principles of Drawing	1a	Draw the scale as per IS SP-46 from given data.	1.1	Use of different drawing instruments and equipment, Types of letters and numbers (single stroke vertical) and Conventions of lines, Dimensioning technique as per IS SP- 46. Scales (reduced, enlarged and full size)-Plain scale, diagonal scale.	CO1
	1b	Redraw the given geometrical figure as per IS SP - 46.	1.2	Redrawing of geometrical figures.	
ngineering Curves	2a	Draw conic sections by specified method from given data.	2.1	Drawing of Conic Sections: Draw an ellipse by: Arcs of circles method; Rectangle method; Concentric circles method; Draw parabola by: Directrix-focus method; Rectangle method; Draw hyperbola by: Directrix–focus method; Passing through a given point with reference to given asymptotes.	CO2

UNIT II: E	2b	Draw involute, and know their applications. Draw cycloidal curve, spiral and helix from given data and know their applications.	2.2	Draw involute of circle and polygon of maximum six sides. Drawing of cycloid, epi-cycloid and hypo-cycloid. Draw Archimedean spiral and Helix.	
	2c	Draw loci of point from given data.	2.3	Drawing of Loci of points- Sihgle slider crank mechanism	
UNIT III: Orthographic Projections	3a	Draw Orthographic projection methods.	3.1	Introduction to orthographic projections, First angle and Third angle method of projections.	CO3
	3b	Visualize, interpret and draw orthographic views from given pictorial views.	3.2	Conversion of simple pictorial view (object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces.) into orthographic views by First angle and third angle projection method.	
UNIT IV: Isometric Projections	4a	Draw isometric scale.	4.1	Introduction to isometric scales, isometric views/drawings and isometric projections.	CO4
	4b	Visualize, interpret and draw Isometric views/ projections from the given orthographic view.	4.2	Isometric views/ projections of simple & cylindrical object (plane surfaces, slanting surfaces, and Rectangular, V, Trapezoidal slots).	
UNIT V: Projection of Straight Line	5a	Draw projection of Lines from the given data.	5.1	Projections of straight lines inclined to one reference plane and parallel to the other–limited to both ends in first quadrant.	CO5
	5b	Draw given geometrical figures from the given data using CAD.	5.2	Introduction to CAD. Different edit and modify commands. Drawing of geometrical figures using CAD.	
al	6a	Sketch proportionate free hand sketches of given screw threads.	6.1	Types of screws threads–Vee and square threads, left hand and right hand threads.	

UNIT VI: Free Hand Sketches/Convention, Representation	6b	Sketch proportionate free hand sketches of given bolts and nuts and locking arrangement.	6.2	Bolts –square and hexagonal bolts, Eyebolt.Types of nuts–square, hexagonal, wing, capstan, cap, flanged, ring and dome nut. Locking arrangement–lock or check nut, split pin, slotted nut, castle nut, swan nut and grooved nut. Foundation Bolts - Lewis, Eye & Rag.	CO6

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Draw lettering, numbers, conventions of lines and figure fordimensioning techniques as per IS SP-46. (Practical Sketch book)	2	CO1
I	2	Draw plain scale and diagonal scale from given data. (Practical Sketch book)	2#	CO1
I	3	Redraw given geometrical constructions. (Practical Sketch book)	2#	CO1
I	4	Apply dimensioning technique as per IS SP-46: 2011 to redraw given geometrical figures. (Sheet No. 1)	2#	CO1
II	5	Draw Engineering Curves - Conic Section - Parabola, Ellipse and Hyperbola by given methods. (Practical Sketch book)	2#	CO2
II	6	Draw Loci of Point by simple mechanism. (Practical Sketch book)	2#	CO2
II	7	Draw givben Conic Sections Engineering Curves and Loci of Point of simple mechanism. (Sheet No. 2)	2#	CO2
II	8	Draw Engineering Curves - Involute of pentagon, circle and Archimedian spial (tangent and normal) and its corrolaries. (Practical Sketch book)	2#	CO2
II	9	Draw Engineering Curves - Cycloidal Curves and Helix (tangent and normal) and its corrolaries. (Practical Sketch book)	2#	CO2
II	10	Draw given Involute, Helix and Cycloidal curves. (Sheet No. 3)	2#	CO2
III	11	Draw Orthographic Projection using third angle method of projection from given pictorial view. (Practical Sketch book)	2	CO3
III	12	Draw Orthographic Projection using third angle method of projection of given pictorial view (Part I). (Sheet No. 4)	2#	CO3
III	13	Draw Orthographic Projection using third angle method of projection of given pictorial view (Part II). (Sheet No. 4)	2#	CO3
III	14	Draw Orthographic Projection using first angle method of projection of given pictorial view. (Practical Sketch book)	2#	CO3

III	15	Draw Orthographic Projection using first angle method of projection of given pictorial view (Part I). (Sheet No. 5)	2#	CO3
III	16	Draw Orthographic Projection using first angle method of projection of given pictorial view (Part II). (Sheet No. 5)	2#	CO3
IV	17	Draw Isometric View of given orthographic view with plane surfaces & with cylindrical, slot, slanting surfaces . (Practical Sketch book)	2	CO4
IV	18	Draw Isometric View of given orthographic view with plane surfaces & with cylindrical, slot, slanting surfaces (Part I). (Sheet No 6)	2#	CO4
IV	19	Draw Isometric View of given orthographic view with plane surfaces & with cylindrical, slot, slanting surfaces (Part II). (Sheet No 6)	2#	CO4
IV	20	Draw Isometric Projection of given orthographic view with plane surfaces & with cylindrical, slot, slanting surfaces. (Practical Sketch book)	2	CO4
IV	21	Draw Isometric Projection of given orthographic view with plane surfaces & with cylindrical, slot, slanting surfaces (Part I). (Sheet No. 7)	2#	CO4
IV	22	Draw Isometric Projection of given orthographic view with plane surfaces & with cylindrical, slot, slanting surfaces (Part II). (Sheet No. 7)	2#	CO4
V	23	Draw Projections of straight lines using first angle method of projection (line inclined to one reference plane and parallel to the other–limited to both ends in first quadrant). (Practical Sketchbook)	2	CO5
V	24	Draw Projections of straight lines using first angle method of projection (line inclined to one reference plane and parallel to the other–limited to both ends in first quadrant) (Part I). (Sheet No. 8)	2#	CO5
V	25	Draw Projections of straight lines using first angle method of projection (line inclined to one reference plane and parallel to the other–limited to both ends in first quadrant) (Part II). (Sheet No. 8)	2	CO5
V	26	Draw Projections of straight lines using first angle method of projection (line inclined to one reference plane and parallel to the other–limited to both ends in first quadrant) (Part III). (Sheet No. 8)	2#	CO5
VI	27	Draw Free Hand Sketches of Types of screws threads–Vee and square threads, left hand and right hand thread. (Practical Sketch book)	2#	CO6

VI	28	Draw Free Hand Sketches of Bolts (square, hexagonal and Eyebolt), Nuts (square, hexagonal, wing, capstan, cap, flanged, ring and dome nut). (Practical Sketch book)	2#	CO6
VI	29	Draw Free Hand Sketches of Locking arrangement– lock or check nut, split pin, slotted nut, castle nut, swan nut and grooved nut. (Practical Sketch book)	2#	CO6
VI	30	Draw Free Hand Sketches of Foundation Bolts (Lewis, Eye and Rag). (Practical Sketch book)	2#	CO6

Note: # Compulsory. Use A2 Size drawing Sheet and A3 size Sketch Book.

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Principles of Drawing	4	C	0	0	0	0
			O	0	0	0	0
2	Engineering Curves	4	C	0	0	0	0
			O	0	0	0	0
3	Orthographic Projections	7	C	0	0	0	0
			O	0	0	0	0
4	Isometric Projections	7	C	0	0	0	0
			O	0	0	0	0
5	Projection of Straight Line	4	C	0	0	0	0
			O	0	0	0	0
6	Free Hand Sketches/Conventional Representation	4	C	0	0	0	0
			O	0	0	0	0
Total		30	C	0	0	0	0
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Neatness , cleanliness and line work on drawing sheet	10
2	Creation of given drawing with proper dimensioning	20
3	In time submission	10
4	Viva Voce	10
	TOTAL	50

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	1	-	-	-	3	2	-	-
CO2	3	-	-	-	-	3	-	-	-
CO3	3	1	-	-	-	3	2	-	-
CO4	3	-	-	-	-	3	-	-	-
CO5	3	-	-	-	-	3	--	-	-
CO6	3	-	-	-	-	3	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Engineering Drawing Practice For Schools and Colleges IS:SP-46	Bureau of Indian Standards, Third Reprint, October 1998	10: 81-7061-091-2
2	Engineering Drawing	N.D.Bhatt, Charotar Publishing House, 53rd Edition, 2019	13: 9789380358963
3	Geometrical and Machine Drawing	N.D.Bhatt & V.M Panchal, Charotar Publishing House, 20th Edition, 2014	13: 9789380358895
4	Engineering Drawing	D.A. Jolhe, Tata McGraw-Hill Edu. 2010	13: 978-0-07-064837-1
5	Engineering Drawing	R.K.Dhawan, S.Chand & co.	10: 81-219-1431-0
6	Engineering Drawing	P.J Shaha, S.Chand & Co. 2013	10: 8121941822

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2. https://www.youtube.com/watch?v=-W7tH49dBLw accessed on 30 June 2021.
3. https://www.youtube.com/watch?v=FXP3tKedM5g accessed on 30 June 2021.
4. https://www.youtube.com/watch?v=j5nwO JwVv4&list=PLDN15nk5uLiBpnIOK5r3KXdfFOVzGHJSt accessed on 30 June
5. https://www.youtube.com/watch?v=77ufJXvXUk4&list=PLIhUrsYr8yHxVky7bfrnbRcdXcHjT_K83&index=2(Iso)accessed on 30 June 2021.
6. https://www.youtube.com/watch?v=Jzr5PTbvkVI&list=PL1xA-ZWMKpOMt3ew5vcn3keBxlqHKtlgaccessed on 30 June 2021.

XVI List of Major Equipment/Machineries with Specification:

1. Drawing Board for Half-Imperial size Drawing Sheet
2. Drafting Machine or Mini-Drafter of good quality
3. All good quality Drawing Instruments
4. Large size Scale, 30-60 & 45-45 Set-Squares
5. French Curve

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. S. S. Baraskar	I/C HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Prof. N. J. Burbure	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
3	Prof. R. S. Khobragade	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
4	Mr. S. P. Wakhare	Manager	Mahindra & Mahindra Ltd., Mumbai
5	Prof. G. F. Potbhare	Principal	NIT Polytechnic, Nagpur
6	Prof. G. H. Dahole	I/C HOD, Mechanical Engineering	Government Polytechnic, Gondia

(Dr. S. S. Baraskar)
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Member Sectretary PBOS, ME

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/AE/CM/IT/AIML/MC/PK/MT/TX/TR
Course Category	:	AEC
Course Code	:	EN101H
Course Title	:	Communication Skills

I Rationale:

Communication and proficiency in language grants an access to communicate on global platform. This course focuses on enhancing language skills like reading, listening, speaking and writing. Proficiency in English language enables a student to make connection with people around through effective communication. In engineering domain, excellence in English language enables a technician to pursue professional career and holistic development as an individual to stand strongly in the society.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Formulate English language into meaningful structures and assess the given information.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Formulate** grammatically correct sentence structures and incorporate appropriate use of vocabulary.

CO2: **Interpret** the text and appreciate literature.

CO3: **Enhance** ability to comprehend text and observe the rules of effective writing.

CO4: **Apply** communicative principles in daily activities.

CO5: **Construct** logical and meaningful sentence structures.

CO6: **Elaborate** thoughts and ideas constructively.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	2	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Application of Grammar & Vocabulary Building	1a	Use Tenses as per given situation.	1.1	Tenses: Present tense, past Tense, Future Tense and Sub types, identification and modification as per instruction.	CO1
	1b	Change the narration of given sentences.	1.2	Narration: Types of Sentence: Assertive, Imperative, Interrogative, Exclamatory. Change into Direct Speech and Indirect Speech.	
	1c	Use words effectively in given sentences.	1.3	Applying Synonyms, Antonyms, Homophones, Homonyms in given situations as per instructions.	
	1d	Enhance the understanding of word formation.	1.4	Replace a group of words/phrases with One Word Substitution.	
	1e	Construct effective sentences using idioms and phrases.	1.5	Enlist Idioms & Phrases with their meanings, make sentences using idiom and phrases.	

UNIT II: Prose	2a	Inculcate the habits to make good impression.	2.1	Abstract Summary of Dale Carnegie: Six Ways to Make People Like You-By Dale Carnegie. Read the text: Understand the 6 ways suggested by the writer. Elaborate the points using real examples. Suggest more ways that help create good impression. Display behavioral changes in yourself.	CO2
	2b	Incorporate positive attitude.	2.2	When Life Gave Me Lemons-By Rashmi Raj: Improve reading skills. Identify the important characters of the story. Associate the situation of the characters with your life. Apply the attitude suggested by the writer. Highlight the moral of the story.	
	2c	Reflect on thoughts, feelings and experiences.	2.3	Two Gentlemen of Verona- By A. J. Cronin: Read the text with correct intonations. Summarize the story in your own words. Highlight new words and write their synonyms and antonyms. Perform the story in a dramatic manner. Write a critical review.	
UNIT III: Comprehension of Seen & Unseen Passages	3a	Prioritize IQ, EQ and SQ for career building.	3.1	Be Remarkable- Naren: Read, interpret and apply the acquired principles in real life.	CO3
	3b	Enhance abilities to stand in job market.	3.2	Employers Look for Potential Employees- By Manish Sabharwal: Acquire the necessities of professional world and implement them for career building.	
unicative Skills	4a	Recognize the need of effective communication.	4.1	Introduction of communication process/cycle, definition of communication, elements of communication. Acquire the manner in which communication is conducted.	CO4

UNIT IV: Comm	4b	Recognize communication barriers.	4.2	Introduction to types of communication barriers, develop a way in which barriers to communication can be minimized so as to ensure effective interactions.	CO4
UNIT V: Writing Skills	5a	Formulate paragraphs with synchronized sentence structure on the given situation/topic.	5.1	Paragraph Writing: Structure of paragraph writing, Types of Paragraphs, Expansion of Ideas.	CO5
	5b	Develop articulation of thoughts and ideas into logical structure.	5.2	Speech Writing: : Structure of speech writing, principles of speech writing, Welcome Speech, Introducing the Guests, Vote of Thanks.	
	5c	Summarize the given information and ideas.	5.3	Note Making: Scanning and skimming of text, identifying key words in the given text, comprehend the central idea and write the gist of given text.	
UNIT VI: Speaking Skills	6a	Draft dialogues logically.	6.1	Principles of dialogue writing, format of dialogue writing, identify formal and informal conversational situations in day to day life, develop and draft dialogues on given situation.	CO6
	6b	Compose sentences to present self and others impressively.	6.2	Identify personality traits and achievements of self and others, draft the information into an effective coherent structure.	
	6c	Develop sentence structure to ask, refuse and give permission.	6.3	Asking, Giving and Refusing Permission, identify formal and informal conversational situations in day to day life, develop and draft dialogues on given situation.	

6d	Develop dialogues to practice language skills in a structured and a meaningful way.	6.4	Inquiries and Information, identify formal and informal conversational situations in day to day life, develop and draft dialogues on given situation.

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Perform Tense Busters- All levels (Language lab/Worksheets on 12 tenses).	2#	CO1
I	2	Change the narration (20 sentences from Direct into Indirect Speech).	2#	CO1
I	3	Use dictionary for vocabulary building (solve worksheet on synonyms & antonyms, homophones, homonyms & one word substitution).	2#	CO1
I	4	Enrich word power (construct 20 effective sentences using frequently used phrases & idioms).	2	CO1
II	5	Express views and counter-views based on given text.	2	CO2
II	6	Expand the idea given in a logical and structured manner.	2#	CO2
III	7	Comprehend seen passages (comprehend any three topics from unit 2/3).	2	CO3
III	8	Comprehend unseen passages (comprehend any two unseen passages).	2#	CO3
IV	9	Identify the various elements of communication in the given situation (formal/informal) and draw a communication cycle.	2#	CO4
IV	10	Identify the barriers to communication in the given situation (formal/informal) and suggest means to minimise it.	2#	CO4
IV	11	Demonstrate through role play, skills of a good communicator like news reader, commentator, RJ, announcers etc.	2	CO4
V	12	Write a paragraph on given topic (write 3 paragraphs of about 75 words on given topics).	2#	CO5
V	13	Write a book review of a book by renowned Indian author.	2#	CO5
VI	14	Introduce self and others impressively (practice self-introduction/introduction of others in formal situation).	2#	CO6
VI	15	Prepare and present speech (draft & present a speech to introduce the guests and vote of thanks speech of any departmental/institute event).	2#	CO6
VI	16	Compose & Practice conversation (compose and practice dialogues on given formal and informal situation/Role play).	2	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Make a list of synonyms and antonyms frequently used in spoken English (minimum 50).
2. Enlist frequently used 30 idioms, write their meanings and make sentences using them.
3. Prepare a report on Teachers' Day/Engineers' Day celebrated in your college.
4. Read a moral based story book and write a review.
5. Enlist any 50 frequently used homophones and homonyms.
6. Write a short story (in about 150 words) using past tense.
7. Write five sentences each in simple present, simple past and simple future tense .
8. Take a sentence in simple present tense and convert into remaining 11 tenses.
9. Formulate 15 words each with prefixes – dis,mis,im,en, un, anti and formulate 15 words each with suffixes – able,ful, less, ment, tion.
10. Interview a renowned personality around you and draft an interview in dialogue format.
11. Prepare a vlog on an event celebration (planning, preparation and execution).
12. Listen a audio lecture of an Indian speaker and summarize it.
13. Interact with and collect monthly budget from three households and compare and contrast them
14. Write a diary noting down your daily activities for a specified period of time.
15. Visit and write a report on a place of interest (Railway museum, Ajab Bangla, Raman Science center).

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Application of Grammar & Vocabulary Building	6	C	4	4	4	12
			O	4	4	2	10
2	Prose	6	C	6	6	2	14
			O	0	0	10	10
3	Comprehension of Seen & Unseen Passages	4	C	2	4	4	10
			O	0	4	4	8
4	Communicative Skills	4	C	2	4	6	12
			O	0	4	0	4
5	Writing Skills	5	C	0	4	6	10
			O	4	0	0	4
6	Speaking Skills	5	C	0	6	6	12
			O	0	4	0	4
Total		30	C	14	28	28	70
			O	8	16	16	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	2R2	3R2	2A2	1R2	1R2	1A2	4R2	5	7
2	4U4	2A4	1A4	2R4	1U4			3	5
3	1U4	3A4	5U4	3U4	3A4			3	5
4	4U4	6U4	1R4	5R4	3U4			3	5
5	4A6	5A6	6U6					2	3
6	2A6	6A6	2U6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Performance	5
2	Overall presentation of given assignment	10
3	Viva Voce	5
4	Activity	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Choice Of Topic	5
2	Analysis And Interpretation	10
3	Presentation	5
4	Viva Voce	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	1	-	3	-	-
CO4	-	-	-	-	-	1	3	-	-
CO5	-	-	-	-	-	1	3	-	-
CO6	-	-	-	-	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	How to Win Friends and Influence people: Six ways to make people like you	Dale Carnegie, Rupa; First edition (20 May 2016)	978-8129140173
2	Two gentleman of Verona	A.J.Cronin, Oxford University Press 2013	-
3	Our muddled generation	Dinesh Kumar, Manish Sabharwal, Golden Harvest.	9788125059523
4	Contemporary English Grammar-structure and composition	David Green, Revised Edition,2004, Himalaya Publication.	033392183-6
5	Interactive English	S.K.Gangal, Revised Edition 1997 Allied Publishers.	81-7023-678-9
6	Applied English Grammar and composition	Dr. P.C. Das, 2013, New Central Book Agency.	978-81-7381-542-3
7	English for Practical Purposes	Z. N. Patil, B.S. Valke	033935098

XV e-References:

1. https://storymirror.com/read/english/story/when-life-gave-me-lemons/krd7xe09, accessed on 18th March 2021
2. https://storymirror.com/read/english/story/when-life-gave-me-lemons/krd7xe09, assessed on 25th July, 2021
3. www.talkenglish.com-grammar, assessed on 12th July, 2021
4. www.perfect-english-grammar.com, assessed on 18th March, 2021

XVI List of Major Equipment/Machineries with Specification:

1. Desktop Computers latest version
2. Headphones
3. Language lab software

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. Rupali Londhe	Lecturer in English	Government Polytechnic, Nagpur
2	Dr. M. M. Machale	Lecturer in English	Government Polytechnic, Nagpur
3	Mr. Nitin Pote	Lecturer in English	Government Polytechnic, Bramhapuri
4	Mr. Ravindra Suryawanshi	Lecturer in English	NIT Polytechnic, Nagpur
5	Mr. Nitin Pathak	Lecturer in English	Kamptee Polytechnic, Nagpur

(Mr. P. T. Khobragade)
HOD & Chairman PBOS, COMMON

(Dr. G. V. Gotmare)
Member Secretary PBOS, COMMON

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in ME/MT/PK
Course Category	:	SEC
Course Code	:	WS151H
Course Title	:	Engineering Workshop Practice

I Rationale:

Workshop practice is an engineering science course. The knowledge of this course is essential for technician to perform his/her duties in Industry. Students are able to perform various operations using hand tools equipment's and machineries in various shops. Working in workshop develops the attitude of group working and safety awareness. This course provides industrial environment in the educational institute.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use workshop tools and machinaries for engineering applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Prepare** utility jobs involving carpentry operations.

CO2: **Prepare** various welding joints.

CO3: **Prepare** job using different tools in fitting shop.

CO4: **Performs** various smithy operations.

CO5: **Perform** various operations of plumbing.

CO6: **Produce** utility jobs involving sheet metal operations.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	4	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	50	20	50	20	-	-

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
Unit I: Carpenrty Shop	1	Identify fire extinguisher according to their specification.	2#	CO1
	2	Perform mock drill session in group of minimum 10 students for extinguishing fire.	2#	CO1
	3	Identify the various hand tools, machine Tools and equipment used in Carpentry Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	2	CO1
	4	Observe demonstration of carpentry operation involve measuring, marking, cutting, planning and assembly with fabrication part.	2#	CO1
	5	Utility Job 1: Prepare utility job like desk bench top fitting and top for stools fitting jobs involving related carpentry operations as per given drawing. (Job to be prepared by group of 2 to 4 students depending on volume of work). Perform marking operation as per drawing.	2#	CO1
	6	Utility Job 1: (Contd.) Perform cutting and planning operations as per drawing.	2#	CO1
	7	Utility Job 1: (Contd.) Perform top fitting, teak wood bidding fitting and finishing/assembly operations as per drawing.	2#	CO1

Unit II: Welding Shop	8	Practice different safety rules in welding shop as per given instruction. Identify hand tools, machine Tools and equipment's used in Welding Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	2#	CO2
	9	Prepare lap joint or but joint using gas welding as per given drawing (individually).	2#	CO2
	10	Utility Job 2: Prepare utility job (like stool, benches, tables or similar jobs) involving arc welding and artificial wood as per given drawing (Job to be prepared by group of 2 to 4 students depending on volume of work). Perform measuring and marking operations as per drawing.	2#	CO2
	11	Utility Job 2: (Contd.) Perform cutting and edge preparation operations as per drawing.	2#	CO2
	12	Utility Job 2: (Contd.) Perform welding and finishing operations as per drawing.	2#	CO2
Unit III: Fitting Shop	13	Identify hand tools, machine Tools and equipment's used in Fitting Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	2	CO3
	14	Individual Job 1: Prepare job involving various fitting operations as per given drawing. Perform filing operation as per drawing.	2#	CO3
	15	Individual Job 1: (Contd.) Perform marking and Punching operation as per drawing.	2#	CO3
	16	Individual Job 1: (Contd.) Perform sawing and drilling operation as per drawing.	2#	CO3
	17	Individual Job 1: (Contd.) Perform tapping and finishing/assembly operation as per drawing.	2#	CO3
: Smithy Shop	18	Identify the various hand tools, machine Tools and equipment used in Smithy Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	2	CO4
	19	Individual Job 2: Prepare job like "L" hook involving related smithy operations. Perform marking and cutting operations as per drawing.	2#	CO4

Unit IV	20	Individual Job 2: (Contd.) Do preparation of fire in electric furnace. Perform heating, holding and bending of material.	2#	CO4
	21	Individual Job 2: (Contd.) Perform finishing operation as per drawing.	2#	CO4
Unit V: Plumbing Shop	22	Identify the various hand tools, machine Tools and equipment used in Plumbing Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	2	CO5
	23	Individual Job 3: Prepare “T” Joint involving related plumbing operations.	2#	CO5
	24	Individual Job 4: Prepare "Elbow" Joint involving related plumbing operations.	2#	CO5
	25	Prepare bill of material for given pipeline layout (individually).	2	CO5
Unit VI: Sheet Metal Shop	26	Identify the various hand tools, machine Tools and equipment used in Sheet Metal Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	2#	CO6
	27	Utility Job 3: (Contd.) Perform edging and end curling as per given drawing.	2#	CO6
	28	Utility Job 3: (Contd.) Perform lancing, soldering and riveting operations as per given drawing.	2#	CO6
	29	Utility Job 3: (Contd.) Perform finishing/assembly operations as per given drawing.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Job Drawing	10
2	Handling Tools, machineries and its operations	10
3	Dimension Accuracy	20
4	Overall finishing of Job	10
	TOTAL	50

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	3	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	-	-	3	-	-	3	-	-
CO5	3	-	-	3	-	-	3	-	-
CO6	3	-	-	3	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Course in Workshop Technology	B.S. Raghuwanshi, Dhanpat Rai sons, New Delhi, 2011	10: 0000017108
2	Elements of Workshop Technology	Hajra; Choudhary; Media Promoters & Publishers Mumbai, 2009	10: 8185099146
3	A Textbook of Manufacturing Process (Workshop Tech.)	Gupta J.K., R.S. Khurmi, S. Chand & Co. New Delhi	10: 81-219-3092-8
4	Workshop Practice Manual for Engineering Diploma & ITI Students	R K Hegde, Sapna Book House, 2012	13: 9798128005830
5	Engineering Workshop Practice	Sarathe, A.K, Khanna Book Publishing CO(P) LTD, New Delhi.	13: 978-93-91505-51-6

XV e-References:

1. https://www.youtube.com/watch?v=dVxjT5kkhFc assessed on 20th August 2023
2. https://www.youtube.com/watch?v=cJceuoRP3NI assessed on 20th August 2023

XVI List of Major Equipment/Machineries with Specification:

1. Circular Saw Machine, Diameter of saw blade 200 mm, Maximum Depth of Cut 50 mm, Table Size -350 x 450 mm, Table Tilting - 450
2. Bench Drilling machine (upto 13 mm drill cap.) with ½ H.P. Motor, 1000 mm height
3. Power Saw machine 350 mm mechanical with 1 HP Motor & all Accessories.
4. Bench Grinder 200 mm Grinding Disc diameter 200 mm. with 25 mm. bore 32 mm. with ½HP/1HP Motor.
5. Welding machine 20 KVA 400A welding current 300A at 50, 100, 200, 250, 300 with std. Accessories and Welding Cable 400 amp. ISI with holder
6. Oxygen and acetylene gas welding and cutting kit with cylinders and regulators.
7. Pipe Bending Machine
8. Portable Hammer Drill Machine 0-13 mm A.C. 230 V, 2.5Amp, Pistol type, having different types of bits
9. Sheet Bending Machine
10. Sheet Cutting Machine

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. S. S. Baraskar	I/C, HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Mr. S. R. Kaduskar	Workshop Superintendent	Government Polytechnic, Nagpur
3	Mr. D. M. Gadhave	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur

(Dr. S. S. Baraskar)
HOD & Chairman PBOS, ME

(Dr. G. V. Gotmare)
Member Secretary PBOS, ME

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/PK/MT/TX/IT/CM/AE/AI/MK/TR
Course Category	:	SEC
Course Code	:	CM151H
Course Title	:	Basics of Computers

I Rationale:

Computer is an essential tool that we cannot avoid as it plays an important role in our day to day life, especially in the present scenario. Basics of Computer course starts with the basic computer skills, learning basic application software tools, Understanding Computer Hardware, Basic Internet awareness. This course will be taken online under spoken tutorial courses IIT, Bombay.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use computer for Documentation, Presentation, Analyse data and different internet services.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** the basics of computer fundamentals.

CO2: **Install** and configure printer setting.

CO3: **Identify** Basic Internet skills.

CO4: **Recognize** various email components.

CO5: **Illustrate** the use of google drive.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	2	2	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)	Topics and Sub-topics	Aligned Cos

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify various Input/output devices of computer.	2#	CO1
I	2	Connect the various components of computer.	2#	CO1
II	3	Connect printer to computer and apply its setting.	2#	CO2
II	4	Configure the setting of printer and print the test page.	2#	CO2
II	5	Apply page layout features such as Themes, page background, paragraph,page setup. Create multicolumn page. Use different options to print the documents	2#	CO2
III	6	Use internet for different web services.	2	CO3
III	7	Create a new google account and login to gmail account.	2#	CO3
III	8	Write and compose an email to given email account.	2#	CO3
III	9	Send an email to given recipients.	2#	CO3
III	10	Use mail merge with options.	2	CO3
IV	11	Compose and attach files to e-mails.	2#	CO4
IV	12	Share of files and folders using google drive.	2#	CO4
IV	13	Insert a photo or link into an email and about the compose window options.	2	CO4
V	14	Create , open and edit worksheet.	2#	CO5
V	15	Apply Page setup and print options for worksheet to print the worksheet.	2#	CO5
V	16	Prepare a slide presentation and apply design theme to given presentation.	2#	CO5
V	17	Add new slides and insert pictures/images, shapes on presentation.	2#	CO5
V	18	Add table and charts in the slides.	2#	CO5
V	19	Create a word document and use different option on document.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare a document on Report of Various Printer types.
2. Prepare Notes using Document/Office.
3. Prepare Study Report using Document/Office.
4. Prepare Playbill (salary statement, tax statement) using spreadsheet.
5. Prepare a time table using Spreadsheet
6. Prepare student Mark sheet using spreadsheet.
7. Prepare presentation for advertisement.
8. Prepare presentation of your Branch/Department.
9. Prepare presentation of Study Report.
10. Prepare presentation on Various Components of Computer.
11. Prepare Google Form in Drive and share.

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

-----NA-----

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	selection of proper tool,execution	5
2	Complete the practical in stipulated time	10
3	Performance	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of Topic	5
2	Content of Report/Assignment	10
3	Submission of Report	5
4	Viva Voce	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	-	-	-	-	-
CO5	3	-	-	3	-	-	-	-	-
CO6									

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Computer Fundamentals	R.S. Salaria Khanna Publishing House	13: 978-938-1068533
2	Computer Course Made Easy	Ramesh Bangia, Khanna Book Publishing Company, First Edition, 2014	13: 978-938-2609377
3	Internet Applications	Ikvinderpal Singh, Khanna Book Publishing Company, First Edition, 2011	10: 938-1068399

XV e-References:

1. https://spoken-tutorial.org/tutorial-search/?search_foss=Introduction+to+computers &search language= accessed
2. https://www.latex-tutorial.com/tutorials/ accessed on 22/6/2022
3. http://www1.maths.leeds.ac.uk/LaTeX/TableHelp1.pdfaccessed on 22/6/2022
4. https://www.wikihow.com/Create-a-Website-Using-Google-Sites accessed on 22/6/2022
5. http://www.tutorialsforopenoffice.org/accessed on 22/6/2022

XVI List of Major Equipment/Machineries with Specification:

1. Computer system with latest configuration.
2. Any Office software or latest version
3. PC tools
4. Any operating system
5. printer
6. Spokent Tutorials IIT bombay study materials

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr.M.V.Sarode	HOD, Computer Engineering	Government Polytechnic, Nagpur
2	Mr P S Thakre	Lecturer in Computer Engineering	Government Polytechnic, Nagpur
3	Dr U B Aher	Lecturer in Computer Engineering	Government Polytechnic, Nagpur
4	Mrs D S Nalinde	Lecturer in Computer Engineering	Government Polytechnic, Nagpur
5	Mrs.V.A.Raje	System Analyst	MSBTE,RO,Nagpur
6	Mr. Dipak Dhote	Operations Manager	IT-Network, Nagpur
7	Dr. Rakesh Kadu	Assistant Professor	Ramdeobaba COEM,Nagpur

(Dr. M. V. Sarode)
HOD & Chairman PBOS, CM

(Dr. G. V. Gotmare)
Member Sectretary PBOS, CM

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/MT/PK/AE/TR/TX/ MK/AI
Course Category	:	VEC
Course Code	:	VE151H
Course Title	:	Integrated Personality Development

I Rationale:

This course aligns with the National Education Policy by fostering holistic development in engineering students, emphasizing values, resilience, and personal growth. It builds essential life skills such as leadership, effective communication, project management, and national pride, enhancing students' adaptability in both personal and professional settings. Through diverse learning experiences, students gain practical insights and develop a balanced, informed perspective essential for responsible, impactful careers.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Demonstrate leadership, effective communication, project management, and resilience in professional and personal environments.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Enhance** personal growth by mastering thought-processes, building productive habits, and managing social media impact.

CO2: **Develop** inspiration from Indian icons by applying lessons from their resilience, values, and leadership qualities.

CO3: **Enhance** communication skills by actively listening and bridging generational gaps to strengthen family connections.

CO4: **Build** resilience by adopting a positive outlook, learning from failures, and embracing faith in daily life.

CO5: **Foster** national pride by exploring, researching, and sharing insights about India's rich historical heritage.

CO6: **Develop** professional skills by building networks, adopting leadership qualities, and practicing effective project management.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	2	2	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	25	10	25	10	25	10

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
UNIT I: Remaking Yourself	1	**Restructuring Yourself:** Develop intellectual, physical, emotional, and spiritual quotients by learning six powerful thought-processes.	2#	CO1
	2	**Power of Habit:** Develop good habits in life by undergoing a study of how habits work, the habits of successful professionals, and the practical techniques.	2#	CO1
	3	**Handling social media:** Learn how social media can become addictive and imbibe simple methods to take back control.	2#	CO1
UNIT II: Learning from Legends	4	**Sachin Tendulkar and Ratan Tata:** Learn from the inspirational lives of India's two legends, Sachin Tendulkar and Ratan Tata & implement lessons through related case studies.	2#	CO2
	5	**A.P.J. Abdul Kalam:** Learn from Dr Kalam's inspirational life displayed legendary qualities such as Dare to Dream, Work Hard, Get Good Guidance, Humility, and Use Your Talents for the Benefit of Others.	2#	CO2

UNIT III: From House to Home	6	**Active Listening & Understanding:** Learn to listen with eyes, ears, mind, and heart, for academic progress and communications.	2#	CO3
	7	**Bonding the Family:** Overcome the generation gap and connect with their family more.	2#	CO3
UNIT IV: Facing Failures	8	**Welcoming Challenges:** Learn to face difficulties through a positive perspective, through the study of successful figures such as Disney, Lincoln and Bachchan.	2#	CO4
	9	**Significance of Failures:** Acquire constructive skills to understand failure as formative learning experiences.	2#	CO4
	10	**Power of Faith:** Learn the power and necessity of faith in our daily lives.	2#	CO4
UNIT V: My India My Pride	11	**Our Nation:** Learn the importance of studying India's glorious past so that they could develop a strong passion and pride for our nation.	2#	CO5
	12	**India's Glorious Past:** Develop a deeper interest in India's glorious past by appreciating the need to read about it, research it, write about it, and share it.	2#	CO5
UNIT VI: Soft Skills	13	**Networking & Leadership:** Learn the means of building a professional network and developing a leadership attitude.	2#	CO6
	14	**Project Management:** Learn the secrets of project management through the Akshardham case study and practice project management skills through an activity relevant to student life.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Perform Selfless Service - Seva: Learn the benefits of performing seva and prepare report showing evidences.

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Content Understanding	10
2	Readability	5
3	Completeness	5
4	Viva voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Originality of work	5
2	Organization and Writing	5
3	Use of Evidence	5
4	Viva voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	-	3	3	3	-	-
CO2	-	-	-	-	3	3	3	-	-
CO3	-	-	-	-	3	3	3	-	-
CO4	-	-	-	-	3	3	3	-	-
CO5	-	-	-	-	3	3	3	-	-
CO6	-	-	-	-	3	3	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Integrated Personality Development Course Workbook-1	IPDC Team, Swaminarayan Aksharpith, Shahibaug, Ahmedabad- 4, India, 2nd Edition 2021.	13: 978-81-7526-702-2
2	Wings of Fire: An Autobiography	A.P.J. Abdul Kalam, Arun Tiwari (Contributor), Universities Press, 67th Edition 2023	13: 978-817371466
3	The Wit & Wisdom of Ratan Tata	Ratan Tata, Hay House India, January 2016	10: 9789385827297 13: 978-9385827297
4	Chase Your Dreams	Sachin Tendulkar, Hachette India, October 2017	10: 9351951995 13: 978-9351951995

XV e-References:

1. Julian Treasure: 5 ways to listen better | TED Talk accessed on 7th July, 2023
2. Listening Statistics: 23 Facts You Need to Hear (creditdonkey.com) accessed on 7th July, 2023
3. Robert Waldinger: What makes a good life? Lessons from the longest study on happiness | TED Talk accessed on 7th July, 2023
4. The Story Behind the Selfless Love of Ahmedabad's Seva Cafe (thebetterindia.com) accessed on 7th July, 2023
5. What Are Soft Skills? Definition, Importance, and Examples (investopedia.com) accessed on 7th July, 2023
6. Welcome to Mystic India accessed on 7th July, 2023

XVI List of Major Equipment/Machineries with Specification:

1. Desktop Computer, Latest Configuration
2. DLP, Latest Configuration
3. Smart Classroom with internet connection

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M.B.Daigavane	Principal	Government Polytechnic, Nagpur
2	Mr. Y.K.Chandarana	HoD, Applied MechanicsEngineering	Government Polytechnic, Nagpur
3	Dr. G. K. Awari	HoD, Automobile Engineering	Government Polytechnic, Nagpur
4	Dr. G.V. Gotmare	I/C, Curriculum Development Cell	Government Polytechnic, Nagpur
5	Dr. Megha Machale (Bhelande)	Lecturer in English	Government Polytechnic, Nagpur

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Semester

II

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/CM/IT/AE/PK/MT/AI
Course Category	:	DSC
Course Code	:	MH102H
Course Title	:	Applied Mathematics

I Rationale:

Mathematics is the backbone of technical courses, Understanding of engineering concepts require logical approach and thinking. The course is extension of Basic Mathematics of first semester and stepping up into the prerequisites to learn Calculus and Numerical method. Applied Mathematics lay down the foundation to understand and express principles and laws involved in other Technological courses.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the concept of Mathematics to solve industry-based technological problems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** the concept of functions to Identify and find the value, Range, Domain,Co-Domain of the given function.

CO2: **Apply** methods of evaluation of limit to solve the given examples of limits.

CO3: **Apply** the concept of limit, define the first principal of derivatives, notation, understood the Rules to solve the examples of derivatives.

CO4: **Solve** indefinite and definite integral problems using integral of standard function, rules, and methods.

CO5: **Apply** the concept of differential equation which helps to solve engineering problems.

CO6: **Apply** various numerical methods to solve algebraic and simultaneous equations.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
4	2	-	2	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	-	-	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Functions	1a	Find the Range, Domainand Co-Domain of the given function.	1.1	Concept of function, Domain, Co-Domain, and Range of the Functions.	CO1
	1b	Find the value of given Function.	1.2	Value of a function.	
	1c	Identify the type of given functions.	1.3	Types of functions:- Logarithmic, Inverse, Algebraic, Trigonometric, & Inverse (LIATE)	
	1d	Check whether the given function is odd or even function.	1.4	Even and odd Function, Parametric, Composite Implicit, Explicit Functions.	
NIT II: Limits	2a	Evaluate limit of the given function by using Algebra of limits.	2.1	Concept of limit. Algebra of limits. (Addition Subtraction, Multiplication & Division). Limits of algebraic functions (By Direct Method, Factorisation, Rationalisation Method).	CO2
	2b	Solve the limit of given trigonometric function, & limit based on infinity type.	2.2	Limits of Trigonometric function, Limit based on x tends to infinity.	

UI	2c	Evaluate limits of the given exponential functions.	2.3	Limits of Exponential Functions.	
	2d	Evaluate the given logarithmic limit and Exponential limit.	2.4	Exponential Limits & Logarithmic Limits, Use of Logarithmic Limits for Exponential Limits.	
UNIT III: Derivetive	3a	Find the derivatives of given function using derivatives of standard function formulae by using Rules of Derivatives.	3.1	First principle of derivatives and Notations (without proof), Derivatives of standard function. (LIATE), Rules for differentiation (without proof) Addition, Subtractions, Multiplication, & Division.	CO3
	3b	Find the derivatives of given composite, inverse and inverse trigonometric, implicit, explicit, parametric, and exponential functions.	3.2	Derivative of composite, inverse and inverse trigonometric, implicit, explicit, parametric, and exponential functions.	
	3c	Differentiate the given function w.r.t. another function.	3.3	Logarithmic differentiation, & Derivatives of one function with respect to another function.	
	3d	Find the second order derivatives of the given function.	3.4	Second order differentiation.	
UNIT IV: Integrations	4a	Evaluate the given integral by substitution method.	4.1	Concept of Integration as a anti derivatives, Integral of standard function (LIATE), Rules of integration. Integration by substitution method.	CO4
	4b	Evaluate the integral of given composite function, rational function, and trigonometric function.	4.2	Integration of Algebraic Rational function, composite function, and trigonometric function.	
	4c	Evaluate the integral of given function by using parts and partial fraction.	4.3	Integration by partial fraction and by parts.	
	4d	Evaluate the given definite integral by using properties.	4.4	Definite integral and their properties.	

UNIT V: Differential Equation	5a	Solve given Differential equations of first order and first degree by variable separable method and reduce the given differential equation to variable separable form.	5.1	Concept of differential equation, Order and degree of differential equation, Formation of differential Equation. Methods of solving Differential equation of first order and first Degree. (a)Variable separable Method. (b) Equation reducible to variable separable form.	CO5
	5b	Check and solve the given exact differential equation.	5.2	Exact differential equation	
	5c	Solve the given Homogeneous differential equations.	5.3	Homogenous differential equation	
	5d	Solve the given Linear differential equations.	5.4	Linear differential equation	
	5e	Solve the given Bernoulli's differential equations.	5.5	Bernoulli's differential equations.	
UNIT VI: Numerical Methods	6a	Find the approximate root of algebraic equation by using given method.	6.1	Identification of root of algebric equation. Solution of algebraic equation by, Bisection method, Regula-Falsi method, Newton-Raphson method.	CO6
	6b	Solve the system of Simultaneous equations containing three unknowns by using given method.	6.2	Solution of Simultaneous Equations containing three unknowns by, Gauss elimination method. Iterative methods: Gauss-Seidal & Jacobi's method.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Find value of any given function.	2#	CO1
II	2	Find limits of algebraic, trigonometric, and exponential functions.	2#	CO2
III	3	Solve examples on derivative using algebraic operations.	2#	CO3
III	4	Find dy/dx of implicit functions.	2#	CO3
III	5	Find dy/dx of parametric functions and inverse trigonometric functions.	2#	CO3
III	6	Find the higher order derivatives of the given function.	2#	CO3
IV	7	Solve examples, integration of rational, algebraic, and composite function.	2#	CO4
IV	8	Solve examples using rules of integration and substitution method.	2#	CO4
IV	9	Solve examples using integration by parts and partial fraction method.	2#	CO5
IV	10	Solve the examples of Definite integral.	2#	CO5
IV	11	Evaluate definite integral using properties.	2#	CO5
V	12	Solve differential equation using variable separable method and reducible to variable separable.	2#	CO6
V	13	Solve Exact, homogenous, linear and Bernoulli's differential equation.	2#	CO6
VI	14	Find the approximate root of algebraic equation.	2#	CO6
VI	15	Solve the system of simultaneous equations.	2#	

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare the list of function which are related with your branch. Identify the types of function, Find the values of the given functions for the particular value.
2. Calculate the limit of the given function by using Laws of Limits.
3. Prepare the list of standard formulas of Derivatives.
4. Find the Derivatives of given functionb by using Laws of Derivatives.
5. Prepare the list of practical experiment in which the derivatives used.
6. Prepare the list of formulas of standard Integration.
7. Evaluate the integration of the given function by rules, Laws and property of definite Integral.
8. Prepare the list of experiment in which the Integration used in your course.
9. Find th order and degree of the given differential Equation.
10. Form the Differential equation for the given solution.
11. Solve the given differential by using Methods and prepare the list of Methods to solve the given Differential equation.
12. Prepare the procedure of Bisection Method, Regula Falsi's methods, Newton Raphason Methods to find the solution of given function.
13. Prepre the procedure of Gauss's Elimination Method, Jacobi's methods, Gauss' Seidal Methods to find the solution of set of simultaneous eqution.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Functions	5	C	02	00	04	6
			O	00	04	00	4
2	Limits	8	C	00	04	04	8
			O	00	02	00	2
3	Derivetive	14	C	04	04	06	14
			O	00	04	04	8
4	Integrations	14	C	04	00	08	12
			O	04	04	00	8
5	Differential Equation	5	C	00	04	08	12
			O	02	00	04	6
6	Numerical Methods	14	C	00	12	06	18
			O	00	00	12	12
Total		60	C	10	24	36	70
			O	6	14	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	3R2	3R2	4R2	4R2	5R2	2U2	5	7
2	1U4	2U4	3U4	1A4	2A4			3	5
3	4R4	3U4	4U4	3A4	4A4			3	5
4	4U4	4A4	5A4	5A4	5A4			3	5
5	6U6	3A6	6A6					2	3
6	6U6	6A6	6A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance (Regularity And Awareness About Performing Assignment)	5
2	Assignment Contents (25-30 examples is compulsory on each unit)	15
3	Completion of Assignment, NeatnessAnd cleanliness of maintaining Assignment Copy.	5
4		
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Interest And Awareness About Performing Assignment	5
2	Assignment Contents	15
3	Completion of Assignment, Neatness And cleanliness of maintaining Assignment Copy.	5
4		
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	1	-	-
CO4	3	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	1	1	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Engineering Mathematics	P N Wartikar, Pune Vidyarthi Griha Prakashan	4567155742
2	Calculus of One Variable	IA Maron, Publisher: Arihant, 5th Edition 2015	9352030559
3	Engineering Mathematics	S.S .Shastry,Prentice Hall Of India, 4th edition 2008	9788120336162
4	Engineering Mathematics	D.T. Gaikwad, S Chand Publication, 1st edition 2010	8121933560
5	Higher Engineering Mathematics	B S Grewal, Publisher: S Chand, 43rd edition 2014	9788174091955
6	Higher Engineering Mathematics	Khanna Publication New Delhi, B.S.Grewal	8174091955

XV e-References:

1. https://msbte.org.in/msbtelectures.html assessed on 24th Sept. 2023
2. https://www.khanacademy.org assessed on 24th Sept. 2023
3. https://www.youtube.com/watch?v=5_TuK1yCPD4 assessed on 24th Sept. 2023
4. http://nptl.ac.in/course/106102064(online Learning Initiatives By IITs and IISc) assessed on 24th Sept. 2023
5. https://www.khannacademy.org/mathqgelid=CnqHuabCys4CFdOJaddHoPig assessed on 24th Sept. 2023

XVI List of Major Equipment/Machineries with Specification:

1. Nil
2. ...
3. ...

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. P.T. Khobaragade	I/C Mathematics Dept.	Govt. Polytechnic Nagpur
2	Mr. S.M. Sayyed	Ex-Lecturer	Govt. Polytechnic Nagpur
3	Mr. G.R. Dewalkar	Lecturer	Govt. Polytechnic Nagpur
4	Dr. P. B. Bahatkar	Professor	Y. C. C. E. Nagpur
5	Mr. V.M.Meshram	Ex-Lecturer	Govt. Polytechnic Nagpur

(Mr. P.T. Khobaragade)
HOD & Chairman PBOS, COMMON

(Dr. G. V. Gotmare)
Member Secretary PBOS, COMMON

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	DIPLOMA IN ME/AE/CE/EE/EC/PK/MT/TX/IT/CM/AIML/MK
Course Category	:	DSC
Course Code	:	CH101H
Course Title	:	Applied Chemistry

I Rationale:

Chemistry is the basic science which is essential to all engineering courses. For an engineer, the usage of equipment's and instruments would require knowledge of chemical substances, their composition and properties. This course describes the basic facts, concepts & principles for the understanding of basic elementary knowledge related to all engineering fields. Chemistry subject knowledge also aims to bridge the theoretical concepts and their practical engineering applications, thus highlighting the role of chemistry in the field of engineering. This will be gateway for development of reasoning capacity of students and understanding new technology as well.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply principles of chemistry to solve broad based relevant engineering problems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Analyse** the Bonding-type in a compounds and application of catalyst in industries.

CO2: **Select** metal and nonmetal materials for industrial applications.

CO3: **Analyse** engineering materials on the basis of properties and applications.

CO4: **Apply** the concept of Electrochemistry to solve engineering and industrial problems.

CO5: **Solve** metal-corrosion problems using relevant preventive methods.

CO6: **Analyse** different type of energy sources for sustainable development.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
4	-	2	2	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Chemical Bonding and Catalysis	1a	Classify valence electrons and type of bond in given compounds.	1.1	Indian Chemistry: Philosophy of atom by Acharya Kanad. Valency: Octet Rule, Duplet Rule, Definition & types of valences (Electrovalence & Covalence), types of bond electrovalent, Covalent, Co-ordinate)	CO1
	1b	Formulate given molecule on the basis of given type.	1.2	Formation of Electrovalent e.g., NaCl, $CaCl_2$, MgO, Formation of Electrovalent e.g., NaCl, $CaCl_2$, MgO, Formation of Covalent Compounds CO_2, NH_3, N_2 Formation of coordinate compound e.g. (NH_4^+), (H_3O^+)	
	1c	Differentiate between Electrovalent and Covalent compound on basis of given properties.	1.3	Distinction between Electrovalent & Covalent compounds (Properties-Formation, Melting point, Boiling point, Type of bond, Solubility, Strength of bond).	

UN	1d	Select the relevant catalyst-type for given application.	1.4	Catalysis: Definitions of Catalyst, Types of Catalyst, Positive Catalyst, Negative Catalyst, Auto-catalyst, Definitions of catalysis, Types of catalysis (Homogeneous, Heterogeneous) Industrial Applications of Catalyst.	
UNIT II: Metallurgy, Alloy and Polymer	2a	Draw the flow chart of metal extraction process with given terms in metallurgy.	2.1	Metallurgy: Definitions of terms used in metallurgy - Minerals, Ore, Gangue, Flux, Slag. Definition of metallurgy, flow chart of Metal extraction process (Crushing, Concentration (physical and chemical), reduction, Refining.	CO2
	2b	Select proper alloy for given application or vice versa.	2.2	Definition of alloy, purposes of alloy formation, Types of alloys (Ferrous alloy and Nonferrous alloy) Composition properties and application of High-speed steel, Magnetic steel, Duralumin, Woods metal.	
	2c	Distinguish between Thermosoftening and Thermosetting plastics on given points.	2.3	Polymer (Plastic): Definition o fpolymer, types opolymer and difference of Thermosoftening and Thermosetting plastics (Properties-Formation, Structure, Molecular weight, Heating effect, Reclaiming, Chemical bonding, Nature, Solubility).	
	2d	Select the given Plastic Polymer for Industry application.	2.4	Formation of Plastic by Addition polymerization of Polyethylene, Polystyrene. Formation of Plastic by Condensation process of Bakelite plastic, Nylon (6, 6).	
	2e	Use given Thermal insulators in industry on their characteristics.	2.5	Insulating material: Characteristics of Thermal insulators. Preparation, Properties & Applications of Thermocol & Glass wool.	

UNIT III: Engineering Materials	3a	Illustrate functions & characteristics of given Lubricants, for different types of machines.	3.1	Lubricants : Definition, Types of Lubricants, Functions of Lubricants. Characteristics of Lubricants- Viscosity, Viscosity Index ,Volatility,Oiliness, Cloud and Pour point, lash and Fire point, Acid value. Selection of Lubricant for various types of machines such as I.C engine, Gear system, Cutting tools, Delicate and Sewing machines, Tractors and Rollers.	CO3
	3b	Detect the adverse effects of hard water as per given industry.	3.2	Water: Types of impurities in natural water. Definitions of hard and soft water, types of hardness, Unit of ardness (ppm) Adverse effects of hard water in Industries-Paper industry, Textile industry, Dyeing industry, Sugar industry.	
	3c	Select relevant water treatment process for removal of given impurities.	3.3	Potable water treatment: Sedimentation , Coagulation, Filtration, Sterilization (Chlorination method).	
	3d	Relate given properties and applications of Cement and Lime as a construction material.	3.4	Cement & Lime: Portland cement: Definition, chemical composition. Special Cements: Properties and Application of Water proofing cement, Super sulphate cement. Lime: Composition, Properties and Uses of Fat lime, Lean lime.	
d Batteries	4a	Interpret the given terms involved in Electrochemistry.	4.1	Basic concepts of electrolysis: Atoms, Ions, Electrolyte, conductivity of electrolytes, type of electrolyte- strong and weak electrolyte. Ionization and electrolytic dissociation, Arrhenius theory of electrolytic dissociation, degree of ionization, factors affecting degree of ionization.	

UNIT IV: Electrochemistry,cells anc	4b	Solve engineering problems using Faraday's law of electrolysis.	4.2	Electrolysis : Faraday's laws of electrolysis: Faraday's First and Second law (Statement and mathematical expression, numericals) Application of electrolysis: Electroplating Silver.	CO4
	4c	Calculate the pH/pOH of solutions with given concentration.	4.3	pH and pOH: Definition of pH, pOH, pH scale, numerical.	
	4d	Use of given cells and batteries in Engineering field.	4.4	Electrochemical cells/ batteries: Basic concepts: cell, attery, distinction between Primary cell (e.g. Dry cell) and secondary cells (e.g. Ni-Cd cell) Fuel cell: Definition, construction, working, advantages, limitations and applications of Hydrogen-oxygen fuel cell.	
UNIT V: Corrosion	5a	Identify the given types of oxide film & its effect on corrosion.	5.1	Definition of corrosion, Types of corrosion, mechanism of Atmospheric corrosion. Effect of oxide film on atmospheric corrosion. Factor effecting atmospheric corrosion.	CO5
	5b	Analyse mechanism of given type of corrosion.	5.2	Immersed Corrosion or Electrochemical Corrosion, definition, types and mechanism (Hydrogen evolution and oxygen absorption).	
	5c	Select different corrosion protection methods and its use in given situation.	5.3	Application of Protective Coatings like metallic coating by - Galvanizing, Tinning, Sherardizing, Metal Spraying, Metal Cladding. Non-metallic coating: Paint - Characteristics, constituents of Paint and their functions.	
trol	6a	Compare types of Fuel on given points.	6.1	Energy: Definitions of a fuel, Classification of fuels with suitable examples, Characteristics of a good fuel, Calorific value and Ignition temperature, Comparison between Solid, Liquid, Gaseous fuels based on their properties.	

UNIT VI: Energy and Pollution Con	6b	Analyse components of fuel by proximate analysis.	6.2	Classifications of fuel: Solid fuels: analysis of solid fuels- Proximate analysis for determination of moisture, volatile matter, ash and fixed carbon, significance of Proximate analysis.	CO6
	6c	Describe the properties and uses of given solid, liquid and gaseous fuel.	6.3	Liquid fuels: Bio diesel - properties, applications. Gaseous fuels: Composition, properties, applications of LPG, CNG.	
	6d	Select proper pollution control methods for sustainable development.	6.4	Pollution control: Definition of pollution – Types of pollution (Air, water pollution) 3R Concept, recycling of plastic. E waste management, sustainable development– significance of Wind Energy, Solar Energy.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Explore the chemistry laboratory.	2#	CO1
I	2	Analyse basic and Acidic Radicals of known salt solution-1 (Confirmatory Test) using qualitative analysis method for compound composition.	2#	CO1
I	3	Analyse basic and Acidic Radicals of known salt solution-2 (Confirmatory Test) using qualitative analysis method for compound composition.	2#	CO1
I	4	Analyse basic and Acidic Radicals of known salt solution-3 (Confirmatory Test) using qualitative analysis method for compound composition.	2#	CO1
II	5	Find the quality of alloy by determining the percentage of Iron in given steel sample by Redox titration.	2	CO2
II	6	Prepare Phenol formaldehyde resin used in manufacturing of Bakelite Plastic, for Polymer industries.	2#	CO2
III	7	Analyse Total hardness (permanent and temporary) of given sample of water by EDTA method, for various industries.	2#	CO3
III	8	Calculate the percentage of calcium content in cement, for different constructional purposes.	2#	CO3
III	9	Estimate the acid value of lubricant by KOH, for various machines. OR Find out the quality of lubricant, by calculating coefficient of viscosity using Ostwald's Viscometer.	2	CO3
IV	10	Detect the nature of given solution by finding its pH value by using pH meters.	2#	CO4
IV	11	Find the Electrochemical equivalent (ECE) of copper,for cell manufacturing industries.	2#	CO4
V	12	Compare the rate of corrosion (Al-strip) with respect to given media for prevention of metal corrosion.	2#	CO5
V	13	Calculate the strength of given Hydrochloric acid solution by titrating it against sodium hydroxide solution to control rate of corrosion.	2#	CO5

VI	14	Categorize the given paint samples by finding thinner content in it, for various Paint industries.	2#	CO6
VI	15	Estimate the percentage of moisture and ash content in the given coal sample by proximate analysis, for power generation.	2	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Collect information by library survey regarding biography/ valuable contribution in Chemistry of any one Indian Chemist.
2. Construct a model of any one ionic /covalent/co-ordinate compounds.
3. Compare the role of given types of catalysts (positive/negative/auto) in different chemical reactions.
4. Categorize given types of alloy by collecting various metal alloy samples.
5. Construct a model of Concentration/reduction/refining process in metal extraction.
6. Collect information by library survey regarding engineering material used in various industries.
7. Analyse different samples of Cement/Lime/Water/Lubricants according to given properties.
8. Compare different chlorinating agent of Sterilization of potable water at domestic level.
9. Categorize various types of Cells by market survey method.
10. Collect various types of corroded metal sample.
11. Compare rate of corrosion process between ferrous and aluminium metals.
12. Prepare a chart construction of Hydrogen-Oxygen Fuel Cell.
13. Compare the type of fuels according to given properties.
14. Prepare a method of recycling of plastic, to sustain environment.
15. Analyse the PUC report (gas analyser method) of vehicle, to sustain environment.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Chemical Bonding and Catalysis	8	C	02	04	04	10
			O	00	04	00	4
2	Metallurgy, Alloy and Polymer	9	C	02	04	06	12
			O	00	08	00	8
3	Engineering Materials	12	C	02	08	04	14
			O	02	00	06	8
4	Electrochemistry,cells and Batteries	12	C	02	04	06	12
			O	00	06	04	10
5	Corrosion	9	C	00	04	06	10
			O	02	00	04	6
6	Energy and Pollution Control	10	C	02	04	06	12
			O	00	00	04	4
Total		60	C	10	28	32	70
			O	04	18	18	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	6R2	5R2	3R2	5	7
2	1U4	1A4	2U4	1U4	2U4			3	5
3	3U4	3U4	3A4	2U4	4A4			3	5
4	4U4	5U4	6U4	5A4	6A4			3	5
5	2A6	4A6	3A6					2	3
6	5A6	6A6	4U6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Method, Selection of Chemicals/Equipments	5
2	Performance + Calculation	10
3	Result, Conclusion	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Ideas and content	5
2	Practical utility in present scenario	10
3	Scientific approach	5
4	Conclusion	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	3	-	-
CO2	3	-	-	2	-	-	3	-	-
CO3	3	-	-	2	-	-	3	-	-
CO4	3	2	-	2	-	-	3	-	-
CO5	3	2	-	-	-	-	3	-	-
CO6	3	2	-	-	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Engineering Chemistry	R. Sivakumar N. Sivakumar and Tata McGraw Hill, edition 10.	9780745- 328896
2	Engineering Chemistry	Jain and Jain , Dhanpat Rai publishing company(P) ltd.15 edition	10092
3	Fundamental of Electrochemistry	Bagotsky V.S. National Council of Education Research and Training, New Delhi, 2013	8174506314
4	Industrial chemistry	Goel Publication, edition-8	81877224002
5	Applied Chemistry with Lab Manual	Anju Rawlley, Devdatta V. Saraf , Khanna Book Publishing Co.(P) Ltd. New Delhi, 2021	978-93-91505-44-8

XV e-References:

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2. http://www.substech.com/dokuwiki/doku.php?id=full_index_of_articles_on_polymers- , assessed on 10 August 2023
3. http://www.substech.com/dokuwiki/doku.php?id=full_index_of_articles_on_fluids- , assessed on 10 August 2023
4. http://www.ausetute.com.au/corrosion.html, assessed on 10 August 2023
5. http://www.sherardizing.com/resources/files/9_Sherardizing_Corrosion.pdf, assessed on 10 August 2023
6. http://www.galvanizeit.org/aga/animation , assessed on 10 August 2023
7. http://www.ehow.com/list_6725219_different-types-metal-cladding.html , assessed on 10 August 2023

XVI List of Major Equipment/Machineries with Specification:

1. Electronic balance (measure up to 0.001 mg)
2. Battery 12 volt
3. Digital multi-meter
4. Rheostat assorted sizes
5. Voltmeter MI 0-150-300 V
6. Ammeter MI 0-5-10 A
7. Electrolytic cell set up
8. Digital PH meter

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr.M.S.Rathod	Lecturer in Chemistry	Government Polytechnic, Nagpur
2	Dr. C.P. Pandhurnekar	Asst.Prof. Deptt. Of Chemistry	Ramdeobaba Engg.college,Nagpur.
3	Dr.P.B.Sarode	Lecturer in Chemistry	Government Polytechnic, Khamgaon
4	Dr.D.B.Rana	Asst.Prof. Deptt. of Chemistry	S.B.Jain Engg. College, Nagpur
5	Dr S.L.Sayre	Lecturer in Chemistry	Government Polytechnic, Nagpur
6	Dr.P.B.Chouke	Lecturer in Chemistry	Government Polytechnic, Nagpur
7	Prof. D.H. Patil	Lecturer in Chemistry	Government Polytechnic, Nagpur

(Mr. P. T. Khobragade)
HOD & Chairman PBOS, COMMON

(Dr. G. V. Gotmare)
Member Secretary PBOS, COMMON

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in ME/PK/MK/TX
Course Category	:	DSC
Course Code	:	EE103H
Course Title	:	Basic Electrical and Electronics

I Rationale:

Diploma engineers are expected to have some basic knowledge of electrical and electronics engineering principles and applications in industrial process of different fields It is therefore necessary for them to apply the principles of electrical and electronics engineering to work in different engineering fields and deal with various types of electrical machines and electronics equipment. Hence it is necessary to understand electrical fundamental, AC circuit, Transformer, AC motors and Basic electronics, filter, rectifier. The basic concepts of electrical and electronics engineering in this course will be very useful for understanding of other higher level courses.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge of basic Electrical and Electronic

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** basic laws of Electrical Engineering

CO2: **Measure** electrical quantities in an electrical circuits.

CO3: **Select** suitable single phase transformer for particular application

CO4: **Select** suitable AC motors for particular application.

CO5: **Use** diode and transistor in electronics circuits

CO6: **Build** rectifier and filter circuits

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	25	10

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
	1a	Select given electrical safety equipment for the given situation	1.1	Importance of Electrical Safety: Causes of electrical accidents, Concept of Electrical Shock (ac and dc), General Safety rules, Safety Signs and Symbols. First Aid, Artificial Respiration and Method of Removing electrocuted person. Types of Firefighting equipment. Earthing - Nessesity of earthing, types of earthing. Purpose of fuse, relay and circuit breaker in electric Circuit	

UNIT I: Electrical Fundamentals	1b	Determine given parameters and quantities used in electric circuit.	1.2	Define : Electric Current, Voltage, Current Source, Voltage Source,Electric Potential, Potential Difference (PD) Electro-Motive- Force (EMF), Resistance, resistivity, Conductivity, Effect of Temperature on Resistance. Ohm's law, Concept of cell and battery, types of batteries and their applications, Concept of Heating Effect, Magnetic Effect and Chemical Effect of Electric current	CO1
	1c	Calculate cost of electrical energy based on given circuits/data	1.3	Definition and numerical based on Electrical Work, Power, Energy and their SI units, Joule's law, Relation between H.P and Watts, kWh and kCal, cost of electrical energy	
	1d	Determine given parameters of electric circuits	1.4	Concept of DC voltage & current. Series-parallel combination, Equivalent resistance of series- parallel combination. Application of ohm's law for simple DC circuits (Numerical problems based) & Concept of Open circuit and short circuit, Kirchhoff's current and voltage law (no Numerical)	
	2a	Compare the points of the given type of power supply	2.1	Concept of DC and AC voltage and Current. Comparison between AC and DC Supply (Single phase)	

UNIT II: AC Circuit	2b	Calculate AC parameters based on given data	2.2	Generation of alternating voltage: Single phase and three-phase, Equation of sinusoidal alternating voltage and current, important terminology such as waveform, instantaneous value, cycle, time period, frequency, amplitude. Maximum, average and R.M.S value, Relation between time, period and frequency, angular velocity and Frequency, Frequency and speed.	CO2
	2c	Find given single phase pure resistive / inductive / cap acitive circuit.	2.3	Concept of A.C. voltage applied to pure resistor, pure inductor, and pure capacitor. Concept of reactance, Impedance and Power factor, power in single-phase Circuits.	
	2d	Select given power supply for particular application	2.4	Voltage and Current relationship in Star and delta connection. Compare three phase AC and DC supply. Application of single phase and three phase AC, DC power supply	
UNIT III: Transformer	3a	Select given type of transformer for particular application	3.1	Concepts of magnetic circuits, Magnetic flux, flux density, magnetomotive force, magnetic field strength, permeability, reluctance and Faraday's laws of electromagnetic induction. Transformer: Principle of operation, construction, only types of transformer, Shell type, Core type and its comparison	CO3
	3b	Calculate voltage ratio,current ratio and transformation ratio from a given data	3.2	EMF equation,voltage ratio,current ratio and transformation ratio, KVA rating of Transformer, voltage regulation and efficiency of transformer.	

	3c	Identify type of transformer from schematic diagram	3.3	Auto-transformer: Definition, principle of operation, Schematic diagram, Special Features and its applications.	
UNIT IV: AC Motors	4a	Select suitable single phase induction motor for the given application	4.1	AC Motor-Single-phase induction: Working principle of A.C. motor. Selection for Different applications, reversal of rotation. Differents types of single phase motors and its application	CO4
	4b	Select suitable three phase induction motor for suitable applications	4.2	Three phase induction motors, application and selection for different applicationsl of rotation. Types:-Squirrel Cage Induction Motor, and Slip Ring Induction Motor and its application.Wiring diagram, reversal direction motors and starters required	
	4c	Compare the salient features of the given Motors on given points.	4.3	Stepper motor and Servo-motor- working principle, construction, and its application	
lectronics	5a	Identify given types of diodes	5.1	Construction, symbol, working principle, specification of' following semiconductor diodes: PN junction diode, Zener diode	
	5b	Select the relevant diodes is used as a different application	5.2	Forward and reverse biasing of V-I characteristic and application of following semiconductor diodes:PN junction diode, Zener diode	
	5c	Select the special diodes is used as a different application	5.3	Special purpose Diodes– Zener diode, LED, Photodiode, Tunnel diode (only Symbol, working and applications)	

UNIT V: Basic E	5d	Identify given type of characteristics of transistor	5.4	Construction of transistor, operating principle and symbol of PNP and NPN transistor and characteristics of Input, Output Characteristic and Current Transfer characteristic of PNP and NPN transistor and operating regions of transistor	CO5
	5e	Justify the use of transistor for given application.	5.5	Definitions of parameters:- input resistance, output resistance, current gains (alpha and beta) and their relationship, leakage current; Application of transistor: transistor as an switch and transistor as an amplifier	
UNIT VI: Rectifiers and Filters	6a	Select suitable rectifierfor the given application	6.1	Rectifier: Definition and types of rectifier, circuit diagram, Half wave, Full wave rectifier (bridge and center tapped) circuit operation, I/O waveforms for voltage and current and its application, advantages, disadvantages with its specification	CO6
	6b	Compare the performance of the given rectifiers	6.2	Parameters of rectifier:Average DC value of current and voltage, ripple factor, ripple frequency, PIV of diode, TUF and efficiency of rectifier	
	6c	Select suitable filter for the given application	6.3	Filter: Necessity and types of Filter: Shunt capacitor, Series inductor, LC and “Pi” (π) filter with its circuit diagram and working.	
	6d	Justify the need of given block of regulated power supply	6.4	Block diagram working and merits of SMPS and Regulated power supply with its application	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify electrical measuring instruments, sources, ICDP/ITDP, switches, loads, wires and execute safety precautions in laboratory.	2#	CO1
I	2	Measure the current, voltage and resistance with the help of multi-meter or tong tester.	2#	CO1
I	3	Find unknown resistance in an electric circuit using Ohms law.	2#	CO1
I	4	Find the branch current and mesh voltage using Kirchhoff's law (KCL & KVL)	2#	CO1
II	5	Find current response of pure resistive / Inductive / capacitive circuit.	2#	CO2
II	6	Make star delta connection in induction motor starters and measure the line and phase values	2	CO2
III	7	Determine the voltage and current ratio of single phase transformer	2#	CO3
IV	8	Start single phase Induction motor and reverse the direction of rotation	2#	CO4
IV	9	Start three phase Induction motor and reverse the direction of rotation	2#	CO4
V	10	Identify given diodes and Transistors	2#	CO5
V	11	Find the relation between voltage and current of PN junction Diode .Plot V-I characteristics of P-N junction diode.	2#	CO5
V	12	Plot voltage regulation characteristics of Zener voltage regulator	2	CO5
VI	13	Connect Full wave Bridge rectifier with filter and observe waveform with and without filter on CRO and draw the input and output waveforms.	2#	CO6
VI	14	Connect the CLC filter circuit with full-wave centre tap rectifier. Plot the input Output waveform	2	CO6
VI	15	Connect CE configuration of transistor with multimeter.Measure the voltage and current. Plot the input and output characteristics of transistor in CE configuration.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Develop a chart of any one method of artificial respiration.
2. Develop a chart of electrical safety signs and symbols.
3. Collect information of various types of fire extinguishers showing its application.
4. Collect various types of resistors and prepare report
5. Develop a report on electrical energy consumption of your house.
6. Observe AC and DC supply of different places of Government polytechnic, Nagpur and prepare a report
7. Visit to college substation and prepare report
8. Collect information of various AC and DC motor available in market and prepare report
9. Calculate number of turns and transformation ratio based on given transformer
10. Draw a characteristic of different diodes and prepare a report
11. Identify on the basis different diagram of rectifiers Circuits and prepare report
12. Develop a ciruit of single stage common base transistor amplifier.
13. Draw the block diagram of different power supply and prepare a report
14. Draw Input and Output characteristic of BJT and prepare a report
15. Prepare a report on the basis of Diodes,Rectifier,Filter and Transistor applications

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Electrical Fundamentals	8	C	02	04	04	10
			O	00	00	00	0
2	AC Circuit	8	C	04	04	04	12
			O	00	00	00	0
3	Transformer	7	C	04	04	04	12
			O	00	00	00	0
4	AC Motors	7	C	04	04	04	12
			O	00	00	00	0
5	Basic Electronics	7	C	04	04	04	12
			O	00	00	00	0
6	Rectifiers and Filters	8	C	04	04	04	12
			O	00	00	00	0
Total		45	C	22	24	24	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q. 01 to Q.35	1R2	1R2	1U2	1A2	1A2			35/35	
	2R2	2R2	2U2	2U2	2A2	2A2			
	3R2	3R2	3U2	3U2	3A2	3A2			
	4R2	4R2	4U2	4U2	4A2	4A2			
	5R2	5R2	5U2	5U2	5A2	5A2			
	6R2	6R2	6U2	6U2	6A2	6A2			

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of Topic	5
2	Performance	10
3	Report Writing	5
4	Viva Voce	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	2	-	2	-	-
CO5	3	-	-	3	2	-	2	-	-
CO6	3	-	-	3	2	-	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Principle of Electrical Engineering and Electronics	V.K. Mehta, S. Chand & Company Ltd., Reprint, 1996	10: 81-219-1053-6
2	A Textbook of Electrical Technology Vol-I	B.L.Theraja, A.K.Theraja, S.Chand & Co Ltd., Reprint, 2006	10: 81-219-2440-5
3	Basic Electrical Engineering	V.N.Mittle, Arvind Mittal, The McGraw Hill Education Pvt. Ltd, Reprint, 2011	13: 978-0-07-059357-2
4	A Textbook on laboratory courses in Electrical	S.G. Tarnekar and P.K. Kharbanda, S.Chand & Company Ltd., Third, 1990	13: 978-8121901048
5	Principles of Electronics	V. K. Mehta, S. Chand& Company Ltd., Reprint, 1996	10: 8121910536
6	Electronic Principles	A.P. Malvino, Tata McGraw Hill, 8th edition	13: 9780073373881
7	Applied Electronics	R. S. Sedha, S. Chand & Co, Revised edition, 2013	13: 9788121927833

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2. http://www.electrical4u.com , accessed on 21st June , 2021
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XVI List of Major Equipment/Machineries with Specification:

1. Ammeter MI 0-5-10
2. Voltmeter MI 0-150-300 V
3. Wattmeter 0-3000 W
4. Digital Multi-meter 3 ½ digits
5. Single phase auto transformer 0-240 Volts, 16A
6. Rheostat assorted sizes
7. Cathode ray oscilloscope- 0 to 50 MHz
8. Function Generator
9. Regulated Power Supply

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M. B. Daigavane	Principal	Government Polytechnic, Nagpur
2	Dr. P. M. Daigavane	HOD, Electrical Engineering	G.H.Raisoni College of Engg, Nagpur
3	Mrs. Divya Piparode	Sr. Engineer	Powergrid Corporation India Ltd. Nagpur
4	Mr. M. N. Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
5	Dr G. V. Gotmare	I/C HOD, Electrical Engineering	Government Polytechnic, Nagpur
6	Mrs. P. S. Rithe	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur
7	Mrs A. A. Alegaonkar	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur
8	Mrs. A. P. Gandhi	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur
9	N.J.Suryawanshi	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur
10	Mrs .P. M. Sonwane	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur

(Dr. G. V. Gotmare)
HOD & Chairman PBOS, EE

(Dr. G. V. Gotmare)
Member Sectretary PBOS, EE

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(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/PK/MT/MK/TX
Course Category	:	DSC
Course Code	:	AM101H
Course Title	:	Engineering Mechanics

I Rationale:

Study of this course develops understanding of effect of force on a body. It helps in analytical and graphical solutions to problem related to forces acting on body. It also helps in understanding concept and application of Equilibrium, friction, centroid and centre of gravity. Study of simple machines gives idea about input, output, efficiency and friction of machine. Study of this course is very useful at higher level like strength of materials, Mechanics of Structure, Design of Structures etc.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the principles of engineering mechanics to solve engineering problems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** the relevant simple lifting machine for given purpose.

CO2: **Apply** various theorems to find the resultant of system of forces.

CO3: **Apply** law of equilibrium on different bodies.

CO4: **Locate** Centre of gravity and Centroid in various sections.

CO5: **Analyze** concept of friction in various conditions.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Simple lifting Machine	1a	Compare given machines on the basis of given points.	1.1	Concept of simple lifting machine, uses of machine, definition of load, effort, mechanical advantage, velocity ratio, efficiency of Machines, reversible and non-reversible machines.	CO1
	1b	Determine given terms of simple lifting machine.	1.2	Ideal machine, friction in machine, law of machine, maximum Mechanical advantage and efficiency.	
	1c	Determine velocity ratios, efficiency and law of various machines for given data.	1.3	Velocity ratios of Simple Axle and Wheel, Differential axle wheel, Single Purchase & Double purchase crab winch, Simple Screw Jack, Weston's Differential pulley block, Geared pulley block, Two Sheaves and Three Sheaves pulley block, Worm and Worm wheel.	
	2a	Classify given terms related to Engineering Mechanics.	2.1	Significance of engineering mechanics, necessity and Classification of engineering mechanics.	

UNIT II: Forces	2b	Classify the given units of scalar and vector quantity.	2.2	Definitions: Space, time, particle, body, rigid body, mass, weight, scalar and vector quantity. Units of measurement, Fundamental units and derived units.	CO2
	2c	Describe given terms related to force.	2.3	Concept of force, definition of force, unit of force, effects of force, Characteristics of force.	
	2d	Identify the given force system and effect of a force.	2.4	System of forces. Principle of transmissibility of force.	
	2e	Resolve and find resultant of force/force system.	2.5	Composition of forces & Resolution of forces (Two dimensional), Orthogonal and Non-Orthogonal components of a force. Resultant force. Resultant of concurrent, non-concurrent and parallel forces, Law of parallelogram of forces: limitations and its applications.	
	2f	Apply Varignon's theorem based on given data.	2.6	Definition of moment, sign convention of moments, types of moments. Law of moment, definition of couple, types of couple, properties of couple, Varignon's theorem of moment and its application.	
	2g	Calculate Resultant force on the basis of given data by graphical method.	2.7	Introduction to graphic statics, graphical representation of force, Bow's notation, Space diagram, force diagram, polar diagram & funicular polygon.	
librium	3a	Determine given term related to equilibrium unknown forces using given methods.	3.1	Equilibrium and Equilibrant. Free body and free body diagram. Analytical and graphical condition of equilibrium.	
	3b	Determine unknown force in the given situation using Lami's theorem.	3.2	Lami's Theorem: limitations and its application.	

UNIT III: Equi	3c	Describe given terms related to Beam, load and supports with examples.	3.3	Equilibrium of concurrent, non-concurrent and parallel forces. Beam, span, type of beams, type of supports, types of loading: point load and Uniformly Distributed Load.	CO3
	3d	Determine reactions in the given type of beam by given method.	3.4	Analytical and Graphical method to calculate reactions at support for point load and Uniformly Distributed Load on simply supported and overhanging beams.	
UNIT IV: Centroid & Centre of gravity	4a	Determine centroids of given plain regular figures.	4.1	Centroid and centre of gravity, difference between centroid and centre of gravity. Locating centroid of regular figures such as triangle, rectangle, circle, Semi circle, quarter circle. (Formula only)	CO4
	4b	Calculate centroid of the given compound plain lamina.	4.2	Centroid of compound figures, having combination of two different geometric areas only.	
	4c	Determine the centre of gravity of given solid bodies.	4.3	Centre of gravity of solid bodies like cuboid, cylinder, cone, sphere and hemisphere.	
	4d	Determine centre of gravity of given compound solids.	4.4	Centre of gravity of compound bodies having combination of only two different geometric shapes.	
UNIT V: Friction	5a	Calculate given terms related to friction.	5.1	Friction and its importance in engineering, types of friction, laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction.	CO5
	5b	Determine the friction force in the given situation of frictional bodies.	5.2	Equilibrium of bodies on horizontal plane subjected to force parallel and inclined to the plane. Body resting on inclined plane subjected to force parallel to the plane. (Excluding ladder friction).	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Determine M.A., V.R., Efficiency of and law of machine for simple /Differential Axle and Wheel.	2#	CO1
I	2	Determine M.A., V.R., Efficiency and law of machine for Simple Screw Jack.	2#	CO1
I	3	Determine M.A., V.R., Efficiency and law of machine for Two Sheave Or three sheave Pulley Block.	2#	CO1
I	4	Determine M.A., V.R., Efficiency and law of machine for Single purchase Crab Or Double purchase Crab.	2	CO1
I	5	Determine M.A., V.R., Efficiency and law of machine for Worm and Worm Wheel.	2	CO1
II	6	Use Force table to determine resultant of concurrent force system using law of Polygon of forces.	2#	CO2
II	7	Determine Forces in the members of jib crane.	2#	CO2
II	8	Determine resultant of co-planer concurrent forces by graphical method. (Problem I)	2#	CO2
II	9	Determine resultant of co-planer concurrent forces by graphical method. (Problem II)	2#	CO2
II	10	Determine resultant of co-planer non-concurrent forces by graphical method. (Problem I)	2	CO2
II	11	Determine resultant of co-planer non-concurrent forces by graphical method. (Problem II)	2	CO2
III	12	Apply lamis theorem to determine unknown force.	2#	CO3
III	13	Determine support reactions for simply supported beam.	2#	CO3
III	14	Determine beam reactions for Vertical Point Load and UDL by Graphical method. (Problem I)	2	CO3
III	15	Determine beam reactions for Vertical Point Load and UDL by Graphical method. (Problem II)	2	CO3
IV	16	Locate the centroid of plane lamina by method of suspension.	2#	CO4
V	17	Determine co-efficient of Friction between different surfaces such as Wood and wood, Wood and glass, Wood and metal.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Collect five different photographs indicating concurrent, parallel, general force system in equilibrium.
2. Prepare table showing type of machine and related industrial application.
3. Collect five different situations where Law of moments plays important role.
4. Prepare models representing different types of supports.
5. Illustrate situations wherein friction is essential and not essential.
6. Prepare models in the form of geometrical figures and solids and locate centroid and center of gravity of them.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Simple lifting Machine	7	C	02	04	04	10
			O	00	04	04	8
2	Forces	12	C	02	08	06	16
			O	02	04	04	10
3	Equilibrium	10	C	02	04	10	16
			O	02	04	06	12
4	Centroid & Centre of gravity	6	C	02	04	06	12
			O	00	04	00	4
5	Friction	10	C	02	04	10	16
			O	00	00	06	6
6			C				
			O				
Total		45	C	10	24	36	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	5R2	2R2	3R2	5	7
2	1U4	2U4	2U4	1U4	2U4			3	5
3	3U4	4U4	5U4	3U4	4U4			3	5
4	1A4	3A4	5A4	1A4	2A4			3	5
5	2A6	3A6	3A6					2	3
6	4A6	5A6	5A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Drawing diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	-	2	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	2	-	-
CO5	3	2	-	2	1	-	2	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Applied Mechanics	R.S. Khurmi, S. Chand & Co. New Delhi, 2014	10:8121916437 13:9788121916431
2	Engineering Mechanics	Sunil Deo, Label Book Publishers New Delhi, 2014	10:9381595550 13:978-938159558
3	Engineering Mechanics	Basu, Tata Mcgraw Hills, 2013	10:125906266X 13:978-1259062667
4	Engineering Mechanics	S Ramamrutham, S Chand & Co. New Delhi, 2008	8187433515 9788187433514

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7. https://www.youtube.com/watch?v=Bx-mMA6k8u4 accessed on 22nd August 2023
8. https://www.youtube.com/watch?v=9XtGJXVnQxk accessed on 22nd August 2023
9. https://www.youtube.com/watch?v=k37FJHbSQA8 accessed on 22nd August 2023

XVI List of Major Equipment/Machineries with Specification:

1. Simple Axle and Wheel
2. Differential axle wheel
3. Single Purchase & Double purchase crab winch
4. Weston's Differential pulley block
5. Simple Screw Jack
6. Geared pulley block
7. Two Sheaves and Three Sheaves pulley block
8. Worm and Worm wheel
9. Jib crane apparatus
10. Beam reaction apparatus and Force table

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. H. L. Wahane	Lecturer in Applied Mechanics	Government Polytechnic, Nagpur
2	Mr. R. D. Dongarwar	Lecturer in Applied Mechanics	Government Polytechnic, Nagpur
3	Mr. A. Ateeque Azher	Lecturer in Applied Mechanics	Government Polytechnic, Nagpur

(Dr. D.K.Parbat)
HOD & Chairman PBOS, CE

(Dr. G. V. Gotmare)
Member Secretary PBOS, CE

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/AE/CM/IT/AIML/MC/PK/MT/TX/TR
Course Category	:	AEC
Course Code	:	EN151H
Course Title	:	Business Communication

I Rationale:

Professional Communication is essential for smooth and efficient functioning of any industry or business. The drafting skills and application of business communication principles are essential for engineering professionals. It plays a vital role to help professionals instruct, guide and motivate peers/ subordinates to achieve desired goals at work place. Strong Communication skills contribute to career growth and opportunities. This course focuses to enrich the professional communication skills for effective presentation both in written and oral forms at workplace.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Communicate technical information clearly and effectively.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Communicate** effectively(oral/written) in formal situations.

CO2: **Develop** and exhibit language skills in professional interactions.

CO3: **Write** job application with resume/CV and compose effective e-mails.

CO4: **Draft** official letters.

CO5: **Draft** business correspondence with minimal errors.

CO6: **Organize** formal meetings and maintain official records.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	25	10	25	10	-	-

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Types of communication	1a	-	1.1	Professional communication - Definition, importance, relevance.	CO1
	1b	-	1.2	Principles/7 C's of Professional communication: Clarity, Conciseness, correctness, coherent, concrete, courteous and complete.	
	1c	-	1.3	Types of communication- Verbal: Written - oral, formal - informal, internal –external, vertical – upward, downward, horizontal, diagonal and Non-verbal.	
	1d	-	1.4	Non-verbal communication – body language: gestures, postures, eye contact, facial expression. Non-verbal codes - dress and appearance, colors, sounds, signs, proxemics, chromatics, artifacts.	

UNIT II: Communication in Practice	2a	-	2.1	Receptive Productive Skills: Receptive language skills- Listening and reading, importance, Difference between listening & Hearing, Types of listening a) Active listening b) Passive listening c) Selective listening, tips to improve receptive skills, qualities of a good listener, scanning & skimming a text, tips to improve receptive skills.	CO2
	2b	-	2.2	Productive language skills- speaking and writing, importance, how receptive skills help to develop productive skills, tips to improve productive skills.	
	2c	-	2.3	Techniques of Note taking, Types of notes taking-Mind Mapping, Flowcharts.	
UNIT III: Formal Drafting	3a	-	3.1	Drafting Letters: Importance of formal drafting, parameters of formal drafting.	CO3
	3b	-	3.2	Job application -Format Resume writing- Differentiate between CV, Bio data and Resume. Leave application: format, use of appropriate language.	
UNIT IV:	4a	-	4.1	Official Drafting: Notice & Circular - difference between notice & circular, purpose of drafting, tips to draft in precise language.	CO4
	4b	-	4.2	Email: Email etiquettes, drafting- email with proper salutation, subject line, cc, bcc, attachments	

UNIT V: Business letters	5a	-	5.1	Business Letters: Enquiry letter and Order letter: format, use of technical language, reply to enquiry and order letter.	CO5
	5b	-	5.2	Complaint letter: format, use of polite language, reply to complaint letter.	
UNIT VI: Minutes & Report Writing	6a	-	6.1	Agenda, Minutes & Report Writing: Preparing checklist to organize official meeting, Drafting agenda: format, sequence of activities.	CO6
	6b	-	6.2	Drafting minutes of meeting: Importance, format, identifying important happenings.	
	6c	-	6.3	Report writing: Investigation /Survey report: format, purpose, techniques.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Enlist advantages and limitations of written/oral communication. Prepare a case study on limitations of written/oral communication and suggest remedies for the same.	2#	CO1
I	2	Undertake a role play/group discussion using suitable body language and non-verbal codes of communication.	2	CO1
I	3	Give a presentation / Seminar using 7 C's of Communication.	2#	CO1
II	4	Listen to motivational audios in the language lab and make notes of it.	2	CO2
II	5	Draw flow chart and mind map for any topic related to the curriculum.	2#	CO2
III	6	Draft a leave application letter to an authority following the rules of drafting.	2#	CO3
III	7	Prepare a Job Application in response to an advertisement following the steps of official drafting.	2#	CO3
III	8	Prepare a Resume highlighting the academic and professional details of the individual.	2#	CO3
IV	9	Draft notices for the organization and events mentioned. (04-topics)	2#	CO4
IV	10	Draft Circulars for the organization and events mentioned (04-topics).	2	CO4
IV	11	Type formal E-mails using email etiquette (04-topics).	2#	CO4
V	12	Draft an Enquiry and order letter for the organization as a designated authority.	2#	CO5
V	13	Draft a complaint letter for various situation (02-topics).	2#	CO5
VI	14	Participate in Group Discussion.	2#	CO6
VI	15	Face mock interview arranged by your teacher.	2#	CO6
VI	16	Write a detailed report on investigation/survey.	2	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Types of communication	8	C	-	-	-	0
			O	-	-	-	0
2	Communication in Practice	6	C	-	-	-	0
			O	-	-	-	0
3	Formal Drafting	4	C	-	-	-	0
			O	-	-	-	0
4		4	C	-	-	-	0
			O	-	-	-	0
5	Business letters	4	C	-	-	-	0
			O	-	-	-	0
6	Minutes & Report Writing	4	C	-	-	-	0
			O	-	-	-	0
Total		30	C	0	0	0	0
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA): -NA-

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Performance	5
2	Overall presentation of given assignment	10
3	Viva Voce	5
4	Activity	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA): -NA-

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	1	-	3	-	-
CO4	-	-	-	-	-	1	3	-	-
CO5	-	-	-	-	-	1	3	-	-
CO6	-	-	-	-	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Professional Communication Skills	S.R.Pravin, S.Chand Publications.	81-219-2092-02
2	Developing Communication Skills	Macmillan Publications, Revised Edition, 2011	0333929195
3	Business Communication and Soft Skills.	G.S.R.K Babu Rao, Himalaya Publication, First Edition, 2009	978-81-8488-596-5
4	Secret of Face-to-Face Communication.	Peter Urs, Bendar, Macmillan Publication	0333937139
5	Technical Communication Principles and Practices	Meenakshi Raman, Prakash Singh, Oxford University Press	0-19-567695-5
6	Effective English Communication	Krishna Mohan, Raman Tata Mc Graw Hills	13978-0-19-566804-9
7	Modern Commercial Correspondence	R.S.Pillai, Bhagwati, S.Chand & Co.	812190519-2

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2. https://www.indeed.com/career-advice/career-development/types-of-business-letters , accessed on 29th July 2021
3. https://in.indeed.com/career-advice/resumes-cover-letters/communication-skills , accessed on 29th July 2021
4. https://www.youtube.com/watch?v=jaxgeXPgAz0 , accessed on 29th July 2021

XVI List of Major Equipment/Machineries with Specification:

1. Desktop Computers latest version
2. Headphones
3. Language lab software

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M. M. Machale	Lecturer in English	Government Polytechnic, Nagpur
2	Dr. Rupali Londhe	Lecturer in English	Government Polytechnic, Nagpur
3	Mr. Nitin Pote	Lecturer in English	Government Polytechnic, [illegible]
4	Mr. Ravindra Suryawanshi	Lecturer in English	NIT Polytechnic, Nagpur
5	Mr. Nitin Pathak	Lecturer in English	Kamptee Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	SEC
Course Code	:	ME157H
Course Title	:	Engineering Drawing

I Rationale:

This course is a visual journey into the techniques of drawing within the engineering realm. It delves into the language of drawing, a vital tool for expressing ideas and conveying instructions crucial for tasks on construction sites and shop floors. By honing skills in developing, drafting, and sketching, students gain the ability to visualize real-world objects and parts based on drawings and blueprints. This foundational course paves the way for more advanced studies in machine drawing and related disciplines, providing a solid base for future endeavors in the field.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Prepare engineering drawings using prevailing drawing standards.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Draw** sectional orthographic views from the given isometric views.

CO2: **Interpret** the techniques and draw projections of lines and planes.

CO3: **Identify** the solids, section of solids and draw its projections.

CO4: **Apply** the techniques of development of surfaces of solids.

CO5: **Convert** the orthographic views into the Missing views.

CO6: **Apply** the techniques of free hand sketching to represent the machine components.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	4	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	50	20	50	20	-	-

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Draw sectional orthographic views from pictorial views. (Part I) (Practical sketch book)	2	CO1
I	2	Draw sectional orthographic views from pictorial views. (Part II) (Practical sketch book)	2#	CO1
I	3	Draw sectional orthographic views from pictorial views. (Part I) (Sheet No. 1)	2#	CO1
I	4	Draw sectional orthographic views from pictorial views. (Part II) (Sheet No. 1)	2	CO1
II	5	Draw projection of lines. (Inclined to both planes (Part I) (Practical sketch book)	2	CO2
II	6	Draw projection of lines. (Inclined to both planes (Part II) (Practical sketch book)	2#	CO2
II	7	Draw projection of lines. (Inclined to both planes) (Sheet No 2)	2#	CO2
II	8	Draw projection of planes. (Triangle, Square and Circle - Plane inclined to one reference plane and perpendicular to other.) (Practical sketch book)	2	CO2
II	9	Draw projection of planes. (Pentagon and Hexagon - Plane inclined to one reference plane and perpendicular to other. (Practical sketch book)	2#	CO2

II	10	Draw projection of planes. (Sheet No. 3)	2#	CO2
III	11	Draw projection of solids. (Prisms and Cylinder - Axis of Solid inclined to one reference plane and parallel to other.) (Practical sketch book)	2	CO3
III	12	Draw projection of solids.(Pyramids and Cone -Axis of Solid inclined to one reference plane and parallel to other.) (Practical sketch book)	2#	CO3
III	13	Draw projection of solids. (Sheet No. 4)	2#	CO3
III	14	Draw section of solid each.(Prisms and Cylinder - Axis of Solid inclined to one reference plane and parallel to other. Section Plane inclined to one reference plane and perpendicular to the other.) (Practical sketch book)	2#	CO3
III	15	Draw section of solid each.(Pyramids and Cone - Axis of Solid inclined to one reference plane and parallel to other. Section Plane inclined to one reference plane and perpendicular to the other.) (Practical sketch book)	2	CO3
III	16	Draw section of solids. (Sheet No 5)	2#	CO3
IV	17	Draw development of surfaces of solid. (Prisms and Cylinder) (Practical Sketch book)	2#	CO4
IV	18	Draw development of surfaces of solid. (Prisms) (Sheet No. 6)	2#	CO4
IV	19	Draw development of surfaces of solid. (Cylinder) (Sheet No. 6)	2#	CO4
IV	20	Draw development of surfaces of solid. (Pyramids) (Practical Sketch book)	2#	CO4
IV	21	Draw development of surfaces of solid. (Pyramids) (Sheet No. 7)	2#	CO4
IV	22	Draw development of surfaces of solid. (Cone) (Practical Sketch book)	2#	CO4
IV	23	Draw development of surfaces of solid. (Cone) (Sheet No. 7)	2#	CO4
V	24	Draw Missing views from given orthographic views. (Part I) (Practical sketch book)	2#	CO5
V	25	Draw Missing views from given orthographic views. (Part II) (Practical sketch book)	2	CO5
V	26	Draw Missing views from given orthographic views. (Sheet No. 8)	2#	CO5

VI	27	Draw Free Hand Sketches of - keys, pulleys, threads. (Practical sketch book)	2#	CO6
VI	28	Draw Free Hand Sketches of sheet metal bends. (Practical sketch book)	2#	CO6
VI	29	Draw Free Hand Sketches of - pipe joints & fittings. (Practical sketch book)	2#	CO6
VI	30	Draw Free Hand proportionate Sketches of keys, pulley, threads. (Practical sketch book)	2#	CO6

Note: # Compulsory. Use A2 size drawing sheet and A3 size sketch book.

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Neatness , cleanliness and line work on drawing sheet	10
2	Creation of given drawing with proper dimensioning	20
3	In time submission	10
4	Viva Voce	10
	TOTAL	50

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	3	3	-	-
CO2	3	-	-	3	-	3	3	-	-
CO3	3	-	-	3	-	3	3	-	-
CO4	3	-	-	3	-	3	3	-	-
CO5	3	-	-	3	-	3	3	-	-
CO6	3	-	-	-	-	3	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Engineering Drawing Practice For Schools and Colleges IS:SP-46	Bureau of Indian Standards, Third Reprint, October 1998	10: 81-7061-091-2
2	Engineering Drawing	N.D.Bhatt, Charotar Publishing house 2010	13: 978-93-80358-17-8
3	Machine Drawing	N.D.Bhatt & V.M Panchal, Charotar Publishing House 2010	13: 978-93-80358-11-6
4	Engineering Drawing	D.A. Jolhe, Tata McGraw-Hill Edu.2010	13: 978-0-07-064837-1
5	Engineering Drawing	R.K.Dhawan, S.Chand & co.	10: 81-219-1431-0
6	Engineering Drawing	P.J Shaha, S.Chand & co. 2008	10: 81-219-2964-4

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3. https://www.youtube.com/watch?v=d2LbmKGtObs accessed on 23/06/2021
4. https://www.youtube.com/watch?v=AzFz8A5HgiQ&list=PLDN15nk5uLiBrAkdOhEvkmVPs2UtwfGao accessed on 23/06/2021
5. https://www.youtube.com/watch?v=61hAV3vh3n4 accessed on 22/06/2021
6. https://www.youtube.com/watch?v=EpkusXjByYA accessed on 15/06/2021

XVI List of Major Equipment/Machineries with Specification:

1. Drawing Board for Half-Imperial size Drawing Sheet
2. Drafting Machine or Mini-Drafter of good quality
3. All good quality Drawing Instruments
4. Large size Scale, 30-60 & 45-45 Set-Squares
5. French Curve

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. S. S. Baraskar	I/C HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Prof. N. J. Burbure	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
3	Dr. Shubhangi Gondane	Lecturer in Packaging Technology	Government Polytechnic, Nagpur
4	Mr. S. P. Wakhare	Manager	Mahindra & Mahindra Ltd., Mumbai
5	Prof. G. F. Potbhare	Principal	NIT Polytechnic, Nagpur
6	Prof. G. H. Dahole	I/C HOD, Mechanical Engineering	Government Polytechnic, Gondia

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/MT/PK/AE/TR/TX/MK/AI
Course Category	:	VEC
Course Code	:	VE152H
Course Title	:	Advance Personality Development

I Rationale:

This course equips students with essential life skills, focusing on well-being, leadership, interpersonal relationships, and citizenship. By integrating ancient wisdom, practical financial literacy, and teamwork skills, students develop a balanced and responsible outlook, supporting both professional success and personal fulfillment. This course aligns with holistic development goals in engineering education, fostering adaptability and resilience for real-world challenges.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Demonstrate resilience, teamwork, integrity, and financial literacy in professional and personal settings.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Enhance** personal well-being by setting goals, managing stress, avoiding addictions, and fostering a positive environment.

CO2: **Develop** effective leadership skills by embracing humility and applying mentor-guided solutions to daily challenges.

CO3: **Enhance** interpersonal relationships by practicing forgiveness in both personal and professional settings.

CO4: **Apply** ancient wisdom to effectively address and navigate modern-day challenges.

CO5: **Foster** responsible citizenship by cultivating values of integrity, loyalty, sincerity, and punctuality for national progress.

CO6: **Build** teamwork skills and financial literacy to achieve stability and harmony in professional and personal life.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	2	2	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	25	10	25	10	25	10

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
UNIT I: Remaking Yourself	1	**Begin with the End in Mind:** Visualize future goals and structure lives through smart goals to give direction to achieve desired outcomes.	2#	CO1
	2	**Being Addiction-Free:** Explore the detrimental effects of addictions on one's health, personal life, and family life and learn how to take control of life by becoming addiction free.	2#	CO1
	3	**Stress Management:** Cope with current and future causes of stress.	2#	CO1
	4	**Better Health Better Future:** Maintain good health through regular exercise, healthy eating habits, and regular and sufficient sleep.	2#	CO1
	5	**Impact of Company:** Develop the ability to create a positive environment around yourself.	2#	CO1
UNIT II: Learning from Legends	6	**Leading Without Leading:** Explore a new approach to leadership, through humility.	2#	CO2
	7	**Words of Wisdom:** Gain practical insights by engaging with mentors to address real-life challenges faced in daily life.	2#	CO2

UNIT III: From House to Home	8	**Forgive & Forget:** Apply the knowledge of forgiveness in personal and professional life.	2#	CO3
UNIT IV: Facing Failures	9	**Timeless Wisdom for Daily Life:** Use ancient wisdom to solve modern-day challenges.	2#	CO4
UNIT V: My India My Pride	10	**Present Scenario:** Implement the transformation of India from a developing country into a developed country it is necessary to have a value-based citizen.	2#	CO5
	11	**An Ideal Citizen - 1:** Develop good values by exploring the values of responsibility and integrity to become value-based citizens.	2#	CO5
	12	**An Ideal Citizen - 2:** Develop values of loyalty, sincerity, and punctuality by trying to keep perfection in every small task and by looking at the bigger picture.	2#	CO5
UNIT VI: Soft Skills	13	**Teamwork & Harmony:** Learn the six steps of teamwork and harmony that are essential for students' professional and daily life.	2#	CO6
	14	**Financial Planning:** Develop a variety of practical financial skills to become financially stable throughout the future careers.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Perform Selfless Service - Seva: Apply previous lessons of seva, to analyse the case study of the Bhuj earthquake relief work or any other relief work.

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Content Understanding	10
2	Readability	5
3	Completeness	5
4	Viva voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Originality of work	5
2	Organization and Writing	5
3	Use of Evidence	5
4	Viva voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	-	3	3	3	-	-
CO2	-	-	-	-	3	3	3	-	-
CO3	-	-	-	-	3	3	3	-	-
CO4	-	-	-	-	3	3	3	-	-
CO5	-	-	-	-	3	3	3	-	-
CO6	-	-	-	-	3	3	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Integrated Personality Development Course Workbook-2	IPDC Team, Swaminarayan Aksharpith, Shahibaug, Ahmedabad- 4, India, 2nd Edition 2021.	10: 8175267062 13: 978-8175267060
2	Wings of Fire: An Autobiography	A.P.J. Abdul Kalam, Arun Tiwari (Contributor), Universities Press, 67th Edition 2023	13: 978-817371466
3	The Wit & Wisdom of Ratan Tata	Ratan Tata, Hay House India, January 2016	10: 9789385827297 13: 978-9385827297
4	Chase Your Dreams	Sachin Tendulkar, Hachette India, October 2017	10: 9351951995 13: 978-9351951995

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1. Julian Treasure: 5 ways to listen better | TED Talk accessed on 7th July, 2023
2. Listening Statistics: 23 Facts You Need to Hear (creditdonkey.com) accessed on 7th July, 2023
3. Robert Waldinger: What makes a good life? Lessons from the longest study on happiness | TED Talk accessed on 7th July, 2023
4. The Story Behind the Selfless Love of Ahmedabad's Seva Cafe (thebetterindia.com) accessed on 7th July, 2023
5. What Are Soft Skills? Definition, Importance, and Examples (investopedia.com) accessed on 7th July, 2023
6. Welcome to Mystic India accessed on 7th July, 2023

XVI List of Major Equipment/Machineries with Specification:

1. Desktop Computer, Latest Configuration
2. DLP, Latest Configuration
3. Smart Classroom with internet connection

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M.B.Daigavane	Principal	Government Polytechnic, Nagpur
2	Mr. Y.K.Chandarana	HoD, Applied MechanicsEngineering	Government Polytechnic, Nagpur
3	Dr. G. K. Awari	HoD, Automobile Engineering	Government Polytechnic, Nagpur
4	Dr. G.V. Gotmare	I/C, Curriculum Development Cell	Government Polytechnic, Nagpur
5	Dr. Megha Machale (Bhelande)	Lecturer in English	Government Polytechnic, Nagpur

(Dr. G.V.Gotmare)
HOD & Chairman PBOS, COMMON

(Dr. G.V.Gotmare)
Member Secretary PBOS, COMMON

Exit Course

I Year

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/AE/MT/PK/TX/MK/AI
Course Category	:	INP
Course Code	:	IN151H
Course Title	:	Internship (Basic Skills)

I Rationale:

Internship (Basic Skill) is a four-week immersive program designed for first-year diploma students, offering hands-on experience in an industrial setting. Guided by the principles of the National Education Policy (NEP), the course aims to bridge academic learning with industry expectations by fostering practical knowledge, workplace skills, innovation, and professional discipline. Emphasizing skill acquisition and teamwork, students maintain daily activity diaries and submit a comprehensive post-internship report, reflecting on their learning journey. This course serves as an exit option after the second semester, fulfilling the requirements for the award of the "Certificate in Vocation."

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Work efficiently in an industrial environment.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Follow** safety guidelines, record measures, and act per industry standards.

CO2: **Collect** data from supervisors, analyze processes, and write concise reports.

CO3: **Follow** instructions, observe processes, and document daily industrial work clearly.

CO4: **Identify** and discuss problems, analyze causes, and suggest possible improvements.

CO5: **Compile** experiences, refine presentations, and prepare a professional internship report.

CO6: **Present** internship report and outcomes confidently, showing skills, technical knowledge, and clear communication.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	-	8	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	-	-	-	-	50	20

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)	Topics and Sub-topics	Aligned Cos

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Adhere to industrial safety practices by consulting the safety officer, recording safety procedures, noting the do's and don'ts, and following all instructions as per industry standards.	10#	CO1
II	2	Conduct an industrial process survey by gathering information through discussions with the assigned supervisor/officer, recording findings, and preparing a concise report.	10#	CO2
III	3	Work effectively in an industrial environment by following supervisor instructions, observing industrial processes, and maintaining a daily work diary.	60#	CO3
IV	4	Analyze industrial problems by discussing with supervisors and workers, identifying issues in systems or processes, and documenting the findings.	20#	CO4

V	5	Compile internship experiences into a clear, professional report and presentation; conduct practice sessions to enhance presentation skills and prepare documents as per faculty guidelines.	10#	CO5
VI	6	Present internship report and outcomes confidently to faculty and peers, demonstrating technical knowledge, communication skills, and clarity in conveying internship learnings.	10#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Choose entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO"s/ Government organizations/ Micro/ Small/ Medium enterprises to make ready for the industry.

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of Type of Industry	5
2	Work done and Feasibility of work	25
3	Report writing	10
4	Presentation Skills and Viva-Voce	10
	TOTAL	50

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	3	3	-	-
CO3	-	-	-	-	-	3	3	-	-
CO4	-	-	-	-	1	3	3	-	-
CO5	-	-	-	-	-	3	3	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Soft Skills: Enhancing Industrial Training and Education	Lokesh Choudhary, Mittal Publications, 2007	10: 8183242367 13: 9788183242363
2	Training Practice	Penny Hackett, McGraw-Hill Education, September 2003	10: 0852929803 13: 9780852929803
3	AICTE Internship Policy: Guidelines & Procedures	All India council of Technical Education New Delhi	-

XV e-References:

1. https://internship.aicte-india.org/ assessed on 23rd April 2024
2. https://www.coursera.org/articles/computer-science-internships assessed on 23rd April 2024

XVI List of Major Equipment/Machineries with Specification:

1. Desktop computers
2. Laser Printer
3. DLP

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M.B.Daigavane	Principal	Government Polytechnic, Nagpur
2	Dr. M. V. Sarode	HoD, Computer Engineering and I/C Trainining & Placement Officer	Government Polytechnic, Nagpur
3	Dr. G. V. Gotmare	I/C Curricullum Development Cell	Government Polytechnic, Nagpur

(Dr. M. V. Sarode)
HOD & Chairman PBOS, CM

(Dr. G. V. Gotmare)
Member Sectretary PBOS, CM

Semester

III

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK201H
Course Title	:	Fundamentals of Packaging

I Rationale:

This diploma course provides a thorough grasp of packaging in business and environmental spheres. It covers economic principles, packaging's impact, and supplier dynamics. Students learn to optimize packaging for storage and transportation, with a focus on sustainability and waste management. This holistic approach equips them to tackle business challenges responsibly.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge of fundamentals of packaging in various packaging applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Determine** the characteristics of products and visualize likely damages due to various hazards to which it is subjected to.

CO2: **Suggest** appropriate method of handling a packaged product.

CO3: **Identify** suppliers of packaging materials and packaging related machineries.

CO4: **Identify** features of a packaging system and search for a package having given features.

CO5: **Identify** issues related to protection of environment from packaging induced burdens and impacts.

CO6: **Select** appropriate method of transportation and handling devices.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25 +	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Basic Economy	1a	Compare the given types of standards on the basis of given points.	1.1	Basic economy - Need for business, Types of business - Production, Trading, and Service. Business processes (Introduction)- Purchasing, Production, Inspection, Quality control, Selling, Marketing, Research, Design and development, etc. Introduction to Standards, their types; local, industrial, national, and international, and its examples.	CO1
	1b	Compare given types of marketing methods on given points.	1.2	Marketing - Concept, Market segments, marketing methods, direct marketing, catalogue marketing, and Network marketing. Value addition - concept of Value, benefits of value addition.	
	1c	Identify given popular brands.	1.3	Branding - Concept, Popular national and international brands, advantages.	
	1d	Distinguish given advertisement.	1.4	Advertising - Concept, need, methods, role of media.	

	1e	Justify the need of given conepts of finance for a business.	1.5	Finance - Concept of investment, need. Return on Investment, Effect of Blocked Investment.	
UNIT II: Packaging in Perspective	2a	Compare given levels of packaging on given points.	2.1	Definition of packaging and its Economic impact. Levels of Packaging; Primary, secondary and Tertiary.	CO2
	2b	Justify the advantages and disadvantages of packaging to given stake holders.	2.2	Advantages of packaging to - Customer, retailer, distributor, handler, transporters, manufacturers, society, and nation. Disadvantages of packaging - Cost, resource utilization, energy, toxicity, litter, solid waste, wastage, deception, convenience, enclosure, multiples, sanitation, quality.	
	2c	Identify the given sector of a packaging business.	2.3	The Business of Packaging: a. Packaging material suppliers: Basic raw materials, materials for packaging. b. Converting of raw materials, converting of packaging materials. c. Ancillary Packaging materials. d. Packaging users: food, non-food. e. Contract packaging.	
	2d	Justify the role of given support services working for promoting packaging business.	2.4	Support services: government, universities, consultants, institutes, publications, trade associations, professional societies.	
	2e	Justify the influence of given demography on business of packaging.	2.5	Packaging Today and Tomorrow: Demographic influence on packaging; growing population, shifts in definition of household units, geographic redistribution, increase in number of working women, increase in number of single living, increase in number of two earner household, Cognizance by consumers of their cultural heritage.	

UNIT III: Product Characteristics	3a	Analyse the given physical characteristics of product based on given data.	3.1	Physical characteristics of the product - Physical state, weight, center of gravity, symmetry, fragility, rigidity, surface finish.	CO3
	3b	Analyse the given physicochemical characteristics of product based on given data.	3.2	Physicochemical characteristics of the product: Susceptibility to water, water vapor, gases, odor, heat, light, spoilage and corrosion.	
UNIT IV: Packaging functions and considerations	4a	Identify the given functions of packaging	4.1	Functional Considerations of Packaging: Technical Functions:- Containment, protection (against mechanical damages), preservation (against Physiochemical damages). Commercial functions - Sanitation, unitization, communication (Human & Machine), dispersing & dispensing, pilferage deterrence, tampering evidence. Other functions like apportionment, gifts, etc.	CO4
	4b	Compare given stores on the basis of given points.	4.2	Storage and Display requirements of retail and departmental stores.	
	4c	Identify given material handling devices.	4.3	Handling Considerations - Need of handling, situations of loading and unloading, need of transshipments, methods of handling - manual and mechanical handling, handling devices - names.	
	4d	Identify the causes of given type of hazards.	4.4	Hazards of movements, hazards of transportation and distribution. Loading & unloading hazards.	

UNIT V: Product Damages	5a	Identify the causes of given type of mechanical damages to given products.	5.1	Mechanical damages: Causes - impact, vibration, crushing, shock. Effects – breaking, bending, cracking, scratching, distortion, deformation, dismantling, loosening.	CO5
	5b	Identify the causes of given type of Climatic damages to given products.	5.2	Climatic damage: Corrodible products: Principal causes of corrosion of packaged articles, atmospheric corrosion. Factors responsible: relative humidity, moisture contents & temperature. Bio deterioration; definition, causes.	
UNIT VI: Environmental Protection Issues	6a	Identify the causes of given environmental burdens and impacts due to man made materials.	6.1	The Environment System: Environment as a system, components of the system; land, water, air, vegetation, animals and organisms, natural cycles. Co- existence, evolution and struggle for existence. Environmental burdens, impacts due to manmade materials, products and utilization of natural resources.	CO6
	6b	Justify the given method of waste management.	6.2	Waste Management: 3R concept, recycling, incineration with or without energy recovery, land filling, composting.	
	6c	Identify the methods of recycling for the given products.	6.3	Packaging Material Recovery and Recycling: Techniques of Recovery, mono-materials systems, multi- material systems. Basic economics of recycling, Recycling of rigid plastic packages, laminates, metals, glass & paper.	
	6d	Justify the given responsibilities of an environmentally responsible package manufacture. Justify the concept	6.4	Environmentally Responsible Package Manufacturer. Role of manufacturer. Identification & control of environmental impacts due to packaging material. Packaging Life cycle analysis: concept and applications.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the various national and international brands in Cosmetics, Pharmaceuticals, Confectionary, Health care products; Visit nearby market or online shopping websites, note down brand name, range of products it offers and write a report on it.	2#	CO1
I	2	Identify the various national and international brands in Food products, Textiles and Electronics items; Visit nearby market or online shopping websites, note down brand name, range of products it offers and write a report on it.	2	CO1
I	3	Prepare a market survey report for value added products. Visit nearby retail store or online shopping websites, search such products, observe them and note down the features based on which the product is considered as value addition.	2#	CO1
I	4	Investigate differences between Retail Stores and Departmental Stores; visit at least one retail store and one departmental store. Observe - available space, arrangement of goods for sale, number of employees engaged, method of dealing with customers, method of making payment, etc. Note down the observations.	2	CO1
I	5	Investigate differences between Retail Stores and Departmental Stores; visit at least one departmental store. Observe - available space, arrangement of goods for sale, number of employees engaged, method of dealing with customers, method of making payment, etc. Note down the observations made and identify the differences. And prepare a report.	2#	CO1
II	6	Prepare a report for Packaging Collection and Analysis: Form suitable number of groups of students, Collect 05 empty packages/ containers of different products (Primary & Secondary) - Products can be assigned by the course teacher.	2#	CO2
II	7	Prepare a report on identification of Basic Packaging Materials of any two flexible Containers by group discussion. Form groups of four students, Assign them a Container / Package; Students should observe it and identify the basic materials of the container & its different components. Note down the findings.	2#	CO2

II	8	Prepare a report on identification of Basic Packaging Materials of any two rigid Containers by group discussion. Form groups of four students, Assign them a Container / Package; Students should observe it and identify the basic materials of the container & its different components. Note down the findings.	2	CO2
II	9	Conduct a survey to study the effect of packaging quality on consumer behavior that influence the purchasing decisions: a) Prepare samples at least one set, prepare a questionnaire.	2#	CO2
II	10	Conduct a survey to study the effect of packaging quality on consumer behavior that influence the purchasing decisions: b) interview people, compile the data, and draw conclusion. And prepare a report.	2#	CO2
III	11	Identify any three products each for its - Physical characteristics - Physical state, Weight, center of gravity, symmetry, fragility, rigidity, surface finish, And prepare a report on it.	2#	CO3
III	12	Identify any three products each for its - Physical characteristics - Physicochemical characteristics – Susceptibility to water, water vapor, gases, odor, heat, light, spoilage and corrosion. And prepare a report on it.	2#	CO3
IV	13	Identify Functions of Assigned Packaging Systems by group discussions. Form groups of four students each, Select a packaging system per group, Identify product characteristics, Note down the packaging material used and the product packed. Determine various functions of the existing packaging system. Draw a neat labeled sketch of the package. And prepare a report.	2#	CO4
V	14	Conduct a Case Study on Packaging Damages/Product Damages in Logistics. Search for a relevant case on the internet. Study the case scrupulously, Note down the causes and effects of the damages, and write a report.	2#	CO5
VI	15	Conduct a Case Study on any one selected Environmental Topic; Search the cases on the internet/magazines for one of the following topics: 3R Concept, Municipal Solid Waste Management and Advantages of Tree Plantation, Study the case scrupulously and write a report.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare a report on types of business.
2. Prepare a report on Packaging Testing Standards. (National and International)
3. Collect the samples of Primary, Secondary and Tertiary Packaging and prepare report.
4. Prepare a report on India Packaging Industry.
5. Prepare a report on Demographic influence on packaging Business.
6. Prepare a report on Physical and Physicochmeical Properties of products. (consider examples)
7. Prepare a report on Technical, Commercial and Other functions of Packaging.
8. Prepare a report on comparison between retail and departmental stores on the various points.
9. Prepare a report on manual and mechanical handling of packages or containers; handling devices used etc
10. Prepare a report on hazards of movements, hazards of transportation and distribution. Loading & unloading hazards.
11. Prepare a report on mechanical and climatic damages.
12. Prepare a report on Municipal Solid Waste Management Techniques.
13. Prepare a report on Environmentally responsible manufacturer.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Basic Economy	10	C	06	04	06	16
			O	00	04	00	4
2	Packaging in Perspective	8	C	02	04	06	12
			O	00	04	00	4
3	Product Characteristics	6	C	02	04	00	6
			O	04	00	06	10
4	Packaging functions and considerations	7	C	02	08	00	10
			O	02	04	00	6
5	Product Damages	6	C	02	04	06	12
			O	02	04	00	6
6	Environmental Protection Issues	8	C	00	08	06	14
			O	00	04	06	10
Total		45	C	14	32	24	70
			O	8	20	12	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	5R2	4R2	5R2	5	7
2	1R4	1U4	2U4	1U4	2U4			3	5
3	3U4	4U4	4U4	3R4	4U4			3	5
4	5U4	6U4	6U4	5U4	6U4			3	5
5	1A6	2A6	3A6					2	3
6	5A6	6A6	6A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of equipment/Materials	5
2	Performance	5
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	10
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of topics	5
2	Collection of data, analysis , results, conclusion	10
3	Report writing quality	5
4	Timely submission & punctuality	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	-	3	-
CO2	3	-	-	3	-	-	-	3	-
CO3	3	-	-	-	2	-	-	-	1
CO4	3	-	-	3	2	-	2	-	-
CO5	3	-	-	-	-	-	-	3	-
CO6	3	-	-	-	-	-	2	3	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Introduction to Packaging	Frank A. Paine, Heather Y. Paine, Springer, Second E, 1983	13: 978-1-4613-6214-2
2	Packaging in the Environment	Geoffrey M. Levy, Springer, Chapman and Hall, 1993	10: 1461358906
3	The Packaging User's Handbook	F.A. Paine, Chapman and Hall, New Edition,1995	13: 9780751401516
4	Handbook of Packaging	F.A. Paine	-
5	Fundamentals of Packaging Technology	Walter Soroka, Institute of Packaging Professionals, Virginia	-
6	Packaging- An Introduction	F.A. Paine	-
7	Fundamentals of Packaging	F.A. Paine	-

XV e-References:

1. https://www.youtube.com/watch?v=qAGCI0-pQ3E assessed on 3rd Feb 2024
2. https://www.youtube.com/watch?v=KMvRqygi04g assessed on 3rd Feb 2024
3. https://www.youtube.com/watch?v=7yAjgT5NAkE assessed on 3rd Feb 2024
4. https://www.youtube.com/watch?v=wugmX85ipRU assessed on 3rd Feb
5. https://www.youtube.com/watch?v=epAh6hHOq3c assessed on 5th Feb 2024
6. https://www.youtube.com/watch?v=CdTx-26q3M8 assessed on 3rd Feb 2024
7. https://www.youtube.com/watch?v=LKW8G_AIYbw assessed on 5th Feb 2024
8. https://www.youtube.com/watch?v=-0w61b6wppg assessed on 3rd Feb 2024
9. https://www.youtube.com/watch?v=jODl07akVHM assessed on 5th Feb 2024

XVI List of Major Equipment/Machineries with Specification:

1. Desktop Computer Systems connected with Internet.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology.	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4	Dr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
5	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

(Mr. Syed Imran Ahmed K.)
HOD & Chairman PBOS, PK

(Dr. G. V. Gotmare)
Member Sectretary PBOS, PK

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
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Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK202H
Course Title	:	Traditional Packaging Materials

I Rationale:

This course focus into various packaging materials, including glass, metals, wood, and textiles. It explores the technologies used to transform raw materials into packaging products such as containers, boxes, and bags. By completing this course, you will acquire foundational knowledge that will prepare for advanced courses and enable to assess packaging made from these materials for different applications.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge in evaluation of packages made out of different materials for various applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** metallic packaging systems, material used for its manufacturing and perform various tests on metallic packaging and packaging material

CO2: **Identify** the type of metal containers and the material used for its manufacturing.

CO3: **Suggest** a suitable returnable container for transporting goods.

CO4: **Perform** different tests on glass containers; also identify the defects in glass containers.

CO5: **Identify** different types of sacks, types of seams and sack materials used in packaging.

CO6: **Perform** different tests on woods and wooden containers; also identify different types of wooden containers.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
4	-	2	2	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
: Metallic Packaging	1a	Compare given metallic sheet on given points.	1.1	Packaging Metals (Description and uses)- Black plate, Coated sheets and uncoated sheets, Tinplate- Methods of tinning- Hot dipping & Electro-Plating, Galvanized steel sheets, Mild steel sheets, Tin free steel, Aluminum and its alloys, Aluminum foil, Non-ferrous metals	CO1
	1b	Suggest the methods to prevent corrosion and metal coating.	1.2	Stress corrosion of metals, presence of inhibitors, passivity, corrosion testing, lacquer coating. Metal coatings - Thermal spraying, vapor deposition.	
	1c	Describe the given sheet.	1.3	Sheets and foil manufacturing processes,Applications of spinning, embossing, punching, shearing, drawing, deep drawing & wall ironing of metals in packaging.	

UNIT I	1d	Identify the given collapsible tube.	1.4	Aluminum collapsible tubes- Advantages, disadvantages and uses, outline of manufacturing process, specification & terminology. Metallic caps & closure - their types, methods of manufacture, uses and applications.	
	1e	Select suitable metal strappings for a given application.	1.5	Seamless aluminum bottles - material of manufacture, its pattern and uses. Steel strapping- strength & adequate elongation, Functions, Uses, merits and demerits, methods of jointing, hand tools, power strapping machine.	
UNIT II: Drums, Tins/cans & Aerosols	2a	Compare given types of drums on given points.	2.1	Metal drums- raw materials used, their types- fixed head drums, removable head drums, internally lined drums, composite drums, galvanized drums, manufacturing process and uses.	CO2
	2b	Differentiate aerosol on given points.	2.2	Aerosols - construction, working, advantages, disadvantages & uses.	
	2c	Describe given type of metal drum, tin and aerosols.	2.3	Metal cans/tin - material, construction, types of seams & joints, types of closures, types and methods of manufacturing of cans. Advantages, disadvantages & uses of steel & aluminum cans	
UNIT III: Containerization & Returnable Containers	3a	Identify the given type of containers.	3.1	Containers; (Containerization) – specification, types, constructional features, purpose and uses.	CO3
	3b	Compare given returnable packages with others on given points.	3.2	Returnable containers – tankers, cylinders- their constructional features, uses and applications.	

UNIT IV: Glass Container	4a	Compare given types of glass on the basis of given points.	4.1	Raw materials used, outline of manufacturing process, Coloring of glass, characteristics of glass, types of glass, types of container, advantages, disadvantages & uses of glass and glass containers.	CO4
	4b	Identify the defects in given glass container.	4.2	Container making processes, defects in glass containers, treatment of glass/containers, Testing &quality control. Recycling process of glass.	
	4c	Determine the strength of given glass under different tests.	4.3	Testing methods - thermal shock test, fragility test, dimensional accuracy, annealing test, etc.	
UNIT V: Textile sacks, Bags, Twines & Cords, Bailing & Composite Packaging	5a	Describe the given steps of sack manufacturing process.	5.1	Material used & sack manufacture process, finishing treatments, nomenclature.	CO5
	5b	Identify types of jute fabric and seams.	5.2	Specification & types of jute fabric, types of seams used, applications, lined sacks & bags, methods of closing sacks and bags.	
	5c	Describe the given steps in bailing process.	5.3	Bales, bailing processes, mailing sack & bag.	
	5d	Identify the given composite packages.	5.4	Composite materials; Definitions & need of composite materials and composite packages, uses of these materials in packaging, advantages.	
	5e	Identify the given type of twines & cords.	5.5	Definition of twines & cords, uses, types of knots, seals	
	6a	Classify given type of wood and identify the defects in it.	6.1	Wood; Nature/characteristics of wood, classification of wood, defects in wood, wood for box making, application of wood as a packaging material - containers & pallets.	

UNIT VI: Wood in Packaging	6b	Describe the given type of seasoning method.	6.2	Seasoning of wood; methods, treatment of wood. (Current standards in use).	CO6
	6c	Describe the given type of plywood manufacturing process.	6.3	Plywood manufacturing process, plywood specifications, types of plywood used in packaging, other materials used in box making, testing and quality control of wood.	
	6d	Compare the given types of wooden packages on the basis of given points.	6.4	Wooden packages; Nailed wooden boxes, simple wooden crate, wire bound boxes & crates, sill & skid base cases, crates, sheathed crates, wooden casks and plywood kegs, plywood barrels - their construction, production methods, types & styles, methods of closing.	
	6e	Identify the given types of pallets.	6.5	Types of wooden pallets- Standard pallets, block class, stringer class, two way entry, four way entry, reversible non-reversible pallets – their sketches and applications.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Measure the gauge/thickness of metallic sheet / metallic foils using micrometer	2#	CO1, CO2
I	2	Determine puncture resistance of metallic sheet & foil.	2#	CO1
I	3	Determine bursting strength of metallic sheet & foil.	2#	CO1
I	4	Determine tensile strength & elongation of given strap.	2#	CO1
I	5	Determine joint strength of given strap.	2	CO1
II	6	Identify material of construction and method of construction of can.	2	CO2
II	7	Identify material & method of construction of drum.	2#	CO2
II	8	Determine compression strength of metal cans.	2#	CO2
IV	9	Perform Thermal shock test of glass bottles	2#	CO4
IV	10	Perform annealing test of on glass container.	2#	CO4
V	11	Determine the tensile strength of a sack / composites / twines & cords.	2#	CO5
V	12	Perform the sewing/closing/seaming of jute sacks/bags by different methods.	2#	CO5
VI	13	Determine nail and screw holding power of wood.	2	CO6
VI	14	Determine of tensile strength/ compressive strength of plywood.	2#	CO6
VI	15	Determine density & moisture content of wood.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare metallic Packging Box
2. Prepare a model on manufacturing of tin cans
3. Perform the thermal shock test of glass bottles and write a report.
4. Perform the tensile strength test for sack / composites / twines & cords and write a report.
5. Prepare s chart on nail and screw holding power of wood.
6. Prepare a report on static bending test on wood.
7. Collect the standard dimension of container.
8. Prepare a model on sensing of wood for wood treatment.
9. Prepare a model on recycling of glass and write a report.
10. Prepare a report on sack manufacturing process.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Metallic Packaging	12	C	06	04	06	16
			O	00	04	00	4
2	Drums, Tins/cans & Aerosols	10	C	02	04	06	12
			O	00	04	00	4
3	Containerization & Returnable Containers	8	C	02	04	00	6
			O	04	00	06	10
4	Glass Container	8	C	02	08	00	10
			O	02	04	00	6
5	Textile sacks, Bags, Twines & Cords, Bailing & Composite Packaging	10	C	02	04	06	12
			O	02	04	00	6
6	Wood in Packaging	12	C	00	08	06	14
			O	00	04	06	10
Total		60	C	14	32	24	70
			O	8	20	12	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	5R2	4R2	5R2	5	7
2	1R4	1U4	2U4	1U4	2U4			3	5
3	3U4	4U4	4U4	3R4	4U4			3	5
4	5U4	6U4	6U4	5U4	6U4			3	5
5	1A6	2A6	3A6					2	3
6	5A6	6A6	6A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of testing equipment/ IS referred/ size of test piece/ etc.	5
2	Procedure & Performance.	5
3	Calculation, result & inference.	5
4	Viva Voce	10
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of testing equipment/ IS referred/ size of test piece/ etc.	5
2	Procedure & Performance.	10
3	Report writing	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	-	2	-
CO2	3	-	-	3	-	-	-	2	-
CO3	3	-	-	-	3	-	-	-	2
CO4	3	-	-	3	3	-	3	-	-
CO5	3	-	-	-	-	-	3	-	-
CO6	3	-	-	-	3	-	3	-	2

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Fundamentals of Packaging Technology	S. Natrajan, M. Govindrajan, B. Kumar, PHILPL, 2E, 2014.	13: 978-81-203- 5054-0
2	IS : 1394 - 1984 Glossary Of Terms Relating To Metal Containers	Bureau of Indian Standards, 1984	-
3	IS : 10106 (Part 2/Sec 1) - 1985 Packaging Materials - Metals	Bureau of Indian Standards, 1985	-
4	IS: 2552 -1989 Steel Drums (Galvanized And Ungalvanized)	Bureau of Indian Standards, 1989	-
5	IS : 3101 : 1995 Aluminium Collapsible Tubes – Specification	Bureau of Indian Standards, 1995	-
6	IS : 10106 (Part 3/Set 3) – 1985 Ancillary Materials - Tensional Strapping	Bureau of Indian Standards, 1985	-
7	IS : 6662 – 1993 Timber Species Suitable for Wooden Packaging-Specification	Bureau of Indian Standards, 1993	-

XV e-References:

1. http://www.madehow.com/Volume-2/Aluminum-Beverage-Can.html assessed on 5th May 2024.
2. https://en.wikipedia.org/wiki/Tin_can assessed on 9th May 2024.
3. https://www.youtube.com/watch?v=QEUV-FWZ8lM assessed on 18th May 2024.
4. https://www.youtube.com/watch?v=hcsDxCagWrY assessed on 13th May 2024.
5. https://www.youtube.com/watch?v=8yOqFbygVAQ assessed on 15th May 2024.
6. https://www.youtube.com/watch?v=Yxo4l9ZDZjc assessed on 27th May 2024.
7. https://www.youtube.com/watch?v=on-_oUajNso assessed on 28th May 2024.
8. https://www.youtube.com/watch?v=zOHmnp3KLYM assessed on 31th May 2024.

XVI List of Major Equipment/Machineries with Specification:

1. Thickness caliper.
2. Micrometer screw gauge.
3. Vernier caliper.
4. Thermometer.
5. Universal testing machine.
6. Bursting strength tester.
7. Puncture resistance tester.
8. Fabric stitching tools/equipment.
9. Water heating kettle.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. A. P. Pardey	Sr. Lecturer Paper Technology	Government Polytechnic, Nagpur.
3	Mr. Subhash N. Madhugiri	Ex. HOD, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Ex. HOD, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
5	Mr. Milind S. Deshpande	Sl. Gr. Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
6	Dr.Shubhangi Gondane	Professor	PVG COE&T, Pune
7	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.

(Mr. Syed Imran Ahmed K.)
HOD & Chairman PBOS, PK

(Dr. G. V. Gotmare)
Member Sectretary PBOS, PK

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK203H
Course Title	:	Plastic Materials in Packaging

I Rationale:

The polymer-based packaging industry plays a crucial role within the broader packaging sector. Various forms of plastics, including flexible, semi-rigid, and rigid, are used in numerous packaging applications, with thermoplastics being the most commonly employed materials for these purposes. This course aims to provide a foundational understanding of polymer science, covering topics such as the polymerization process, the use of additives, the properties and types of different plastics, methods for their identification and testing, as well as the role of adhesives and adhesive tapes.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge of plastic properties and its applications in various plastic manufacturing processes and differnt applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identity** various thermoplastics & thermosetting plastics, describe the Polymerization processes, and the functions of additives.

CO2: **Identify** Polyolefins and Polyvinyls and Select a suitable plastic for packaging applications.

CO3: **Identify** Polyamides, Styrene and Ester Polymer and Select a suitable plastic for packaging applications.

CO4: **Identify** Thermosetting Plastics, Elastomers and Other Polymer and select a suitable plastic for packaging applications.

CO5: **Perform** various plastic identification tests and conduct various tests for performance assessment.

CO6: **Identify** various types of adhesives & adhesive tapes for packaging applications.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Plastic	1a	Compare the types of given polymerization processes on given points.	1.1	Genesis of polymer, Defination of polymer, Raw Material sources. Polymerization process and methods of polymerization. Molecular weight, Molecular weight, and Degree of polymerization.	CO1
	1b	Describe the given terminologies related to the polymer.	1.2	Glass transition Temperature, Factors affecting glass transition temperature, Glass Transition Temperature and Melting Point, Importance of Glass Transition Temperature. Heat Distortion Temperature, Crystallinity in polymers, Degree of Crystallinity, Effect of Crystallinity on properties of polymers.	

	1c	Differentiate the given polymerization process on given points.	1.3	Introduction, Meaning of copolymerization, Purpose, and uses of copolymerization. free–radical copolymerization and Ionic copolymerization. Polymer alloys, Blending and Compounding of polymers. Advantages of Copolymerisation and Blending	
	1d	Compare given types of plastic on given points.	1.4	The structure of Polymers, Types of Polymers, thermoplastics, and Thermo-Sets, Thermoplastics and Thermosets.	
	1e	Compare the given functions of additives on given points.	1.5	Additives and materials used in processing of plastics-Materials such as Antioxidants, Antifoaming, Antisplit, Antiblocking, Antistatic, Blowing agents, Colourants, Fillers, Lubricants, Heat stabilizers, Flame retardants, Mould release agents, Impact Modifiers, Plasticizers, Slip additives, Ultraviolet stabilizers, Optical Brighteners.	
UNIT II: Polyolefins and Polyvinyls	2a	Analyze the properties of plastic to select appropriate compounds for given applications.	2.1	Identification, Properties, and Uses of the following compounds- Polyolefins Compound like Polyethylene compound, Low-density polyethylene compound, Linear Low-density polyethylene compound, High-density Polyethylene compound, High molecular high-density polyethylene compound, Expanded polyethylene compound, Polypropylene, Biaxially oriented Polypropylene compound, Ethylene/Vinyl Acetate Copolymers (EVAs) compound.	CO2

	2b	Select a compound for given application.	2.2	Identification, Properties and Uses of following compounds- Polyvinyls compounds like - Polyvinyl chloride, Polyvinylidene chloride, Ethylene/Vinyl Alcohol Copolymer (EVOH), Poly Vinyl Alcohol.	
	2c	Compare the polyvinyl and polyolefins on the given points.	2.3	Differentiate between polyvinyl and polyolefins with their properties and applications.	
UNIT III: Polyamides, Styrene and Ester Polymers	3a	Analyze the properties of plastic to select appropriate compounds for given applications.	3.1	Identification, Properties, and Uses of the Polyamides compounds- such as Nylon 6, Nylon 6-6, Nylon 6-10, Nylon 11.	CO3
	3b	Select compounds for given applications.	3.2	Identification, Properties, and Uses of Styrene polymers - such as Unmodified or crystal Polystyrene, High Impact Polystyrene, Expanded Polystyrene, and Acrylonitrile Butadiene Styrene (ABS).	
	3c	Analyze the properties of plastic to select appropriate compounds for given applications.	3.3	Identification, Properties, and Uses of Ester polymers - such as Polyesters- Thermoplastics & Polyesters- Thermosets, Poly Ethylene Terephthalate (PET), and Crystalline PET (CPET).	
rs and Other Polymers	4a	Analyze the properties of plastic to select appropriate compounds for given applications.	4.1	Identification, Properties, and Uses of following compounds Thermosetting plastics such as Phenol Formaldehyde (PF resins), Urea Formaldehyde (UF resins), Epoxy Resins, Polyurethenes, Silicone Polymers.	CO4

UNIT IV: Thermosetting Plastics, Elastomer	4b	Select the compounds for given applications.	4.2	Identification, Properties and Uses of Elastomers compounds, Introduction, Elastomeric materials, Fiber forming materials, Properties & their Characteristics, Elastomers, and their types, Applications of Elastomers in packaging.	
	4c	Analyze the properties of plastic to select appropriate compounds for given applications.	4.3	Identification, Properties and Uses of Other polymers compounds such as Polycarbonate, Acrylics-Polyacrylonitrile, High Nitrile Polymers (HNPs), Cellulosics-Cellulose Acetate, Cellulose Nitrate, Cellophane-Regenerated films, Biodegradable plastics, Ionomers.	
UNIT V: Testing of Plastics and Plastic Packages	5a	Describe the given general testing methods of plastic packages.	5.1	General test methods like compatibility, product change, product loss, taste and odor, leakage, and decolaration.	CO5
	5b	Describe the different testing for blown molded containers.	5.2	Testing of blown molded containers such as Stress Crack Resistance, container breakage, container collapse, neck and thread dimension, weight and material distribution, container volume and weight.	
	5c	Select the test for given type of heavy-duty packages of plastic.	5.3	Testing of heavy-duty packages like fabric strength, seam strength, drop test, laminates, storage test, overall migration test.	
	5d	Select the test given packages of plastic.	5.4	Testing for flexible, semirigid, and rigid packages like stack load test, drop test, vibration test, hot tack method, Gawis method, and Online monitoring devices.	

	5e	Identify the testing for given plastic films.	5.5	Testing of flexible plastic films such as Optical tests, machinability tests, Mechanical tests, and test for ink adhesion of printed pouches.	
UNIT VI: Adhesives and Adhesive Tapes	6a	Identify the properties for the given application.	6.1	Adhesives: Definition and Principle of adhesion. Theories of adhesion, Bond and bond strength, Factors affecting bond strength. Terminologies in adhesives and adhesion (Tack time, Open time, Setting time, Cure time, etc.), Types and classification of adhesives.Properties of specific types of adhesives. Adhesives used in paper-plastic bonding. Adhesives used in Plastic-Plastic bonding. Adhesives used in Plastic-metal bonding.	CO6
	6b	Select the criteria for given packaging application.	6.2	Criteria for selection of adhesives tapes in packaging. Adhesive system, Aqueous, Solvent, Emulsion, Pressure sensitive, Heat sensitive. Advantages and disadvantages of different adhesives. Application & uses.	
	6c	Identify the adhesive tape material for given application.	6.3	Adhesive tapes Materials of tapes, Suitability of different tapes in particular application. Paper tapes, plastic tapes, Leather tapes, Cloth tapes, Metal tapes, tape systems- Gummed tapes, Pressure sensitive tapes, Heat sensitive tapes. Advantages, disadvantages, and application of different tapes. Criteria for selection of adhesive tapes in packaging.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Perform the synthesis of polymer by addition polymerization and write a report on it.	2#	CO1
II	2	Determine the specific densities of given plastic samples.	2	CO2
II	3	Perform the solubility test for a given polyolefins, and polyvinyl chloride plastic sample in various solvents.	2#	CO2
II	4	Perform the burning test for given polyethylene (PE) polypropylene (PP) and polyvinyl chloride (PVC)samples.	2#	CO2
III	5	Perform the identification of plastics by plastic recycling code. Collect the different samples, Identify as per code written on them, and Write a report.	2#	CO3
III	6	Perform the burning test for given polystyrene (PS) and Nylon compounds samples.	2	CO3
IV	7	Perform the solubility test for a given thermosetting plastic sample in a various solvents.	2#	CO4
IV	8	Determine the moisture content of a given elastomers and other polymer samples.	2#	CO4
V	9	Perform dart impact test on plastic films.	2#	CO5
V	10	Perform the bursting strenth test on a given palstic sample.	2#	CO5
V	11	Determine the tensile strength and percentage elongation of given plastic samples using a UTM machine.	2#	CO5
V	12	Perform the impact resistance test for a given plastic sample.	2#	CO5
V	13	Perform slip test on plastics film.	2	CO5
V	14	Perform drop test on plastic pouches.	2#	CO5
VI	15	Determine peel strength of various adhesives.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Identify the differnt recycling codes of plastic and write a short report on it.
2. Collect the samples according to its recycling codes and write a report as per its applications.
3. Collect the information on the various types of adhesives used in the indusrty and domestic applications.
4. Collect the information on the various applications and idenfication of polyolefins compounds and write a report on it.
5. Collect the information on the various applications and idenfication of polyvinyl compounds and write a report on it.
6. Collect the information on the various applications and idenfication of polyamides compounds and write a report on it.
7. Collect the information about various types of additives used in the plastic industry and find its individual function. Also write a report on it.
8. Collect the information about the thermoplastic and thermosetting plastic. Write a report on it with suitables examples.
9. Perform the various types of tests on the selected plastic iteam and write a report on it.
10. Collect the information about identification methods like solubility test and burning test for various samples and write a report on it.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Plastic	8	C	6	4	6	16
			O	2	4	0	6
2	Polyolefins and Polyvinyls	7	C	2	4	6	12
			O	4	0	0	4
3	Polyamides, Styrene and Ester Polymers	7	C	2	4	0	6
			O	0	4	6	10
4	Thermosetting Plastics, Elastomers and Other Polymers	7	C	2	4	0	6
			O	0	4	6	10
5	Testing of Plastics and Plastic Packages	8	C	0	8	6	14
			O	2	4	0	6
6	Adhesives and Adhesive Tapes	8	C	2	8	6	16
			O	0	4	0	4
Total		45	C	14	32	24	70
			O	8	20	12	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	6R2	1R2	5R2	5	7
2	1R4	1U4	3U4	1U4	2R4			3	5
3	3U4	4U4	5U4	3U4	4U4			3	5
4	5U4	6U4	6U4	5U4	6U4			3	5
5	1A6	2A6	3A6					2	3
6	5A6	6A6	4A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of apparatus, writing procedure, etc.	5
2	Performance/ Skill	5
3	Observation, Inference, Conclusion, Result, etc.	5
4	Viva Voce	10
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of topic	5
2	Performance and interpretation of information/Skill	10
3	Report writing	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	3	-	-	-	-
CO2	3	-	3	3	3	-	1	-	1
CO3	3	-	3	3	3	-	-	1	-
CO4	3	-	3	3	3	-	-	1	-
CO5	3	-	3	3	3	-	-	-	-
CO6	3	-	-	3	-	-	1	-	1

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Handbook of Plastic Processes	Charles A. Harper, John Wiley & Sons, Inc., First Edition, 2006	13: 978-0-471-662556 10: 0-471-66255-0
2	Plastics in packaging	A.S. Athaley, Tata McGraw-Hill, First Edition, 1992.	10: 0-07-460014-7
3	Rigid and Semirigid Plastic containers	J. H. Boriston, Longman Group Limited, First Edition, 1994.	10: 0-582-01491-3
4	Handbook of package engineering	Joseph F. Hanlon , Robert J. Kelsey , Hallie Forcinio, CRC Press, Taylor & Francis Group, Third Edition, 1998.	13: 978-1566763066 10: 1566763061
5	Advances in Plastic Packaging Technology	John Briston, Pira International, First Edition, 1993	13: 9780902799967 10: 0902799967
6	Plastics Packaging	Susan Selke, John Culter, Ruben Hernandez, Hanser Gardner Publications, Inc, Second Edition, 2004	13: 978-1569903728 10: 1569903727
7	Plastics in Flexible Packaging	A. S. Athaley, Multi-Tech Publishing Co., First Edition, 1992	-

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2. https://en.wikipedia.org/wiki/Plastic assessed on 25th May 2024.
3. http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Material%20Science/pdf/ Lecture Notes/MLN_11.pdf assessed on 25th May 2024.
4. http://www.pnl.gov/main/publications/external/technical_reports/PNNL-17764.pdf assessed on 25th May 2024.
5. http://nsdl.niscair.res.in/jspui/bitstream/123456789/404/2/Basic%20concepts.pdf assessed on 25th May 2024.
6. http://www.ncert.nic.in/ncerts/l/lech206.pdf assessed on 25th May 2024.

XVI List of Major Equipment/Machineries with Specification:

1. Analog Substance Indicator/GSM Tester.
2. Cotton swabs and test tubes.
3. Disposable droppers or capillary tubes, Alcohol burner.
4. Bursting strength tester, Dart impact tester.
5. Spool of small gauge copper wire.
6. Small piece of balsa.
7. Copression tester, Bursting strength tester, Drop tester etc
8. Disposable 3 or 5 ml test tubes. Disposable droppers.
9. Graduated pipettes - 1 ml or tuberculin syringes.
10. Pasteur pipettes.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. HoD Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. A. P. Pardey	Sr. Lecturer, Paper Technology	Government Polytechnic, Nagpur.
3	Mr. Subhash N. Madhugiri	Ex. HoD, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Ex. HoD Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
5	Mr. Milind S. Deshpande	Sl. Gr. Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK204H
Course Title	:	Packaging Papers & Products

I Rationale:

This course delves into the Indian paper & pulp industry, focusing on raw materials like wood pulp and recycled paper. It explores fiber selection and advanced manufacturing processes such as Fourdrinier machines and twin-wire formers. Emphasizing the physical, mechanical, and optical properties of paper and paperboard, it covers their applications in packaging and specialized uses like wrapping and shock absorption. The course also includes technical insights into paperboard types, envelope production, paper cups, straws, composites, fiber cans, SFB drums, environmental regulations, and the intricacies of paper recycling.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge in evaluation of packages made out of different materials for various applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Test** various properties of paper and paperboard, gaining insights into the Indian paper and pulp industry

CO2: **Identify** the different types of papers and their applications in packaging.

CO3: **Prepare** a paper bag by hand and assess its strength through various testing methods

CO4: **Prepare** a paper cup by hand and test it for its usability.

CO5: **Identify** the composite packages and its layers.

CO6: **Conduct** case studies to better understand the compliance requirements in the paper sector.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
4	-	2	2	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Paper Making	1a	Describe with justification the overview of Indian paper making industry and manufacturing process.	1.1	Indian paper & pulp industry - overview, raw materials used for paper making and their functions, types of fibers used, paper manufacturing process - fourdrinier machine, twin-wire formers, multi-ply formers.	CO1
	1b	Describe with justification properties of papers and its storage precautons.	1.2	Properties of paper and paper board - Physical/mechanical, surface and optical. Storage of paper & paper board.	
UNIT II: Types of Papers and Boards	2a	Identify different types of papers and their applications.	2.1	Nomenclature of paper products, Main packaging papers, applications of different types of papers used in packaging, other applications of unconverted paper like wrapping, interleaving, stiffening & supporting, shock absorption & space filling, types of wrapping materials available.	CO2
	2b	Identify different types of paper boards and their applications.	2.2	Paper Board - types, structure and applications.	

UNIT III: Paper Bags	3a	Describe with justification paper bag making process.	3.1	Paper bag making processes - making by hand and by machines, raw material used.	CO3
	3b	Identify different types of paper bags.	3.2	Types of paper bags - Flat bags, Square bottom flat bags, Square bottom gusseted type bags, SOS bags, Satchel Bottom bags, Multi walled paper bags, Yarn-net laminated paper bags, Jute laminated paper bags, and Bitumen laminated paper bags.	
	3c	Suggest suitable type of paper bags for given products.	3.3	Applications and suitability of paper bags and multi walled paper sacks in packaging. Bag filling and sealing techniques.	
	3d	Describe with justification envelope making process.	3.4	Envelope making processes - making by hand and by machines, raw material used.	
	3e	Identify different types of envelopes.	3.5	Types of envelope and their applications.	
UNIT IV: Paper Cups	4a	Idnetify differnet types of papers cups.	4.1	Papers Cups: Introduction, Type; Tea/coffee cups, cones, Ice-cream & other cups, paper crimped cups etc.	CO4
	4b	Draw the outline of Paper cup manufacturing process.	4.2	Paper cup manufacturing; raw material used, manufacuring process.	
	4c	Describe with justification of different types of paper cups.	4.3	Advantages, limitations and applications of different types of paper cups.	
	4d	Draw the outline of Paper straw manufacturing process.	4.4	Paper straw: manufacturing process, raw material used, applications.	

UNIT V: Paper Comoposites; can, drum and tubes	5a	Describe paper composites with justification.	5.1	Composites - Paper laminates, Aluminum/ paper laminates.	CO5
	5b	Identify the functions of each layer in composites.	5.2	Lamination structure; elements of laminated structure, their functions.	
	5c	Draw Fiber cans, SFB Drums and tubes showing their constructional features.	5.3	Fiber cans, SFB Drums and tubes; Introduction, constructional features.	
	5d	Draw the outline of Fiber cans, SFB Drums and tubes: Manufacturing process,	5.4	Fiber cans, SFB Drums and tubes: Manufacturing process, raw material used	
	5e	Suggest suitable type of container for given product.	5.5	Applications of Fiber cans, SFB Drums and tubes.	
UNIT VI: Regulatory Requirements	6a	Describe with justification the different Regulatory requirements in Paper making.	6.1	Regulatory requirements in Paper making; Water consumption, water pollution, air pollution, solid waste generation etc.	CO6
	6b	Identify the marks and logos for the bodies working for environmental proection.	6.2	Other environmental concerns: Eco mark criteria, role of Forest Stewardship Counci, their logos for identification.	
	6c	Descrbe with justifiction the advantages and limitations ofrecycling paper and paper products.	6.3	Recycling of paper & paper products: process, advantages and limitations of recycling.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Conduct the tests to identify the grain direction of paper/board.	2#	CO1
I	2	Conduct the tests to determine top side & wire side of paper / paper -board.	2	CO1
I	3	Carry out bursting strength test and calculate burst factor of paper/paper board.	2#	CO1
II	4	Perform grammage / GSM test - on paper/ paperboard.	2	CO2
II	5	Conduct the test to find out thickness/caliper of paper/ paperboard/composite.	3	CO2
II	6	Perform folding endurance test - for paper /paperboard used in paper bags.	2#	CO2
III	7	Draw, design and make by hand any one type of paper bag as instructed by the course faculty.	2#	CO3
III	8	Perform tensile strength and breaking length tests- on paper bag handle /paper bag /given paper.	2#	CO3
IV	9	Conduct a Cobb test to find out the water absorptiveness of paper/ paperboard.	2#	CO4
IV	10	Draw, design, and make by hand any one type of paper cup as instructed by the course faculty.	2#	CO4
V	11	Identify the layers of a composite package material by observation/ply separation.	2#	CO5
V	12	Perform Tear strength test (Internal) - on paper/paper boards.	2#	CO5
V	13	Collect the various types of composite packages. and write a report on its type and material.	2#	CO5
VI	14	Conduct a cae study on recycling of paper; Use internet to search relevant data, prepare questionnaire, visit nearby scrap dealer, observe and note the process of recycling paper	2#	CO6
VI	15	Conduct a case study to find out the importance of Eco mark and Forest stewardship council (FSC) and write a report.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Conduct a case study on the Indian paper and pulp industry and Write a detail report on it.
2. Prepare a report on importance of proper storage of paper and paper boards.
3. Prepare a report on various types of paper and paper board packages.
4. Prepare a report on the non-packaging application of paper and paper board such as wrapping, interleaving, supporting, space-filling, and shock absorber.
5. Create any two types of paper bags and write a report on it.
6. Prepare a report on multiwall paper bags and their applications.
7. Create a paper creamped paper cup/Tea/coffee cup and write a report on it.
8. Collect the various samples of paper used for making different types of paper cups and write a report on it.
9. Prepare a report on lamination strcture of any two types of composite packages and state the function of each layer in it.
10. Prepare a report on the application of different paper composite packages.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Paper Making	12	C	06	04	06	16
			O	00	04	00	4
2	Types of Papers and Boards	10	C	02	04	06	12
			O	00	04	00	4
3	Paper Bags	8	C	02	04	00	6
			O	04	00	06	10
4	Paper Cups	8	C	02	08	00	10
			O	02	04	00	6
5	Paper Composites, Can, and Tubes drum	10	C	02	04	06	12
			O	02	04	00	6
6	Regulatory Requirements	12	C	00	08	06	14
			O	00	04	06	10
Total		60	C	14	32	24	70
			O	8	20	12	40

*C - Co Write a report c O - Optional
*R – Re Write a report c U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.		Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	5R2	4R2	5R2	5	7
2	1R4	1U4	2U4	1U4	2U4			3	5
3	3U4	4U4	4U4	3R4	4U4			3	5
4	5U4	6U4	6U4	5U4	6U4			3	5
5	1A6	2A6	3A6					2	3
6	5A6	6A6	6A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of testing equipment/ IS referred/ size of test piece/ etc.	5
2	Procedure & Performance.	5
3	Calculation, result & inference.	5
4	Viva Voce	10
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of testing equipment/ IS referred/ size of test piece/ etc.	5
2	Procedure & Performance.	10
3	Report writing	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	-	2	-
CO2	3	-	-	3	-	-	-	2	-
CO3	3	-	-	-	3	-	-	-	2
CO4	3	-	-	3	3	-	3	-	-
CO5	3	-	-	-	-	-	3	-	-
CO6	3	-	-	-	3	-	3	-	2

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Fundamentals of Packaging Technology	Walter Soroka, Institute of Packaging Professionals, Virginia	10: 1930268254
2	IS : 1394 - 1984 Glossary Of Terms Relating To Metal Containers	Bureau of Indian Standards - 1984	-
3	IS : 10106 (Part 2/Sec 1) - 1985 Packaging Materials - Metals	Bureau of Indian Standards - 1985	-
4	IS: 2552 -1989 Steel Drums (Galvanized And Ungalvanized)	Bureau of Indian Standards -1989	-
5	IS : 3101 : 1995 Aluminium Collapsible Tubes – Specification	Bureau of Indian Standards - 1995	-
6	IS : 10106 (Part 3/Set 3) – 1985 Ancillary Materials - Tensional Strapping	Bureau of Indian Standards – 1985	-
7	IS : 6662 – 1993 Timber Species Suitable for Wooden Packaging- Specification	Bureau of Indian Standards – 1993	-

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4. https://www.youtube.com/watch?v=hcsDxCagWrY assessed on 13th May 2024.
5. https://www.youtube.com/watch?v=8yOqFbygVAQ assessed on 15th May 2024.
6. https://www.youtube.com/watch?v=Yxo4l9ZDZjc assessed on 27th May 2024.
7. https://www.youtube.com/watch?v=on-_oUajNso assessed on 28th May 2024.
8. https://www.youtube.com/watch?v=zOHmnp3KLYM assessed on 31th May 2024.

XVI List of Major Equipment/Machineries with Specification:

1 Micrometer thickness gauge.
2 Brightness Tester
3 Universal testing machine.
4 Bursting strength tester.
5 Puncture resistance tester.
6 Ring Crush Tester
7 Cobb teaster
8 Tearing resistance tester
9 Folding endurance tester
10 GSM substance indicator /Electronic Grammage tester

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. A. P. Pardey	Sr. Lecturer Paper Technology	Government Polytechnic, Nagpur.
3	Mr. Subhash N. Madhugiri	Ex. HOD, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Ex. HOD, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
5	Mr. Milind S. Deshpande	Sl. Gr. Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
6	Mr. Prasad B. Iyer	Director	SIES' School of Packaging, Mumbai.
7	Dr.Shubhangi Gondane	Professor	PVG COE&T, Pune
8	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	SEC
Course Code	:	PK251H
Course Title	:	Packaging Processes

I Rationale:

Efficient and reliable packaging is essential for product protection, presentation, and distribution in every industry. This practical course develops hands-on skills in liquid and dry product filling, shrink wrapping, blister packing, vacuum packaging, and related operations. Learners study packaging materials and styles through case studies on pouches, paper bags, cartons, corrugated boards, and pallets. Skills in creasing, slitting, box assembly, stretch wrapping, and strapping prepare students to meet modern packaging and load unitization standards, blending theoretical knowledge with industry-oriented practice.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge of different types of Packaging Processes

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Operate** various liquid and dry product filling systems efficiently and accurately.

CO2: **Implement** protective packaging techniques for product preservation and presentation.

CO3: **Analyze** packaging materials and formats for suitability in different applications.

CO4: **Execute** structural preparation processes to meet packaging specifications.

CO5: **Apply** load unitization and securing methods for safe handling and transport.

CO6: **Evaluate** packaging performance to recommend process or design improvements.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	4	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	50	20	50+	20	-	-

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Perform liquid filling by liquid volumetric filling machine (model/portable). Note the findings and observations.	2#	CO1
I	2	Perform liquid filling by constant level filling machine (model/portable). And prepare a report on it.	2#	CO1
I	3	Perform dry product filling by filling by weight model or portable machine.	2#	CO1
I	4	Perform dry product filling by filling by count model or portable machine.	2	CO1
II	5	Perform shrink wrapping by manually or using a portable or model machine-a)Collect information on the concept, process and types of shrink wrapping machines available in the market. (Use magazines,books and internet)	2#	CO2
II	6	Perform shrink wrapping by manually or using a portable or model machine-b) Prepare the raw material required, prepare three samples and perform shrink wrapping on them.	2#	CO2

II	7	Carry out a case study on various styles of plastic pouches used inpackaging (Usemagazines, books and internet)-a)Search and collect information on different styles of plastic pouches and material used for manufacturing.	2#	CO2
II	8	Carry out a case study on various styles of plastic pouches used in packaging (Usemagazines, books and internet)-b) Collect at least three different samples and identify them.	2#	CO2
II	9	Carry out a case study on Blister Packs for tablets/ toys/ stationery items (use internet/ magazines/ books)-a)Search and collect the information on the concept, process, material used and its applications.	2#	CO2
II	10	Carry out a case study on Blister Packs for tablets/ toys/ stationery items (use internet/ magazines/ books)-b) Collect three samples and measure thickess at different places on the samples and note it.	2#	CO2
III	11	Perform vacuum packaging by model or portable vacuum packaging machine (Use magazines, books and internet)-Search and collect the information on the concept, process, raw material used.	2#	CO3
III	12	Perform vacuum packaging by model or portable vacuum packaging machine (Use magazines, books and internet)-Collect three samples and raw material used and perform vacuum packaging.	2#	CO3
IV	13	Carry out a case study on various styles of paperbags used in packaging (Use magazines, books and internet)- a) Search and collect the information on the concept, raw material, process, styles of paper bags.	2#	CO4
IV	14	Carry out a case study on various styles of paperbags used in packaging (Use magazines, books andinternet)- b) Collect three different types of paper bags, identify them and draw the labeled diagram.	2#	CO4
IV	15	Perform Creasing and slitting operationon Corrugated Fiber Board using creasing and slitting machine. a) Collect the information on the concept and process and applications, and prepare three samples	2#	CO4

IV	16	Perform Creasing and slitting operation on Corrugated Fiber Board using creasing and slitting machine. a)Perform Creasing and slitting operation on the prepared samples.	2#	CO4
V	17	Perform CFB box packaging manually-erection, loading and sealing-a) Search and collect the information on unitization, styles of corrugated boxes and box sealing methods and materials.	2#	CO5
V	18	Perform CFB box packaging manually-erection, loading and sealing-b)Collect the raw material to be used,perform packaging manually. Draw diagram and take pictures.	2	CO5
V	19	Carry out the package evaluation of any two styles of folding cartons-a) Collect information on the concept, process, raw material used, styles and their applictions.	2#	CO5
V	20	Carryout the package evaluation of any two styles of folding cartons-b)Collect three smples, identify the styles,measure dimension check and check for paper type.	2#	CO5
VI	21	Analyze the standard wooden pallets; Block class and Stringer class-a) Collect the information on the concept, raw material used for manufacturing, process, types and applications.	2#	CO6
VI	22	Analyze standard wooden pallets (Block class and Stringer class)- b)Analysis-Identifythe type,note physical measurements of each component of the pallets, draw the diagram.	2#	CO6
VI	23	Perform stretch wrapping by manually or by stretch wrapping machine - a) Collect the information on the concept, raw material used, process, advantages and applications.	2#	CO6
VI	24	Perform stretch wrapping by manually or by stretch wrapping machine - b) Identify the materials like the pallet, CFB boxes, stretch film and tools required and perform stretching wrapping.	2#	CO6
VI	25	Perform strapping operation on a corrruaged box using automatic strapping machine - a) Collect information on the concept, strapping process, types of strapping material used and applications.	2#	CO6

VI	26	Perform strapping operation on a corrruaged box using automatic strapping machine - b) Prepare corrugated box samples, staple and seal it, load strapping bundle, make necessary adustments and perform strapping on different settings.	2#	CO6
VI	27	Perform strapping operation on a corrruaged box using automatic strapping machine - c) Take pictures of workdone and write an report.	2	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	**10**
2	Regular Lab Performance	**10**
3	Record/Journal Submission (Quality of work / Neatness)	**10**
4	Viva Voce (During Sessions)	**10**
5	Internal Practical Test (Mock)	**10**
	TOTAL	**50**

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	10
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	10
3	Correctness and quality of result and execution	20
4	Viva Voce	10
	TOTAL	50

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	3	3	3	-	3	3	3	-
CO2	-	3	3	3	-	3	3	3	-
CO3	-	3	3	3	-	3	3	3	-
CO4	-	3	3	3	-	3	3	3	-
CO5	-	3	3	3	-	3	3	3	-
CO6	-	3	3	3	-	3	3	3	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Fundamentals of Packaging	F.A. Paine , The Institute of Packaging; Revised Ed edition, 1981.	13: 978-0950756707 10: 0950756709
2	Packaging Users Handbook	F.A. Paine , Springer, 1991.	13: 9780751401516 13: 978-1-4613-1483-7
3	The Wiley Encyclopedia of Packaging Technology.	Marilyn Bakker, John Wiley & Sons Inc. Canada	10: 0471-80940-3
4	Fundamentals of Packaging Technology	S. Natrajan, M. Govindrajan, B. Kumar, 2E, PHI LPL, 2014.	13: 978-81-203-5054-0
5	Packaging Machinery Operations Series	C. Glen Davis, PMMI, USA, 1991.	--

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8. http://contimeta.com/en/catalog/packaging-system/plastic-strap 21stDecember 2021.
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10. https://www.pinterest.com/pin/258745941064286677/ 5th December 2021.

XVI List of Major Equipment/Machineries with Specification:

1. Universal Testing Machine.
2. Cobb Tester.
3. Micrometer or Thickness Caliper.
4. Model /simulated/ portable liquid volumetric filling machine.
5. Model /simulated/ portable constant level filling machine.
6. Model /simulated/ portable machine of product filling by count.
7. Electronic weighing balance/ substance indicator
8. Model / simulated/ portable vacuum packaging machine.
9. Creasing and slitting machine.
10. Compression Tester.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
3	Mr. Subhash N. Madhugiri	Head of Department, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Lecturer in Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
5	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali Mohd Zeeshan MSM	Assistant Professor	Anjuman College of Engineering and Technology, Nagpur

(Mr. I. A. K. Syed)
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Member Sectretary PBOS, PK

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CO/IT/AE/MT/ PK/TX/TR/AI/MK
Course Category	:	VEC
Course Code	:	VE251H
Course Title	:	Environmental Sustainability

I Rationale:

This course aims to equip students with practical skills and knowledge necessary for promoting environmental sustainability in engineering practices. The focus will be on hands-on activities, real-world applications, and practical projects that address key areas of environmental sustainability.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Address environmental concerns and provide sustainable solutions.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** and plant native and drought-resistant tree species to enhance local biodiversity.

CO2: **Manage** different types of waste, and create effective collection and processing plans for recyclable materials.

CO3: **Analyse** environmental data such as temperature and CO2 levels, and present findings through graphs and reports.

CO4: **Implement** systems for rainwater harvesting, waste water minimization, and conduct audits.

CO5: **Develop** analytical and problem-solving skills to assess environmental practices and recommend improvements for sustainability.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	2	2	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	25	10	25	10	25	10

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
	1	Select and plant native and drought-resistant tree species to provide shade and cool the environment through evapotranspiration.	2#	CO1
	2	Prepare seed bomb and plant it in campus.	2#	CO1
	3	Develop a schedule and assign teams to take care of the planted trees.	2#	CO1
	4	Identify and document different species of flora and fauna.	2	CO1
	5	Categorize and quantify different types of waste generated in institute campus.	2#	CO2
	6	Create a collection and processing plan for recyclable materials.	2#	CO2
	7	Monitor the effectiveness of the segregation system and provide feedback.	2	CO2
	8	Prepare a solid waste management plan of your campus.	2#	CO2
	9	Develop composting plant for biodegradable waste of your campus.	2#	CO2
	10	Create graphs and reports on temperature and CO2 levels over time.	2	CO3
	11	Calculate the carbon footprint of the campus or individual students.	2#	CO3
	12	Design a rainwater harvesting system for any building in your campus.	2#	CO4

	13	Prepare a report on wastewater generation in any one building in your campus including comments to reduce it.	2#	CO4
	14	Conduct a simple energy audit in the classroom or home.	2#	CO5
	15	Analyse energy consumption and identify saving opportunities in any campus building / home..	2#	CO5
	16	Conduct a simple waste audit in the classroom or home.	2	CO5
	17	Analyse waste generation and identify reduction opportunities.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Organize a tree planting day on campus or in the local community.
2. Design and create useful items from waste materials, such as furniture from pallets or art from plastic bottles.
3. Create educational materials and conduct workshops on energy-saving practices.
4. Organize an awareness drive to educate peers and the community about global warming and its effects.
5. Install a small-scale rainwater harvesting system at home/campus and test its efficiency.
6. Prepare and Install bird feeders in appropriate location.
7. Organize a waste material collection drive in campus or in the local community.
8. Organize a energy conservation drive in campus or in the local community.

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Prepare SWM Plan / Audit / Graph	5
2	Performance / Observation	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Problem statement given to students	5
2	Performance / Observation	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	-	3	2	3	-	-
CO2	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	3	2	3	-	-
CO5	-	-	-	-	3	2	3	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A text book of Environmental Science.	Arvind Kumar	978-8176485906
2	Environmental Science	Y. K. Singh	81-224-2330-2
3	A text book of Environmental Science	Shashi Chawla, Tata McGraw-Hill Publication.	
4	Environmental Studies	Erach Bharucha, UGC, New Delhi	

XV e-References:

1. https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf. Accessed on 24 may 2024.
2. https://wbchse.wb.gov.in/storage/2024/03/ENVS_FINAL.pdf. Accessed on 24 may 2024.
3. https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/2015wess_ch5_en.pdf. Accessed on 24
4. https://dl1.cuni.cz/pluginfile.php/909144/mod_resource/content/1/Goodland_Environmental%20sustainability.pdf.Accessed on 25 may 2024.
5. https://egyankosh.ac.in/bitstream/123456789/85700/1/Unit-4.pdf. Accessed on 25 may 2024.
6. https://assets-global.website-files.com/5f10ce18aa01d050c26b7c5e/62bc04ffacfdfa6cab3fa9b9_Environment

XVI List of Major Equipment/Machineries with Specification:

1. Models of rain water harvesting.
2. Models / chart of biodiversity.
3. Models / charts of composting.
4. Models/ charts of carbon foot print.
5. Models / charts of environmental sustainability.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. D. K. Parbat	Head, Civil Engineering	Government Polytechnic, Nagpur
2	Mr. R. M. Walke	Lecturer, Civil Engineering	Government Polytechnic, Nagpur
3	Dr. B. R. Ambade	Lecturer, Civil Engineering	Government Polytechnic, Nagpur
4	Er. G. B. Takey	EE, Vigilance & Quality Control	PWD, Nagpur
5	Dr. Abhay Shende	Principal	J. L. Priyadarshini College of Engg, Nagpur
6	Dr. V. G. Kondekar	Head, Civil Engineering	Government Polytechnic, Sakoli

(Dr. D. K. Parbat)
HOD & Chairman PBOS, CE

(Dr. G. V. Gotmare)
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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/AE/MT/PK/TX/MK/AI
Course Category	:	INP
Course Code	:	IN251H
Course Title	:	Basic Internship

I Rationale:

The Basic Internship course provides diploma students in engineering with a four-week summer vacation internship opportunity after the second semester. The internship encompasses various inter/intra-institutional activities aimed at skill development, innovation, and professional growth. Students engage in practical experiences within institutional settings and are evaluated based on their daily activities documented in a diary.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply theory, engage in diverse learning, develop soft skills, document, and present internship experiences.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** theoretical knowledge in practical engineering challenges.

CO2: **Participate** in trainings, conferences, workshops, competitions, and institutional laboratories work to enhance learning.

CO3: **Develop** essential soft skills through training, workshops, conferences, competitions, and institutional laboratories work.

CO4: **Prepare** daily diaries and internship report for evaluation by faculty mentors.

CO5: **Present** internship report for evaluation by faculty mentors

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	2	6	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	-	-	-	-	50	20

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)	Topics and Sub-topics	Aligned Cos

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Introduction to Real-World Engineering Challenges - Identify internship project area, Identify common engineering problems in related fields of engineering (Electrical, Civil, Computer etc.), Discuss with mentor on the importance of practical application of theoretical knowledge.	6#	CO1
I	2	Internship area Selection and Planning - Select internship area based on interests and skill sets, set objectives, define scope, and identify resources.	6#	CO1
I	3	Hands-On Internship Work - Work on selected area under the guidance of faculty mentor, provide regular feedback to mentor on progress of Internship and take guidance as needed.	30#	CO1

II	4	Participation in Training and Skill Enhancement - Participate in trainings/ conferences/ workshops/ competitions/ institutional laboratories work.	30#	CO2
III	5	Soft Skills Development - Attend sessions focused on developing essential soft skills such as communication, teamwork, and problem-solving, perfom role-playing exercises, group discussions, and interactive activities to enhance interpersonal skills.	18#	CO3
IV	6	Daily Diaries and Internship Report Preparation - Maintain daily diaries documenting their activities, challenges faced, and lessons learned during the internship.	10#	CO4
IV	7	Progress Review and Presentation Preparation - Compile internship experiences and outcomes into a comprehensive presentation, conduct practice sessions to refine presentation skills and ensure clarity and professionalism in delivery, Prepare internship report for submission to faculty mentors in prescribed format	10#	CO4
V	8	Internship Report Presentation - Present internship reports and Internship outcomes to faculty mentors and peers, Demonstrate presentation skills, technical knowledge, and Internship outcomes.	10#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. During the summer vacations, after the 2nd Semester, students are required to be involved in:
2. Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Continuing Education Department.
3. Contribution at incubation/ innovation /entrepreneurship cell of the institute.
4. Participation conferences/ workshops/ competitions etc.
5. Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop.
6. Working for consultancy/ research project within the institutes.
7. Join family business, (a declaration by a parent may be submitted directly to the Head of the Department.)

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of Internship area	5
2	Work done and Feasibility of work	20
3	Report writing	15
4	Presentation Skills and Viva-Voce	10
	TOTAL	50

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	3	3	-	-
CO3	-	-	-	-	-	3	3	-	-
CO4	-	-	-	-	1	3	3	-	-
CO5	-	-	-	-	-	3	3	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Soft Skills: Enhancing Personal and Professional Success	Dr. Soma Mahesh Kumar, McGraw Hill, first edition, 2023	ISBN 13 - 978-9355325259
2	Communication Skills For Engineers	Muralikrishna and Sunita Mishra, Pearson Education India, Second Edition, 2011	ISBN 13 - 978-8131733844
3	AICTE Internship Policy: Guidelines & Procedures	All India council of Technical Education New Delhi	-

XV e-References:

1. https://internship.aicte-india.org/ assessed on 23rd April 2024
2. https://www.coursera.org/articles/computer-science-internships assessed on 23rd April 2024

XVI List of Major Equipment/Machineries with Specification:

1. Desktop computers
2. Laser Printer
3. DLP

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M.B.Daigavane	Principal	Government Polytechnic, Nagpur
2	Dr. M. V. Sarode	HoD, Computer Engineering and I/C Trainining & Placement Officer	Government Polytechnic, Nagpur
3	Dr. G. V. Gotmare	I/C Curricullum Development Cell	Government Polytechnic, Nagpur

(Dr. M. V. Sarode)
HOD & Chairman PBOS, CM

(Dr. G. V. Gotmare)
Member Sectretary PBOS, CM

GE Courses

Sem: III

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in ME/EE/EC/CM/IT/PK/MT/AE/MK/TX/AI
Course Category	:	GE
Course Code	:	CE291H
Course Title	:	Civil Engineering Practices

I Rationale:

The engineering students should know the facts, concepts, principles and procedures in civil engineering. This course describes the basic knowledge related to civil engineering. It is very useful course for the students to visualize the Civil Engineering structures which helps to engineering students in their professional and personal life.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use basic engineering Knowledge to solve the problems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** different types of buildings and their components.

CO2: **Identify** tools and Equipment used in construction activity.

CO3: **Identify** different components of Civil Engineering structures like Roads, Bridges, Railway Track.

CO4: **Identify** various components of Irrigation structures.

CO5: **Draw** flow diagram showing components of Water Supply Scheme & STP.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Building Construction	1a	Identify the components of building with its function.	1.1	Components of Building - Foundation, Column, Beam, Plinth, DPC, Sill, Lintel, Chajja, Slab, Doors, Windows, Parapet, Stair.	CO1
	1b	Select the type of equipment for a given situation.	1.2	Tools & Equipments used - Hand tools; screwdrivers, brushes, trowels, wrenches, knives, crimpers, clamps, Trolleys etc. Power tools: Concrete mixers, saws, cutters, drills, grinders, guns, breakers, Concrete lift, vibrater, tower crane etc.	
	1c	Compare between load bearing and frames structure with given parameters.	1.3	Load bearing structures - Definition, Its components and use. Framed structure - Definition, Its components and use.	
/s	2a	Classify the roads.	2.1	Classification of roads (Nagpur plan and Lucknow plan), Urban Roads.	

UNIT II: Highway	2b	Identify the given cross section of road and its componenets.	2.2	Cross section of road showing its component as per IRC. Road margin, road formation, right of way, Kerbs.	CO2
	2c	Select the type of road in given situation.	2.3	Various technical terms- Camber, super elevation, curves, pavements and its types, road intersections.	
UNIT III: Bridge and Railway	3a	Identify the components of bridge with its functions.	3.1	Bridge - Definition, Component of Bridge and its function. Classification of bridges.	CO3
	3b	Mention the importance of given basic terms in bridge engineering	3.2	Basic terms: Scour, Afflux, Runoff, Economic Span, Clearance, and Freeboard.	
	3c	Mention the importance of given basic terms in bridge engineering	3.3	Rail track cross sections – standard cross section of Broad Gauge (BG) and Meter Gauge (M.G), Single and double line in cutting and embankment. Metro rail and Mono Rail – types, factors affecting selection.	
	3d	Select a rail gauge to be used under given situation with justification.	3.4	Component parts of Permanent ways - rails, sleepers, rail joints, ballast and fixtures.	
: Irrigation Engineering	4a	Justify the Scope and development of irrigation in India.	4.1	Definition of irrigation Concept, Necessity, Scope and development of irrigation in India. Hydrological Cycle, Types of irrigation schemes, single & multipurpose projects.	CO4
	4b	Classify irrigation scheme for given condition.	4.2	Crops and cropping seasons in Maharashtra- Kharif, Rabi, Hot weather & Perennial.	

UNIT IV	4c	Draw a labeled sketch of dams for given condition	4.3	Dams and its classification- Gravity and Earthen dams, their components, Bandhara, weirs, Barrages, Sprinkler and drip irrigation.	
UNIT V: Public Health Engineering	5a	Identify the impurities present in water and it's classification.	5.1	Surface and subsurface sources of water, water borne diseases, Impurities present in water and it's classification.	CO5
	5b	Identify the given units of water treatment plant.	5.2	Treatment of water, various units in Water Treatment Plant (WTP) and their function	
	5c	Identify the given units of sewage treatment plant and house drainage system.	5.3	House drainage system, sanitary fittings, Generation of wastewater. Treatment of waste water, its units and their functions.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the various components of buildings with sketches / images.	02#	CO1
I	2	Prepare a report on tools and Equipment used in construction activity.	02#	CO2
I	3	Identify Load Bearing & Framed structures in the vicinity of area and prepare a report.	02#	CO1
II	4	Sketch the labeled cross section of roads mentioning various components and elements.	02#	CO3
II	5	Identify various types of roads in your area and prepare a report.	02#	CO3
III	6	Draw the labeled sketch of bridge mentioning functions of component parts.	02#	CO3
III	7	Identify various types of bridges in your area and prepare a report.	02#	CO3
III	8	Draw a labeled sketch of Railway Track mentioning the function of components.	02#	CO3
III	9	Identify various types of railway tracks in your area and prepare a report.	02#	CO3
IV	10	Identify various crops and cropping seasons in your area and prepare a report.	2	CO4
IV	11	Draw the sketches of various types of Dams with their circumstances .	02#	CO4
IV	12	Prepare a report on various methods of Irrigation.	02#	CO4
V	13	Draw flow diagram of water supply scheme & identify the various processes involved in it.	02#	CO5
V	14	Prepare a report on House drainage system.	02#	CO5
V	15	Draw flow diagram of sewage treatment plant & identify the various processes involved in it.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. NIL

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Building Construction	6	C	04	04	04	12
			O	00	00	00	0
2	Highways	6	C	04	04	04	12
			O	00	00	00	0
3	Bridge and Railway	6	C	04	06	06	16
			O	00	00	00	0
4	Irrigation Engineering	6	C	04	06	06	16
			O	00	00	00	0
5	Public Health Engineering	6	C	02	06	06	14
			O	00	00	00	0
Total		30	C	18	26	26	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q1 to Q35	1R2	1R2	1U2	1U2	1A2	1A2	2R2	35/35	
	2R2	2U2	2U2	2A2	2A2	3R2	3R2		
	3U2	3U2	3U2	3A2	3A2	3A2	4R2		
	4R2	4U2	4U2	4U2	4A2	4A2	4A2		
	5R2	5U2	5U2	5U2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment	5
2	Performance / Observation	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	-	-	2	3	-	-
CO2	-	-	-	-	-	2	3	-	-
CO3	-	-	-	-	2	2	3	-	-
CO4	-	-	-	-	2	2	3	-	-
CO5	-	-	-	-	3	2	3	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Building Construction	Rangwala, Charotar Publishing House Pvt. Ltd., 33rd Edition,2015	978-93-85039-04-1
2	Transportation Engineering	V.N.Mittal, Arvind Mittal, McGraw Hill Education Pvt. Ltd, Reprint, 2011	13: 978-0-07-059357-2
3	Irrigation Engineering	S.K.Bhattacharya and K.M.Rastogi., New Age International Publisher, Reprint, 2009.	978-81-224-1042-6
4	Environmental Engineering	S.G.Tarnekar and P.K.Kharbanda, S.Chand& Company Ltd., Third, 1990	13: 978-8121901048
5	Civil Engineering Through Objective Type Questions.	Gupta S. P. 4th Ed.	ISBN-10 : 8123907974 13 : 978-8123907970

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1. https://www.sanfoundry.com/1000-basic-civil-engineering-questions-answers/#google_vignette.Accessed on 24 May 2024.
2. https://www.grabstudy.com/Civil/Civil-Engineering.php. Accessed on 24 May 2024.
3. https://www.scribd.com/document/369866732/100-Civil-Engineering-Objective-Type-Questions. Accessed on 25 May 2024.
4. https://www.researchgate.net/publication/355183897_CIVIL_ENGINEEING_OBJECTIVE_TYPE_QUESTIONS_AND_ANSWERS_FOR_COMPETITIVE_EXAMS. Accessed on 25 May 2024.

XVI List of Major Equipment/Machineries with Specification:

1. Models of building components.
2. Models of roads.
3. Models of bridges.
4. Models of Irrigation structures.
5. Models of Water and sewage treatment.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. D. K. Parbat	Head, Civil Engineering	Government Polytechnic, Nagpur
2	Mr. R. M. Walke	Lecturer, Civil Engineering	Government Polytechnic, Nagpur
3	Dr. B. R. Ambade	Lecturer, Civil Engineering	Government Polytechnic, Nagpur
4	Er. G. B. Takey	EE, Vigilance & Quality Control	PWD, Nagpur
5	Dr. Abhay Shende	Principal	J. L. Priyadarshini College of Engg, Nagpur
6	Dr. V. G. Kondekar	Head, Civil Engineering	Government Polytechnic, Sakoli

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Member Sectretary PBOS, CE

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/EE/EC/AE/CM/IT/MK/AI/TX/PK/MT
Course Category	:	GE
Course Code	:	ME291H
Course Title	:	Elements of Mechanical Engineering.

I Rationale:

This course is generic elective course. This course describes elementary knowledge related to mechanical engineering, which are commonly used in any discipline of Engineering & Technology. This course will help the students to gain the basic knowledge of mechanical tools, power transmission, brakes, bearing, boiler, I. C. Engine, refregeration and air coditioning which will be helpful to them when they will go to the world of work.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge of Mechanical Engineering.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** the components of transmition systems.

CO2: **Interpret** the working of braking systems and bearing.

CO3: **Recognize** the Engine parts and working of I.C.Engines.

CO4: **Interpret** the working of boilers along with their mountings and accessories

CO5: **Use** proper maintenance tools according to the situaion

CO6: **Interpret** the working of refrigeration and air conditionig.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Power Transmission	1a	Suggest the application of given type of Belt drive.	1.1	Flat belt, V- belt, timing belt and its advantages & applications.	CO1
	1b	Suggest the application of given type of drive.	1.2	Chain drives, Rope drive Advantages & Disadvantages and applications.	
	1c	Justify the application of given type of Gear Drives.	1.3	Spur gear terminology, types of gears and gear trains, their selection for different application	
UNIT II: Brakes and Bearings.	2a	Identify the application of different types of brakes.	2.1	Function of brakes, types of brakes, Construction and working of i) shoe brake, ii) Band Brake, iii) Internal expanding shoe brake iv) Disc Brake. Various application of brakes.	CO2
	2b	Choose the proper Bearings for different conditions.	2.2	Bearings types - i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot.	

UNIT III: Internal Combution Engines	3a	Justify the need of given IC Engine .	3.1	Internal combustion engine: Necessity, Components and terminologies of I.C.engine. Classification & Fuels used for I.C. Engines, Applications of I.C. Engines.	CO3
	3b	Justify the use of given IC Engine for particular application	3.2	Construction, working principle & applications of Two stroke & four stroke engines. (Petrol & Diesel)	
	3c	Compare given types of engines on the basis of given parameters.	3.3	Comparison between: i)Two stroke & Four stroke engine ii) S.I. Enaine & C.I. Engine.	
UNIT IV: Boilers.	4a	Classify given types of boiler.	4.1	Classification of boilers fire tube boiler, water tube boiler advantages disadvantages.	CO4
	4b	Identify the different boiler Mountings and accessories.	4.2	Boiler Mountings and Accessories (Sketch, location and function)	
	4c	Identify the parts of La-Mount Boiler, Benson Boiler.	4.3	Construction and working of La-Mount Boiler, Benson Boiler.	
V: Maintenance Tools	5a	Compare given type of tools on given points.	5.1	Cutting tools- files, drills, chisels, hacksaws- their types, specifications, applications & precautions while handling.	CO5
	5b	Justify the application of given maintenance tool.	5.2	Hammering tools- hammers, mallets- their types, specifications, applications & precautions while handling.	
	5c	Illustrate given maintenance tools with sketches.	5.3	Maintenance tools- screw drivers, pliers, spanners, wrenches- their types, specifications, applications & precautions while handling.	

UNIT V	5d	Identify the given Pneumatic tools.	5.4	Principle of working of Pneumatic tools, pneumatic tools like pneumatic drill and screw driver, air impact wrench, pneumatic staple gun,grease gun, brad nailer.	
	5e	Identify the given fasteners.	5.5	Fasteners (Nut, Bolt & Screws), their use and specification.	
UNIT VI: Refrigeration and Air conditioning System.	6a	Classify given type of Refrigeration system.	6.1	Clasification of Refrigeration system, vapour compresion system, Air absortion system. Construction and working of vapour compresion refrigeration system.	CO6
	6b	Identify application of Refrigeration system.	6.2	Various application of refrigeration in indusries.	
	6c	Identify the different components of air conditioning system.	6.3	Requirements of air conditioning systems. Working of Compressor, condenser, Expansion valve, Evaporator.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify various drives used in transmission system.	2#	CO1
II	2	Identify various types of brake.	2#	CO2
II	3	Identify various types of bearing.	2	CO2
II	4	Identify the parts of internal exponding brake.	2#	CO2
II	5	Identify the parts of disc brake .	2#	CO2
III	6	Identify the parts of I.C.Engine and run it.	2	CO3
III	7	Identify the parts of S.I..Engine and run it.	2#	CO3
III	8	Identify the difference between S.I. and C.I.Engine.	2#	CO3
IV	9	Identify the various type of boilers.	2#	CO4
IV	10	Identify various mountings of boiler.	2#	CO4
IV	11	Identify the parts of La-Mount Boiler.	2	CO4
V	12	Identify Fasteners (Nut, Bolt & Screws) and write its specifications.	2#	CO5
V	13	Identify various Cutting tools- files, drills, chisels, hacksaws- their types and write its specifications.	2#	CO5
VI	14	Identify different components of air conditioning systems.	2#	CO6
VI	15	Identify various components of vapour compression refrigeretion system.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Power Transmission	4	C	02	04	04	10
			O	00	00	00	0
2	Brakes and Bearings.	6	C	04	04	04	12
			O	00	00	00	0
3	Internal Combution Engines	6	C	02	04	06	12
			O	00	00	00	0
4	Boilers.	4	C	02	04	04	10
			O	00	00	00	0
5	Maintenance Tools	6	C	02	04	06	12
			O	00	00	00	0
6	Refrigeration and Air conditioning System.	6	C	04	06	04	14
			O	00	00	00	0
Total		32	C	16	26	28	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q1 to Q35	1R2	1U2	1U2	1A2	1A2	2R2	2R2	35/35
	2U2	2U2	2A2	2A2	3R2	3U2	3U2	
	3A2	3A2	3A2	4R2	4U2	4U2	4A2	
	4A2	5R2	5U2	5U2	5A2	5A2	5A2	
	6R2	6R2	6U2	6U2	6U2	6A2	6A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing and selection of equipment.	5
2	Writing procedure.	10
3	Working of equipment.	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	1	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-
CO5	3	-	-	1	-	-	1	-	-
CO6	3	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Elements of Workshop Technology-vol.1	S.K. Hajra Choudhary, A.K. Hajra Choudhary, Media Promotors & Publishers Pvt. Ltd., Mumbai.	13: 9780906216019
2	Mechanisms and Mechanical Devices	Neil Sclater, Mc-Graw Hill Education.	13: 9780071704427
3	A Textbook Of Thermal Engineering	R.S. Khurmi, J.K. Gupta, S. Chand & Company Ltd., New Delhi.	13: 9788121925730
4	Refrigeration and Air conditioning	R. S. Khurmi, S.Chand & Company Pvt. Ltd	13: 9788121927819

XV e-References:

1. https://www.youtube.com/watch?v=BaEHVpKc-1Q,accessed on 23th May, 2024
2. https://www.youtube.com/watch?v=qbyL--6q7_4, accessed on 25th May, 2024

XVI List of Major Equipment/Machineries with Specification:

1. Different types of belt
2. Different types of gears.
3. Different types of chain.
4. Model of shoe brake
5. Internal expanding brake
6. I.C.Engine test rig.
7. Boiler model
8. Mechanical tools, fasteners.
9. Refregeration test rig.
10. Air conditioning test rig.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr.S.R.Kaduskar	I/C Head of Mech. Department	Government Polytechnic, Nagpur
2	Mr.N.J.Burbure	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
3	Mr.N.E.Pise	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
4	Dr.M.M.Pawade	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
5	Mr.A.R.Sheikh	Director	A.R.Automation, Jafer Nager, Nagpur
6	Mr.G.F.Potbhare	Principal	NIT Polytechnic, Nagpur
7	Mr.G.H.Dahole	I/C Head of Mech. Department	Government Polytechnic, Gondia.

(Mr. S. R. Kadusksr)
HOD & Chairman PBOS, ME

(Dr. G. V. Gotmare)
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GOVERNMENT POLYTECHNIC, NAGPUR
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EC/CM/IT/AI/PK/MT/MK/TX/AE
Course Category	:	GE
Course Code	:	EE291H
Course Title	:	Electrical Generation, Transmission and Distribution

I Rationale:

This NEP-aligned multidisciplinary elective course equips diploma engineering students with essential knowledge in electrical engineering, covering fundamental concepts, principles, and procedures. It includes the basics of electrical generation, transmission, and distribution. This course offers a comprehensive foundation, fostering a well-rounded understanding crucial for various engineering disciplines, in line with the NEP's vision for holistic and interdisciplinary education.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge of basic electrical engineering.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** basic laws of Electrical Engineering to solve basic DC circuits.

CO2: **Measure** various electrical quantities in AC circuit.

CO3: **Identify** various system in electrical power generation.

CO4: **Identify** various components in electrical power trasnmission system.

CO5: **Identify** various components in electrical distribution system.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
T I: Fundamentals of Electricity.	1a	Differentiate between given electrical parameters.	1.1	Concept of electric charge, current, voltage drop, EMF, potential difference, direction of current and their SI units. Resistance, unit of resistance, law of resistance (Factors affecting resistance), Effect of temperature on resistance, Ohms law.	CO1
	1b	Solve given electric circuit.	1.2	Resistance in series and parallel, properties of series circuit and parallel circuit, voltage distribution in series circuit, Current distribution in parallel circuit, equivalent resistance of series circuit, equivalent resistance of parallel circuit. Applications of series circuits and parallel circuits. Kirchhoff's current and voltage law.	

UNI	1c	Suggest the measuring instrument for measuring given electrical quantity.	1.3	Work, power, energy and their SI units, Relation between H.P and watts, Kwh and Kcal. Connection of ammeter, voltmeter and wattmeter in single phase AC circuit and its measurement.	
	1d	Compare given supply on a given parameter.	1.4	Concept of AC and DC supply comparison between AC and DC supply.	
UNIT II: AC Fundamentals	2a	Compare the given generation on basis of given points.	2.1	Generation of alternating voltage- single phase and three- phase.	CO2
	2b	Identify the different terminologies related to AC supply.	2.2	Equation of sinusoidal alternating voltage and current, important terminology such as- waveform, instantaneous value, cycle, time period, frequency, amplitude, Relation between time period and frequency, angular velocity and frequency, frequency and speed. Maximum, average and R.M.S. value of sinusoidal waveform, form factor and peak factor.	
	2c	Compare the given types of loads.	2.3	AC voltage applied to pure resistor, pure inductor, and pure capacitor. Concept of reactance, impedance and power factor, power in single phase circuit.	
	2d	Classify the different types of induced electromotive force.	2.4	Faraday's laws of electro-magnetic induction, Basic construction of transformer, Lenz's law, Fleming right hand rule, Induced EMF, statically induced EMF, dyanamically induced EMF, self-inductance, mutual-inductance.	
	2e	Compare the different types of induced EMF.	2.5	Dynamically and statically induced EMF, self and mutual induced Electromotive force and its inductances.	

UNIT III: Electrical Power Generation	3a	Identify the blocks of given power plants.	3.1	General layout, working and site selection of thermal power plant, hydroelectric power plant and nuclear power plant.	CO3
	3b	Identify different types of renewable energy sources.	3.2	Renewable energy sources- Solar Energy, wind Energy and its block diagram.	
	3c	Compare given power stations on the basis of given points.	3.3	Comparison between different generating stations with respect to sources of energy, site, initial cost, and running cost, pollution, efficiency, maintenance and stand by losses.	
UNIT IV: Electrical Power Transmission	4a	Classify transmission line on basis of given data.	4.1	Need of high voltage line, classification of transmission lines: on the basis of voltage and line length, single line diagram.	CO4
	4b	Compare different types of conductors.	4.2	Transmission Line Parameters, types of conductors (single and double circuits - solid, stranded and bundled conductors)	
	4c	Identify different effects related to transmission line.	4.3	Skin effect, Ferranti effect and Proximity effect.	
	4d	Suggest suitable components of given transmission line.	4.4	Conductors- desirable properties, types- copper, all aluminum (AAC), all-aluminum alloy. Line insulators: desirable properties of insulator materials, selection of material, types of insulators (For transmission and distribution lines), applications, causes of insulator failure.	
uition.	5a	Identify the different component of distribution line.	5.1	Introduction, feeders, distributor and service lines. Construction of overhead distribution lines, earth wire, guarding.	

UNIT V: Electrical Power Distrib	5b	Classify different distribution schemes on basis of given points.	5.2	Primary distribution systems & Secondary distribution systems, Types of different distribution schemes: Radial, ring mains and grid, layout, advantages, limitations & applications.	CO5
	5c	Identify given components of substation.	5.3	Introduction, classification of substations according to service & location, typical single line connection diagrams of substation layouts, 11 KV/0.415 KV pole mounted distribution substation.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Connect voltmeter, ammeter and wattmeter in electrical circuit.	2#	CO1
I	2	Measure the current, voltage and resistance with the help of multi-meter or tong tester.	2#	CO1
I	3	Calculate unknown resistance of DC series and parallel circuits.	2#	CO1
I	4	Calculate unknown parameter in electrical circuit using KCL & KVL.	2#	CO1
II	5	Calculate transformation ratio of single phase transformer.	2#	CO2
II	6	Find current response of pure resistive/ inductive/ capacitive circuit.	2	CO2
II	7	Measure power in single phase AC circuit.	2#	CO2
III	8	Identify the parts of nuclear fired thermal power plant after watching a video programme.	2#	CO3
III	9	Identify the parts hydroelectric power plant after watching a video programme.	2	CO3
III	10	Draw a schematic of micro hydro power plant.	2#	CO3
III	11	Identify the different components of solar PV system.	2#	CO3
IV	12	Identify different types of transmission and distribution line supports. Prepare report and draw it on sketch book.	2#	CO4
IV	13	Identify different types of overhead line insulators. Prepare report and draw it on sketch book.	2#	CO4
V	14	Prepare a visit report of 132 KV substation.	2	CO5
V	15	Prepare a visit report of 11 KV substation.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Fundamentals of Electricity.	4	C	02	04	04	10
			O	00	00	00	00
2	AC Fundamentals	6	C	02	06	04	12
			O	00	00	00	00
3	Electrical Power Generation	6	C	04	06	06	16
			O	00	00	00	00
4	Electrical Power Transmission	7	C	04	06	06	16
			O	00	00	00	00
5	Electrical Power Distribuition.	7	C	04	06	06	16
			O	00	00	00	00
Total		30	C	16	28	26	70
			O	00	00	00	00

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q. 01 to Q.35	1R2	1U2	1U2	1A2	1A2				35/35
	2R2	2U2	2U2	2U2	2A2	2A2			
	3R2	3R2	3U2	3U2	3U2	3A2	3A2	3A2	
	4R2	4R2	4U2	4U2	4U2	4A2	4A2	4A2	
	5R2	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	1	-	-	1	-	-
CO2	3	-	-	1	-	-	1	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Text Book on Laboratory Courses in Electrical Engineering	S.G.Tarnekar and P.K.Kharbanda, S.Chand & Company Ltd., Third, 1990	13: 978-8121901048
2	A Textbook of Electrical Technology Vol-I	B.L.Theraja, A.K.Theraja, S.Chand & Co Ltd., Reprint, 2006	10: 81-219-2440-5
3	Generation Of Electrical Energy	B.R.Gupta, Eurasia Publishing House (Pvt.) Ltd, Third Edition, 1996.	10: 81-219-0102-2
4	Principles Of Power System	V.K. Mehta, S.Chand & Co.Ltd, Reprint, 1996.	10: 81-219-0594-X

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4. https://www.youtube.com/watch?v=bfR0k0BJeBE , accessed on 10th May , 2024
5. https://www.youtube.com/watch?v=A9sRsIghUxY ,accessed on 10th May , 2024
6. https://library.automationdirect.com/basic-electrical-theory/ , accessed on 10th May , 2024

XVI List of Major Equipment/Machineries with Specification:

1. Ammeter MI 0-5-10
2. Voltmeter MI 0-150-300 V
3. Wattmeter 0-1000 W
4. Digital Multi-meter 3 ½ digits
5. Single phase auto transformer 0-240 Volts, 16A
6. Rheostat assorted sizes 10 Ohm, 50 Ohm

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M. B. Daigavane	Principal	Government Polytechnic, Nagpur
2	Dr. P. M. Daigavane	HOD, Electrical Engineering	G.H.Raisoni College of Engg, Nagpur
3	Mrs. Divya Piparode	Sr. Engineer	Powergrid Corporation of India Ltd. Nagpur
4	Mr. M. N. Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
5	Dr. G. V. Gotmare	I/C HOD, Electrical Engineering	Government Polytechnic, Nagpur
6	Mr. A. P. Dasarwar	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur

(Mr. M. C. Musale)
HOD & Chairman PBOS, EE

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Member Sectretary PBOS, EE

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/CM/IT/PK/AI/MT/MC/AE/TX
Course Category	:	GE
Course Code	:	EC291H
Course Title	:	Analog and Digital Electronics

I Rationale:

Analog and Digital Electronics form the foundation of modern electronic systems. Analog electronics deals with continuous signals and voltage levels, while digital electronics focuses on discrete signals and binary numbers. Students learn about to integrate analog and digital circuits to create electronic systems that meet specific requirement. Analog and Digital Electronics interface with various engineering disciplines. Students develop a multidisciplinary approach to problem solving and gain knowledge about electronic devices.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge of electronic components and circuits.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** given type of active and passive components for specific application.

CO2: **Choose** appropriate type of rectifier and filter.

CO3: **Select** given type of operational amplifiers.

CO4: **Implement** the basic logic gates using universal gates.

CO5: **Use** combinational and sequential logic circuits.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Active and Passive Components	1a	Identify the components from given types of components.	1.1	Active components - Definition and types, Passive components Definition and types	CO1
	1b	Classify the given types of passive components.	1.2	Passive components- Symbol, properties and applications of resistor, capacitor and inductor. Types of Resistors, Types of Capacitors, Types of Inductor	
	1c	Select given type of active component as per application.	1.3	Active components - Symbol of Diode and transistor. Diodes - Introduction and symbol of PIN diode, Varactor diode, Tunnel diode, Zener diode, LED a Photo diode.	
	1d	Interpret the working of given PN junction diode.	1.4	Diodes - Basic construction of PN junction diode, formation of PN junction, Depletion layer, Advantages, Disadvantages and applications.	

	1e	Choose given type of transistor.	1.5	Transistor - Basic construction of NPN and PNP transistor, Working principle, Advantages, Disadvantages and applications.	
UNIT II: Rectifiers and Filters	2a	Classify given type of rectifier.	2.1	Definition of rectifier.Types of rectifier–Half wave rectifier, Full wave center tapped rectifier, Full wave bridge rectifier.	CO2
	2b	Draw input and output waveforms of given rectifier.	2.2	Half wave rectifier– Circuit diagram, Waveforms, working principle, advantages and disadvantage.	
	2c	Choose given type of full wave rectifier as per requirement.	2.3	Full wave rectifier- Circuit diagram, Waveforms, working principle, advantages and disadvantages of center-tapped full wave rectifier and full wave bridge rectifier.	
	2d	Illustrate the working principle of given filter.	2.4	Definition and types of filter. Filters- Circuit diagram and working principle of series inductor, shunt capacitor, LC filter, PI filter.	
UNIT III: Operational Amplifiers	3a	Identify given symbol of operational amplifier.	3.1	Introduction to Op-amp, OP-amp symbol and terminals, Equivalent circuit.	CO3
	3b	Interpret the pin diagram and functions of given op-amp I.	3.2	Operational amplifier IC 741 – Pin diagram and pin function.	
	3c	Illustrate the working of given block diagram.	3.3	Block diagram of Operational amplifier and function of all stage.	
	3d	Select given type of operational amplifiers.	3.4	Circuit diagram and working principle of Inverting amplifier and Non Inverting amplifier.	
	3e	Select operational amplifier for given applications	3.5	Circuit diagram and working principle of Adder and subtractor	
: Gates	4a	Compare analog and digital systems on given points.	4.1	Introduction to digital signal, Advantages of Digital System over analog systems.	

UNIT IV: Number System and Logic	4b	Differentiate given number systems.	4.2	Number Systems: Different types of number systems Decimal, Binary, Octal, Hexadecil.	CO4
	4c	Identify given logic gates.	4.3	Logic gates: Basic gates – AND, OR, NOT gate. Derived Gates – NAND, NOR, EX- OR, EX-NOR gate.	
	4d	State the De Morgan's theorems.	4.4	De Morgan's theorems. Statement and Proof.	
	4e	Implement given basic logic gate using universal gates.	4.5	Universal Gates: NAND and NOR as Universal gate. Implementation of basic logic gates using NAND an NOR gate.	
UNIT V: Combinational and Sequential Circuits	5a	Design given K-maps.	5.1	Karnaugh Map representation of Logic Functions using Truth table (2 variables, 3 variables, 4 variables) Canonical SOP and POS and Don't Care condition.	CO5
	5b	Illustrate the working of given multiplexer and demultiplexer.	5.2	Multiplexers (MUX) and De-multiplexer (DEMUX): Block diagram, truth table, logic expression and logic diagram of 2:1, 4:1 MUX and 1:2,1:4 DEMUX.	
	5c	Distinguish given flip flops.	5.3	Flip Flops - S R Flip flop, JK flip flop, D-Type flip-flop, T-Type flip flop (Block diagram, truth table and logical expression and application.	
	5d	Select given shift register for specific applications.	5.4	Introduction to Registers, Types of Shift Registers, Applications of Shift register.	
	5e	Classify given types of counter.	5.5	Classification and applications of counter.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify various active and passive components.	2#	CO1
I	2	Test resistor, capacitor and inductor using digital multimeter and LCR-Q meter	2#	CO1
I	3	Test PN junction diodes using digital multimeter.	2#	CO1
I	4	Test transistors using digital multimeter.	2	CO1
II	5	Build the half wave rectifier circuit on breadboard and draw input-output waveforms.	2#	CO2
II	6	Build the full wave bridge rectifier circuit with PI filter on breadboard and draw input-output waveforms.	2#	CO2
III	7	Build inverting amplifier circuit on breadboard and observe input-output waveforms on CRO.	2#	CO3
III	8	Build non-inverting amplifier circuit on breadboard and observe input-output waveforms on CRO.	2#	CO3
IV	9	Test the behaviour of different logic gates by using truth table.	2#	CO4
IV	10	Assemble various basic gates using universal gates and relate it with truth table.	2#	CO4
V	11	Build and test the functions of MUX IC 74151.	2#	CO5
V	12	Build and test the functions of DEMUX IC 74155.	2#	CO5
V	13	Construct and test functions of D flip flop using IC 7476.	2#	CO5
V	14	Construct and test functions of T flip flop using IC 7476.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Active and Passive Components	6	C	04	04	04	12
			O	0	0	0	0
2	Rectifiers and Filters	5	C	02	08	04	14
			O	0	0	0	0
3	Operational Amplifiers	6	C	02	08	04	14
			O	0	0	0	0
4	Number System and Logic Gates	6	C	04	06	04	14
			O	0	0	0	0
5	Combinational and Sequential Circuits	7	C	02	08	06	16
			O	0	0	0	0
Total		30	C	14	34	22	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
1	1R2	1R2	1U2	1U2	1A2	1A2	2R2	35/35
2	2U2	2U2	2U2	2U2	2A2	2A2	3R2	
3	3U2	3U2	3U2	3U2	3A2	3A2	4R2	
4	4R2	4U2	4U2	4U2	4A2	4A2	5R2	
5	5U2	5U2	5U2	5U2	5A2	5A2	5A2	
6								

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Drawing circuit diagram, selection of equipment	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	3	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	-	-	3	-	-	3	-	-
CO5	3	-	-	3	-	-	3	-	-
CO6	3	-	-	3	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Principles of Electronics	V. K. Mehta, S. Chand & Company Ltd., Reprint, 1996	10: 8121910536
2	Electronic Principles	A.P. Malvino, Tata McGraw Hill, 8th edition	13: 9780073373881
3	Applied Electronics	R. S. Sedha, S. Chand & Co, revised edition, 2013	10: 8121927838, 13: 97881219 27833
4	Digital Integrated Electronics	Herbert Taub (Author), Donald L. Schilling, McGraw-Hill Inc, 1977	10: 0070857881 13: 9780070857889
5	Digital Principles and Application	Malvino, Albert Paul; Leach, Donald P., Mcgraw-Hill, 1986	10:0070398836 13: 9780070398832
6	Modern Digital Electronics	R.P.Jain, McGraw Hill Education (India) Private Limited, 2009	10: 0070669112 13: 9780070669116

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6. www.electrical4u.com/digital-electronics , accessed on 25th May 2024.
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XVI List of Major Equipment/Machineries with Specification:

1. Digital Multi-meter.
2. Cathode ray oscilloscope- 0 to 30MHz.
3. Function Generator–0-5MHz.
4. Regulated Power Supply - 0-30 V
5. Photodiode, Varactor diode, Tunnel diode, Zener diode.
6. Logic Gates ICs (7400,7402,7404,7408,7432,7486)
7. Multiplexer and De multiplexer IC (74150,74151,74138,74139)
8. Flip Flops ICs (7472,7474,74H71,74L71)
9. Breadboard and LEDs

XVII List of Industry Experts and Faculties who contributed for this curriculum:

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1	Dr. R. V. Yenkar	HOD, Electronics & Telecomm. Engg.	Government Polytechnic, Nagpur
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3	Mrs. R.R.Vairagade	Lecturer, Electronics & Telecomm. Engg	Government Polytechnic, Nagpur
4	Mrs. J.A.Raut	Lecturer, Electronics & Telecomm. Engg	Government Polytechnic, Nagpur
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6	Dr. V. J. Dongre	HOD, Electronics & Telecomm. Engg.	Government Polytechnic, Arvi
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(Dr. R. V. Yenkar)
HOD & Chairman PBOS, EC

(Dr. G. V. Gotmare)
Member Secretary PBOS, EC

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/PK/MT/MC/AE/TX
Course Category	:	GE
Course Code	:	IT291H
Course Title	:	Applied Multimedia Techniques

I Rationale:

Multimedia provides the benefit of interactive learning. Multimedia is utilized in various fields including education, entertainment, communication, game design, and digital art, reflecting its broad impact on modern technology and media to create presentations and visualization extensively. This course aims to produce graduates with a versatile skill set, ready to tackle the challenges posed by multimedia-rich environments in various professional settings and also used in various fields like education, training, reference material, business presentations, advertising and documentaries.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use various multimedia tools and software for various application.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** variety of multimedia tools and software for image editing efficiently.

CO2: **Use** vector graphics to design various tools like 2D,3D rendering images and logos orderly.

CO3: **Apply** the skills of multimedia presentation software to create user interfaces for improved user experiences.

CO4: **Apply** multimedia techniques for data visualization, effectively communicating complex information through interactive elements.

CO5: **Apply** the multimedia concepts for capturing photographs to provide improved visualization.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	-	-

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction	1a	Select the steps to install the GIMP.	1.1	Introduction to GIMP, overview of the software, installation and setup.	CO1
	1b	Select the different tools available on GIMP workspace.	1.2	Exploring the workspace: toolbars, panels and navigation tools: shortcuts keys, navigation control and dialog.	
	1c	Select the uses of Layers based on given point.	1.3	Explore the layers, using the zoom and hand tools.	
	1d	Select the different basic Image adjustments on given parameter.	1.4	Basic image adjustments, removing backgrounds using selection tools: rectangle select, ellipse select and free select.	
	1e	Specify the Advanced Background Removal Techniques.	1.5	Advanced Background Removal Techniques, Cropping, Resizing, and Rotating Images.	

UNIT II: Vector Graphics	2a	Compare the given features of vector graphics on given point.	2.1	Introduction to vector graphics: raster image (gif, png, jpg) and vector image (svg).	CO2
	2b	Identify the basics of given vector graphics software.	2.2	Overview of Blender software and Inkscape software.	
	2c	Select the vector graphics tools on given point.	2.3	Vector graphics tools: points, lines, curves, and shapes.	
	2d	Create a vector graphics image on the basis of given parameter.	2.4	Vector graphics image creation: design, choose a tool, create shapes edit and modify, save and export.	
	2e	Select the given tools for vector graphics based on given point.	2.5	2D and 3D rendering design in vector graphics.	
UNIT III: Presentation Software	3a	Analyse the multimedia presentation software.	3.1	Introduction: ppt, canva managing slides, templates and presentations.	CO3
	3b	Apply the dependencies and libraries of ppt.	3.2	Enable dependencies and slide Library of ppt, macros, cascade, slide sorter.	
	3c	Choose the tools for the given presentation.	3.3	Design layout, browse for themes, background styles and insertion- charts, clipart, tools-textbox, header footer.	
	3d	Use animation techniques on given points.	3.4	Using custom animations-transition sound and speed, video and images.	
	3e	Create the given multimedia presentation.	3.5	Protect presentation, adding and managing comments.	
Video Editing	4a	Analyse the given Audio and video Editing softwares.	4.1	Introduction of Audio/video: Color correction, audio post-production, voice altering effects, text and image tracking.	
	4b	Use given softwares for Audio and video Editing.	4.2	Overview of Audacity, Adobe Audition, and OBS (Open Broadcaster Software).	

UNIT IV: Audio and V	4c	Apply the given techniques for Audio Editing.	4.3	Audio Editing Techniques: trimming, adjusting volume, adding sound effects, waveform editing.	CO4
	4d	Apply the given techniques for video Editing.	4.4	Video Editing Techniques: color correction, color grading, cutaways, cutting on action.	
	4e	Apply Audio/video Editing softwares on the basis of given softwares.	4.5	Applications of Audio/video Editing softwares: adobe premier rush, cyber link powerdirector 365.	
UNIT V: Photography with Camera	5a	Analyse the basics of photography and camera on given scenario.	5.1	Introduction to photography: basics photography, working of camera: light, focus, record, shutter, process,n store and view.	CO5
	5b	Analyse the given functions of camera for photography.	5.2	Functions of camera: capturing images, storing images, controlling image quality and controlling motion.	
	5c	Classify the given techniques of given multimedia photography.	5.3	Techniques of basic photography: composition, Aperture, background, exposure, Histogram.	
	5d	Apply the given photography modes on camera.	5.4	Basic photography modes: auto mode, manual mode, program mode.	
	5e	Apply the given advanced modes on camera.	5.5	Advanced camera modes: Shutter-priority mode, shutter speed, ISO, Macro mode.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Install GIMP and explore various tools for editing of images.	2#	CO1
II	2	Design simple logos or icons using vector graphics software like Blender or Inkscape.	2#	CO2
II	3	Create raster and vector images using vector graphics software like Blender or Inkscape.	2#	CO2
III	4	Create custom animation-based presentation using transition speed and sound, images, and videos.	2#	CO3
III	5	Develop a presentation based on given dependencies and Libraries of the software.	2#	CO3
III	6	Develop a layout using theme, background styles etc. tools.	2#	CO3
III	7	Develop a multimedia presentation using software like Canva etc.	2#	CO3
IV	8	Install the open broadcaster software and explore various tools of it for audio and video editing.	2#	CO4
IV	9	Use Audio and video techniques for editing using OBS.	2#	CO4
IV	10	Use Audio and video techniques for editing using Adobe premier-rush or Cyberlink powerdirector 365.	2#	CO4
V	11	Use different functions of digital camera or smartphone to take photographs.	2#	CO5
V	12	Apply different modes digital camera or smartphone to click photographs for multimedia purposes.	2#	CO5
V	13	Apply advanced camera modes to edit photographs.	2	CO5
V	14	Create animated presentation based on real-world application using all dependencies and libraries of Microsoft Powerpoint presentation.	2	CO5
V	15	Prepare multimedia project using canva software based on real-world scenario.	2	CO5

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction	6	C	02	04	04	10
			O	0	0	0	0
2	Vector Graphics	7	C	02	04	08	14
			O	0	0	0	0
3	Presentation Software	6	C	02	04	10	16
			O	0	0	0	0
4	Audio and Video Editing	6	C	02	04	10	16
			O	0	0	0	0
5	Photography with Camera	5	C	02	04	08	14
			O	0	0	0	0
6			C				0
			O				
Total		30	C	10	20	40	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
1	1R2	1U2	1U2	1A2	1A2	2R2	2U2	35/35
2	2U2	2A2	2A2	2A2	2A2	3R2	3U2	
3	3U2	3A2	3A2	3A2	3A2	3A2	4R2	
4	4U2	4U2	4A2	4A2	4A2	4A2	5R2	
5	5R2	5U2	5U2	5A2	5A2	5A2	5A2	
6								

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Activities	5
2	Writing program	5
3	Performance / Execution of program	10
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	-	-	-	-	-
CO5	3	-	-	3	-	-	1	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Adobe Photoshop CC Classroom in a Book	Andrew Faulkner and Conrad Chavez, Adobe Press, 2019	978-0-13-526178-1
2	Inkscape: Guide to a Vector Drawing Program	Tavmjong Bah, Prentice Hall, 4th Edition	978-0-13-276414-8
3	The Animator's Survival Kit: A Manual of Methods, Principles, and Formulas for Classical, Computer, Games, Stop Motion, and Internet Animators	Richard Williams, Faber & Faber	978-0-571-20228-7
4	Presentation Zen: Simple Ideas on Presentation Design and Delivery	Garr Reynolds, New Riders	978-0-321-52565-9
5	Understanding Exposure: How to Shoot Great Photographs with Any Camera	Bryan Peterson, Amphoto Books, 4th Edition	978-1-64051-114-0

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2. https://inkscape.org/learn/tutorials/, accessed on 12th Feb 2024
3. https://www.animationmentor.com/free-maya-basic-animation-tutorials/, accessed on 12th Feb 2024
4. https://www.canva.com/designschool/, accessed on 12th Feb 2024
5. https://obsproject.com/kb/quick-start-guide, accessed on 12th Feb 2024
6. https://www.blender.org/support/tutorials/, accessed on 12th Feb 2024
7. https://www.gimp.org/tutorials/, accessed on 12th Feb 2024

XVI List of Major Equipment/Machineries with Specification:

1. Compuer latest version

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
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4	Mrs. V. A. Raje	System Analyst	MSBTE, RO, Nagpur
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6	Mr.L.D.Vilhekar	Lecturer, Information Technology	Government Polytechnic, Nagpur

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Member Secretary PBOS, IT

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/CM/IT/PK/AIML/MK/AE/TX
Course Category	:	GE
Course Code	:	MT291H
Course Title	:	Foundry Technology

I Rationale:

A Foundry Technology course equips diploma students in India with essential skills in casting and metalworking, crucial for the manufacturing sector. It bridges the gap between theoretical knowledge and practical application, fostering expertise in metal production, quality control, and industrial processes. This specialization meets the growing demand for skilled professionals in automotive, aerospace, and infrastructure industries, driving economic growth and technological advancement

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Perform casting and foundry operations

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Use** various patterns in foundry

CO2: **Construct** various core bores

CO3: **Construct** Moulds and Patterns for castings

CO4: **Perform** various tests on moulding sand to find its suitability in foundry applications

CO5: **Produce** castings of different metals/alloys for various applications

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: PATERN AND PATTERN MAKING	1a	Select suitable manufacturing process for given appliaction	1.1	Various manufacturing processes, Steps involved in Making a Casting. Advantages of metal casting, Applications of Metal Casting, Different sections of a Foundry, types of foundry Function of pattern, Difference between pattern and casting	CO1
	1b	Identify given ISI coloring code on pattern	1.2	various types of pattern materials. Types of patterns, Pattern allowances,Steps involved in pattern construction, ISI coloring code on pattern	
ORE AND CORE AKING	2a	Select proper core making machine for given application	2.1	Function of core, core applications, Core sand properties , Core sand ingredients	
	2b	Choose proper core sand ingredients for making of core	2.2	Core materials ,core sand mixture, Core making procedure , Types of core, Core prints	CO2

UNIT II: C M	2c	Choose proper Core making machines for making of core	2.3	Core making machines, core baking and machining operations on cores,Core shifting and Chaplet, Core applications, Construction of core box	
UNIT III: MOULD AND MOULD MAKING	3a	Select proper moulding sand for mold making	3.1	Functions of mould, Mould materials-sand, binder, water, additives, etc Types of Moulding sands and their Properties	CO3
	3b	Sequece correct steps in sand preperation.	3.2	Moulding sand preparation and conditioning (a) objectives of sand preparation (b) Steps for sand preparation (c) Working of sand Muller	
	3c	Choose proper sand control test for mould making.	3.3	Sand control tests- (a) Moisture content test (b) Clay content test (c) Grain fineness test	
	3d	Select proper steps in mold making	3.4	Steps involved in mould making, mould making machines, Moulding methods, hand Moulding tools,venting of moulds. Mould -metal reaction	
UNIT IV: SOLIDIFICATION OF CASTINGS	4a	Identify given types of solidification	4.1	Concept of solidification of metals	CO4
	4b	Select proper gating system to obtain sound casting	4.2	GATING system: - function of each component of the gating system pressurized and unpressurised ,RISER - Function of risers, types of riser	
MELTING PRACTICE	5a	Select Furnaces for melting ferrous and non-ferrous metals.	5.1	Furnaces for melting ferrous and non-ferrous metals	CO5
	5b	Identify given Zones of Cupola	5.2	Cupola – Construction, Various operations, Zones of Cupola, Crucible furnaces-types, working principle, advantages, disadvantages and applications	

UNIT V:	5c	Select proper post casting operation to get sound casting in foundry	5.3	Heat treatment of Castings-Stress Relieveing, Post casting operations: Fettling

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify various Foundry tools	2#	CO1
I	2	Identify various furnances used for melting operation	2#	CO1
II	3	Identify patterns for casting opertaion	2#	CO2
II	4	Identify moulds for casting opertaion	2#	CO2
III	5	Identify core boxes for making of castings	2#	CO3
III	6	Determine Moisture content in Moulding sand by Infra-red bulb method	2#	CO3
IV	7	Determine the amount of clay content in moulding sand..	2#	CO4
IV	8	Determine A.F.S. fineness No. of sand	2#	CO4
IV	9	Identify given metal scrap for melting operation	2#	CO4
IV	10	Perform melting operation for given metal/ alloys	2	CO4
V	11	Prepare proper molding sand by mixing , screening and sieving of given sand	2#	CO5
V	12	Colour given patterns as per ASTM colour coding	2#	CO5
V	13	Choose proper gating and risering system for given mould	2#	CO5
V	14	Select suitable post casting operation for finishinf of casting	2	CO5
V	15	Identify defects occured in casting	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	PATERN AND PATTERN MAKING	2	C	04	04	06	14
			O	00	00	00	0
2	CORE AND CORE MAKING	4	C	04	04	0 0	8
			O	00	00	00	0
3	MOULD AND MOULD MAKING	4	C	02	04	06	12
			O	00	00	00	0
4	SOLIDIFICATION OF CASTINGS	10	C	04	08	06	18
			O	00	00	00	0
5	MELTING PRACTICE	10	C	04	08	06	18
			O	00	00	00	0
6			C	00	00	00	0
			O	00	00	00	0
Total		30	C	18	28	24	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	
1	1R2	1R2	1U2	1U2	1A2	1A2	1A2	35/35	
2	2R2	2R2	2U2	2U2	3R3	3R3	3R3		
3	3A2	3A2	3A2	4R2	4R2	4U2	4U2		
4	4U2	4U2	4A2	4A2	4A2	5R2	5R2		
5	5U2	5U2	5U2	5U2	5A2	5A2	5A2		
6									

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing diagram, selection of equipment & tools. writing	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	
CO4	3	-	-	3	-		-	-	-
CO5	3	-	-	3	-	1	-	-	-
CO6	3	-	-	3	-		-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Text Book of Foundry Technology	O.P. Khanna, Dhanpat Rai Publications (1 January 2011)	13: 978-8189928346
2	Foundry Technology	D.B. Goyal & Sinha Standard Publishers Distributors	10: 8186308121, 13: 9788186308127
3	Principle of Metal Castings	R.W. Heine and P.C. Rosenthal, Mc Graw Hill Education; 2nd Edition (22 February 2001)	13: 978-0070993488

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2. https://www.youtube.com/watch?v=qbUDYobvqvI , accessed on 28th May 2024
3. https://www.youtube.com/watch?v=MoTKlQLdtTQ accessed on 28th May 2024
4. https://www.youtube.com/watch?v=9Lsrxgd_cNo accessed on 28th May 2024
5. https://www.youtube.com/watch?v=QEtpDGj9ax4 , accessed on 28th May 2024

XVI List of Major Equipment/Machineries with Specification:

1. Various types of Patterns ,foundry sand, moulding machines, Foundry tools
2. Furnaces for melting of metals/alloys.
3. Sieve shaker setup
4. Infra red bulb heating unit

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Shri.K.L. Meshram	HOD, Metallurgical Engineering	Government Polytechnic, Nagpur
2	Miss.V.C. Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
3	Shri.S.M.Waikar	Sr. Engineer	Durgapur Steel Plant, Durgapur
4	Prof. Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT , Nagpur
5	Shri D.P.Mukharjee	Sr. Engineer	Ordanace Factory, Ambazari, Nagpur
6	Shri.A.V.Abhyankar	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli
7	Shri S.B.Varadpande	Chief Managing Director	Orange city alloys Pvt.Ltd

(Mr. K.L.Meshram)
HOD & Chairman PBOS, MT

(Dr. G. V. Gotmare)
Member Sectretary PBOS, MT

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/IT/MT/PK/CM/AE/AI/MK
Course Category	:	GE
Course Code	:	TX291H
Course Title	:	General Textile Technology

I Rationale:

This course's goal is to identify the raw materials used in textiles, such as fibers, their sources, and their characteristics. The process of converting fiber into yarn and converting yarn into various fabric development. Since clothing and home furnishings account for a large portion of the family budget, therefore both customers looking to make smart fabric selections need to be knowledgeable about textiles. This course is designed for other program students to gain the knowledge of General textile Technology.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Identify different fibres used in Textile Industry.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** different fiber end use application in textile.

CO2: **Identify** the different spun yarn end use application in woven fabric.

CO3: **Determine** the yarn count of spun yarn

CO4: **Identify** the processes for weaving.

CO5: **Evaluate** the characteristics of woven fabric

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Overview of Textile Industries	1a	Identify textile fibers based on their origin	1.1	Defination of textile Fiber, yarn and fabrics.Classification of textile fibers.Essential and Desirable Properties of Fiber, yarn and fabric	CO1
	1b	Select given textile fibre according to end uses.	1.2	Brief study of some important fibers with their special l characteristics and end uses- Cotton, Jute, linen,Silk, Wool, rayon, Polyster, Nylon, Acrylic, polypropylene and Polyethyelene.	
	1c	Identify the given fibre by given test.	1.3	Identification of textile fibres by different tests- Burning, Microscopic and solubility	

UNIT II: Textile process	2a	Select the different processes required for producing the given yarn.	2.1	Commonly used processes in making of a textile finished product. Various stages involved to convert the raw material into ring spun yarns or threads. Various stages involved to convert the raw material into openend yarns or threads.	CO2
	2b	Compare the given type of yarns on given points.	2.2	Ring spinning yarn manucaturing stages. Classification of textile yarns - spun yarn, carded yarn, combed yarn, woolen yarn, worsted yarn, monofilament yarn and multifilament yarn.	
UNIT III: Yarn quality parmeters	3a	Calculate the count of yarn with the given data.	3.1	Defination of yarn count. Yarn numbering system, Direct yarn numbering system and indirect yarn numbering system. Simple yarn count calculation in indirect and direct yarn numbering system.	CO3
	3b	Determine the characteristics of given yarn.	3.2	Yarn Twist- Direction of yarn twist, characteristics of single yarn and plied yarn. Types and Characteristics of novelty/fancy yarns.	
UNIT IV: Weaving process	4a	Prepare process flow chart for given types of fabric.	4.1	Defination of woven fabric. Preparatory Processes for Weaving - Winding ,warping, pirn winding, sizing and Drawing -in process.	CO4
	4b	Identify the given motions of weaving machine.	4.2	Types of weaving machines. Basic motions of the loom - brief working and defination of shedding motion, picking motion, beatup motion, take up motion, let-off motion, weft stop motion, warp stop motion and brake motion.	

UNIT V: Woven fabric structures	5a	Evaluate the characteristics of given types of fabric.	5.1	Classification of Woven Fabric. Specification Of Woven Fabrics. Importance of dobby weaves and jacquard weaves. Characteristics of shirting fabrics, suiting fabric, towel cloths and fuirnishing cloths	CO5
	5b	Analyse the weave of given fabric sample.	5.2	Fabric Weaves and Properties- Plain weave, rib weave, basket weave, twill weave, satin weave, sateen weave.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Draw the classification chart of textile fibres.	02#	CO1
I	2	Collect different fibre samples- cotton, wool, polyester, viscose, nylon and write their origin, properties and end uses.	02#	CO1
I	3	Identify the given textile fibre by suitable test.	2	CO1
II	4	Prepare passage of materials for yarn formation process of given spinning system.	02#	CO2
II	5	Draw the structure of different types of yarns with its characteristics.	02#	CO2
II	6	Identify different types of yarns.	02#	CO2
III	7	Identify different type of yarn count system .	02#	CO3
III	8	Calculate the count of yarn in given system from the given data.	02#	CO3
III	9	Identify the twist direction in given yarn.	02#	CO3
IV	10	Prepare passage of materials for given fabric formation.	02#	CO4
IV	11	Identify the given type of loom.	02#	CO4
IV	12	Draw daigram of different motion by observing the weaving machine.	2	CO4
V	13	Observe and write the characteristics of different types of fabric.	02#	CO5
V	14	Evaluate the given types of weaves.	2	CO5
V	15	Draw design , draft and peg plan of given weave.	02#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Overview of Textile Industries	4	C	02	04	04	10
			O	0	0	0	0
2	Textile process	8	C	02	08	08	18
			O	0	0	0	0
3	Yarn quality parmeters	4	C	02	04	04	10
			O	0	0	0	0
4	Weaving process	8	C	02	08	08	18
			O	0	0	0	0
5	Woven fabric structures	6	C	02	06	06	14
			O	0	0	0	0
Total		30	C	10	30	30	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q.01 to Q.35	1R2	1U2	1U2	1A2	1A2	2R2	2U2	35/35	
	2U2	2U2	2A2	2A2	2A2	2A2	3R2		
	3U2	3U2	3A2	3A2	4R2	4U2	4U2		
	4U2	4U2	4A2	4A2	4A2	4A2	4A2		
	5R2	5U2	5U2	5U2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Draw neat sketches and working procedure.	10
2	Identify the functions of important parts.	5
3	Calculation	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	-	-	-	3	-	-
CO2	3	-	-	-	-	-	3	-	-
CO3	3	-	-	1	-	-	3	-	-
CO4	3	-	2	-	-	-	3	-	-
CO5	3	-	2	1	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Woven Cloth Construction	A. T. C. Robinson R Marks, Textile Institute Manchester, 1967	13: 9781489958556
2	Weaving : Conversion of Yarns to Fabric	Lord P R and Mohamed M H	13: 9781855734838
3	Winding and Warping	Dr M K Talkudar, Mahajan Publisher	13: 9781859434641
4	Industrial Practices in Weaving Preparation	M K Singh, Woodhead Publishing India	13: 9780857098252
5	Modern Preparation and Weaving Technology	Ormerod A, Butterworth publishers ltd	13: 9780408012126
6	Handbook of Textile Fibres	Cook, J.Gordon, Shildon: Merrow-1984	10: 0904095398
7	Conversion of Yarn to Fabric	P.R.Lord, Wood head Publishing, ltd, England	13: 9781845692902

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6. https://www.textilesphere.com/2021/11/warping-process-in-weaving.htm accessed on 27 may 2024
7. https://www.textileadvisor.com/2019/10/drawing-in-process-weaving-process.html accessed on 27 may 2024
8. https://www.youtube.com/watch?v=zw8idLj5U2s accessedon 27 may 2024
9. http://www.textileassociationindia.org/ accessed on 27 may 2024
10. https://nptel.ac.in/courses/116/102/116102005/accessed on 27 may 2024

XVI List of Major Equipment/Machineries with Specification:

1. Rapier Loom
2. Warping machine
3. Hand Loom
4. Ring Frame
5. Twist tester
6. Wrap Reel
7. Analytical balance

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr.C.P.Kapse	I/C HOD Textile Manufacture	Government Polytechnic, Nagpur
2	Dr. S.G Gaikwad	Selection Grade Lecturer Textile Manufacture	Government Polytechnic, Nagpur
3	Mrs. L.S.Chakraborty	Lecturer, Textile Manufacture	Government Polytechnic, Nagpur
4	Mr Harshal Ramteke	HOD Textile Technology	SASMIRA, Mumbai
5	Dr. Ganesh Kakad	HOD Textile Engineering	JDIT, Yavatmal
6	Mr.Laxminarayan Kaushik	Director	LLP Professional, Nagpur
7	Mr S.S.Lawand	Selection Grade Lecturer, Textile Manufacture	Government Polytechnic, Nagpur
8	Mr.Wasudev Varade	Textile Consultant	LLP Professional, Nagpur

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Member Sectretary PBOS, TX

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/PK/MT/IT/CM/AI/MK/TX
Course Category	:	GE
Course Code	:	AE291H
Course Title	:	Basics of Automobile

I Rationale:

This course takes students through the working of automobiles from the basics. Students will learn about automobiles piece by piece, even without a any prior knowledge. This course provides an overview of the basic automobiles. It's designed for those seeking a career in the automotive industry or anyone who wants to learn about vehicle repairs.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge of automobile systems for maintance of vehicle.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Prepare** vehicle layouts with chassis specification.

CO2: **Select** suitable engine for given automobile applications.

CO3: **Interpret** power flow diagrams of transmission systems.

CO4: **Select** suitable braking and steering systems for different applications.

CO5: **Service** the different wheels and tyres.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Automobile	1a	Classify the automobile on the given parameters.	1.1	Automobile: Definition, Classification of Automobiles, Major Components of Automobiles with their Function and Location Vehicle Layout: Definition Significance of Vehicle Layout	CO1
	1b	Identify the type of layout used in given vehicle.	1.2	Different types of Vehicle layouts(FEFWD, FERWD, RERWD, 4WD), Advantages, Disadvantages, Applications and Comparisons of Different types of vehicle layouts.	
	1c	Justify the significance of chassis and frame in given automobile.	1.3	Function of Chassis, Frame and Body: Requirement of Chassis, Frame and Body.	

UNIT II: Engine Systems	2a	Interpret the working of given engine.	2.1	Engine: definition, classification of engines, major parts of multicylinder engine with their location and function, engine terminology and nomenclature, working of four stroke SI engine, working of four stroke CI engine	CO2
	2b	Identify the components of given system in engine.	2.2	Lubrication and Cooling system: Purpose of lubrication, types of lubrication systems, working of pressurized lubrication system. Purpose of cooling system, construction and working of engine air cooling, construction and working with major components of engine liquid cool system.	
	2c	Justify the significance of given battery.	2.3	Battery: Function and Requirements of Battery, Types of Battery, Principle of Lead Acid Battery. Ignition System: Function and Requirement of Ignition System, working and components with their function of distributor-less ignition System	
	2d	Determine the requirements of given system.	2.4	Charging System: Function and Requirement of Charging System, Components of Charging System. Starting System: Function and Requirement of Starting System, Components of Starting System. Charging System: Function and Requirement of Charging System, Components of Charging System	

UNIT III: Automobile Transmissions Systems	3a	Justify the necessity of given clutch.	3.1	Function and Necessity of Clutch: Requirement of Clutch, Classification of Clutch, Working Principle of Clutch, Construction and Working of Single Plate (Coil Spring and Diaphragm).	CO3
	3b	Identify components of the given gear box.	3.2	Function and Necessity of Gear Box Manual Transmission: Classification of Gear Box, Construction and working of Constant Mesh and Synchro Mesh Gear Box. Automatic Transmission: Advantages & disadvantages, Components and their Function	
	3c	Classify the given givenr shaft of automobile.	3.3	Propeller Shaft Assembly: Function, Necessity and Types of Propeller Shaft, Function and necessity of Universal and Slip Joint	
	3d	Determine the Working principle of given differential in automobile.	3.4	Final Drive: Function and Necessity of Final Drive, Differential, Working principle Construction and Working of Differential	
	3e	Specify the types of axles in given automobile.	3.5	Axles: Significance of Live and Dead Axle, Function and Requirement of Front Axle, Types of (Front) Stub axle.	
Control System	4a	Differentiate between given brakes.	4.1	Automobile Braking System: Function and Requirement of Braking System: Principle of Braking, Basic Terms related to Braking (Stopping Distance, Braking Efficiency, Fading of Brakes) Types of Braking System: Layout, Construction, Working of Drum, Disc, Hydraulic and Air Brakes.	

UNIT IV: Automobile	4b	Justify the significance of steering system in given automobile.	4.2	Automobile Steering System: Function and Requirements of Steering System: Basic Terms related to Steering(Steering Ratio, Turning Radius, Understeering and Oversteering), Basic Components of Steering Linkages. Necessity and Principle of Power Steering, working of hydraulic and electronic power steering. steering gear box: function and types	CO4
UNIT V: Automobile suspension, wheels and tyres	5a	Justify the significance of suspension system in given automobile.	5.1	Automobile Suspension System: Function and Requirement of Suspension System, Types and Constructional Features of Leaf Springs	CO5
	5b	Identify Components of given suspension system.	5.2	Function and Requirement of Independent Suspension System: Advantages of Front Wheel Independent Suspension, Shock Absorbers and Air Suspension: Layout, Construction and Working of Air Suspension.	
	5c	Justify the significance of wheel balancing and alignment.	5.3	Wheels, Rims and Tyres: Function, Necessity and Requirement of Wheel, Rim and Tyres: Factors affecting to Tyre Life, Tyre Wear and Rotation, Tyre Designation. Wheel Alignment and Balancing: Purpose of Wheel Alignment, Purpose of Wheel Balancing,	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Prepare a layout of vehicle available in your Laboratory.	2#	CO1
II	2	Dismantle/Assemble and identify the components of single cylinder engine.	2	CO2
II	3	Dismantle/Assemble and identify the components of Multicylinder cylinder engine.	2#	CO2
II	4	Dismantle/Assemble and identify the components of engine lubrication system.	2	CO2
II	5	Dismantle/Assemble and identify the components of engine cooling system.	2	CO2
II	6	Dismantle/Assemble and identify the components of engine charging system.	2	CO2
II	7	Dismantle/Assemble and identify the components of engine Ignition system.	2#	CO2
II	8	Perform test on given battery and comment condition of it.	2#	CO2
III	9	Dismantle/Assemble and identify the components of manual gearbox.	2#	CO3
III	10	Dismantle/Assemble and identify the components of automatic transmission.	2	CO3
III	11	Dismantle/Assemble and identify the components of clutch.	2#	CO3
III	12	Dismantle/Assemble and identify the components of differential.	2#	CO3
III	13	Dismantle/Assemble and identify the components of propeller shaft.	2	CO3
III	14	Dismantle/Assemble and identify the components of axle and drive.	2	CO3
IV	15	Dismantle/Assemble and identify the components of steering system.	2#	CO4
IV	16	Dismantle/Assemble and identify the components of braking system.	2#	CO4
V	17	Dismantle/Assemble and identify the components of suspension system.	2	CO5
V	18	Perform puncture repair, replace spare tyre and identify the tyre wear.	2#	CO5
V	19	Perform wheel balancing and wheel alignment of given vehicle.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Automobile	4	C	02	04	02	08
			O	00	00	00	00
2	Engine Systems	8	C	04	06	08	18
			O	00	00	00	00
3	Automobile Transmissions Systems	6	C	04	06	06	16
			O	00	00	00	00
4	Automobile Control System	6	C	02	06	06	14
			O	00	00	00	00
5	Automobile suspension, wheels and tyres	6	C	02	06	06	14
			O	00	00	00	00
Total		30	C	14	28	28	70
			O	00	00	00	00

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyse / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
1	1R2	1U2	1U2	1A2	2R2	2R2	2U2	35/35
2	2U2	2U2	2A2	2A2	2A2	2A2	3R2	
3	3R2	3U2	3U2	3U2	3A2	3A2	3A2	
4	4R2	4U2	4U2	4U2	4A2	4A2	4A2	
5	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyse / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	System diagram, selection of equipment	5
2	Performance	10
3	Identification of compenets	5
4	Viva Voce	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-
CO2	3	3	-	3	-	-	-	-	-
CO3	3	3	-	3	-	-	-	3	-
CO4	3	3	-	3	2	-	2	-	-
CO5	3	3	-	3	2	-	2	-	2
CO6	3	3	-	3	2	-	2	3	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Automobile Engineering Vol.I	Dr. Kripal Singh, Standard Publishers Distributors, 13th Edition, 2023	13: 97881801419669
2	Automotive Mechanics	Crouse. W.H., Anglin, McGraw Hill Education (India) Private Limited,10th Edition, 2021	10: 81-219-2440-5
3	Basic Electrical Engineering	V.N.Mittle, Arvind Mittal, The McGraw Hill Education Pvt. Ltd, Reprint, 2021	10: 0070634351
4	Automotive Mechanics	N. K. Giri, Khanna Publishers, Delhi,Eighth Edition, 2020	13: 9788174092168
5	Motor Automotive Technology	Anthony E. Schwalle, Delmar Publisher Inc., 2nd Edition, 2020	13: 978-0827351004
6	Automotive Mechanics	S. Srinivisan,Tata McGraw – Hill, 2nd Edition, 2023	13: 9780070494916
7	Basic Automobile Engineering	Nakra CP , DhanpatRai Publishing Company (P) Limited, 2018	13: 9788187433224

XV e-References:

1. https://www.youtube.com/watch?v=QPaUJfA1KsY, assessed on 30th May 2024
2. http://auto.howstuffworks.com/cvt.htm,assessed on 30th May 2024
3. http://www.carbibles.com/transmission_bible_pg3.html, assessed on 30th May 2024
4. https://www.youtube.com/watch?v=hs7bABMtOMI&list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MlJau4F assessed on 30th May 2024
5. https://www.youtube.com/watch?v=UJfjR1O52F8&list=PLaukeqsMWUOCoI7_tTgB494kRPaSaREVY assessed on 30th May 2024

XVI List of Major Equipment/Machineries with Specification:

1. Air compressor-1 HP 3 phase, Max Pressure: 4, 95 kg/cm², 70 ltr.
2. Bottle/Floor/Scissor Jacks- 3 ton Capacity.
3. Socket/ Impact wrenches-¼", 3/8", ½" and 3/4"
4. Torque wrenches- 3/8", ½"and 3 NM, Ratcheting type/Click-type.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. G.K. Awari	HOD, Automobile Engineering	Government Polytechnic, Nagpur
2	Dr. K.S. Dixit	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur
3	Prof. D. K. Bawane	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur
4	Prof. Syed J. M.	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur
5	Dr.Suhas Kongre	Sr. Lecturer in Mechanical	ASTS Polytechnic, Wardha
6	Mr. Pramod Nichat	Rtd. Asst. General Manager	Ashok Leyland Ltd; Chennai
7	Dr Manoj Basashankar	HOD, Mechanical Engineering	Suryodya Polytechnic & Engineering College, Nagpur

(Dr. G. K. Awari)
HOD & Chairman PBOS, AE

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/IT/MT/TX/AE/CM/MK/AI
Course Category	:	GE
Course Code	:	PK291H
Course Title	:	Basics of Packaging Technology

I Rationale:

This course introduces the basics of packaging, covering its different levels and functions in business. Students will learn about various packaging materials and how demographics affect packaging choices. The course also includes an overview of testing and quality standards, helping students understand how to ensure packaging meets industry requirements. This foundational knowledge is useful for anyone interested in the broader aspects of packaging business.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge of basics of packaging in various packaging applications

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** the levels of packaging.

CO2: **Identify** the technical and commercial functions of packaging.

CO3: **Identify** the various sectors of a packaging business**.**

CO4: **Identify** the packaging material and appreciate the demographic influence on packaging business.

CO5: **Identify** the testing and quality standards and perform the test.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

** Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Packaging Technology	1a	Justify the importance of packaging in supply chain.	1.1	Introduction; Definition and Importance of Packaging in supply chain, Evolution of Packaging.	CO1
	1b	Identify given segmentation of packaging industry	1.2	Indian packaging industry present scenerio; Key Players and Market Segmentation.	
	1c	Identify the given levels of packaging.	1.3	Levels of packaging: Primary, Secondary and Tertiary.	
	1d	Select the correct advantages and disadvantages of packaging.	1.4	Advantages of packaging to - Customer, retailer, distributor, handler, transporters, manufacturers, society, and nation. Disadvantages of packaging - Cost, Environmental Impacts; resource utilization, energy, toxicity, litter, solid waste, deception.	

UNIT II: Functional Considerations of Packaging	2a	Identify the technical functions of packaging from given options.	2.1	Functional Considerations of Packaging: Technical Functions - Containment, protection (against mechanical damages), preservation (against Physiochemical damages).	CO2
	2b	Identify the commercial functions of packaging from given options.	2.2	Commercial functions - Sanitation, unitization, communication (Human & Machine), dispersing & dispensing, pilferage deterrence, tampering evidence etc.	
UNIT III: The Packaging Business	3a	Identify the given sector of a packaging business.	3.1	The Packaging Business: a. Packaging material suppliers: Basic raw materials, materials for packaging. b. Converting of raw materials, converting of packaging materials. c. Ancillary Packaging materials. d. Packaging user industries; Food, Pharma and other.	CO3
ging Materials	4a	Identify packaging materials from given properties.	4.1	Overview of Packaging Materials; Wood, paper, plastics, glass, metals. Properties and Characteristics of Packaging Materials Selection Criteria for Packaging Materials. Emerging Trends in Sustainable Packaging Materials.	

UNIT IV: Packa	4b	Select the correct point for demographic influence on packaging industry.	4.2	Demographic influence on packaging business; growing population, shifts in definition of household units, geographic redistribution, increase in number of working women, increase in number of single living, increase in number of two earner household.	CO4
UNIT V: Packaging Processes , testing and quality control.	5a	Identify the given packaging process.	5.1	Packaging Processes: Packaging Design Principles, Printing and Labeling Techniques, Forming and Filling Processes, and Sealing and Closing Techniques.	CO5
	5b	Identify the given testing standard.	5.2	Packaging Testing and Quality Control; Importance of Packaging Testing, Testing Standards and Methods, Testing and Quality control , Packaging Tests; durability, leakage, compression.	
	5c	Identify the given quality standard.	5.3	Quality standards in packaging business; quality management system, food safety management systems, Goods Manufacturing Practices. Food and Drug Administration (FDA)	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Conduct a case study on Indian Packaging Industry: A current scenerio and write a report on it.	2#	CO1
I	2	Carry out group discussion to identify the levels of packaging; form groups, collect the samples, observe, study, search relevant information and write a report.	2#	CO1
II	3	Carry out group discussion to identify the Technical Functions of a given Packaging System. Form groups, collect the samples, observe, search relevant information and write a report.	2#	CO2
II	4	Conduct a case study on demographic influence on growth of packaging business. Take any one topic from; shifts in definition of household units, geographic redistribution, increase in number of working women, increase in number of single living, increase in number of two earner household. And write a report.	2#	CO2
II	5	Carry out a group discussion to identify the commercial functions of a given Packaging System; form groups, select a packaging system, observe and study it, collect information, brain storm and write a report.	2#	CO2
III	6	Carry out a case study on Exploring the Dynamics of the Indian Packaging Business and write a report.	2	CO3
IV	7	Perform CFB box packaging manually - erection, loading and sealing. Search and collect the information on unitization, styles of corrugated boxes and box sealing methods and materials.	2#	CO4
IV	8	Perform box compression test on a given sample.	2#	CO4
IV	9	Perform liquid filling by liquid volumetric filling machine (model/portable). Note the findings and observations.	2#	CO4
IV	10	Perform box filling, stapling, sealing, and shrink wrapping operations.	2#	CO4

IV	11	Perform box filling, sealing, automatic strapping and stretch wrapping operations.	2#	CO4
V	12	Carry out a case study on Functions of Food and Drug Administration.	2#	CO5
V	13	Identify the plastic by manual observation and handling the product. Write a report.	2	CO5
V	14	Draw a format related to testing of packaging material by reading the existing any one Indian Standard.	2#	CO5
V	15	Draw a format related to the quality standard by reading the existing any one standard from: quality management system/ food safety management systems/ Goods Manufacturing Practices/ Food and Drug Administration (FDA).	2	CO5

Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hour	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Packaging Technology	6	C	02	06	04	12
			O	0	0	0	0
2	Functional Considerations of Packaging	6	C	02	06	04	12
			O	0	0	0	0
3	The Packaging Business	6	C	02	06	04	12
			O	0	0	0	0
4	Packaging Materials	6	C	06	08	04	18
			O	0	0	0	0
5	Packaging Processes, testing and quality control	6	C	04	06	06	16
			O	0	0	0	0
Total		30	C	16	32	22	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
1	1R2	2R2	3R2	4R2	5R2	4R2	5R2	35/35
2	4R2	1U2	2U2	3U2	4U2	5U2	1U2	
3	2U2	3U2	4U2	5U2	5U2	4U2	3U2	
4	2U2	1U2	4U2	1A2	2A2	3A2	4A2	
5	5A2	5A2	4A2	3A2	2A2	1A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of equipment/Materials	5
2	Performance	10
3	Calculation, Result, Drawing Graphs, diagram (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	2	-	2	-	-
CO5	3	-	-	3	2	-	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Introduction To Packaging	Frank A. Paine, Heather Y. Paine, Springer, Second E, 1983	13: 978-1-4613-6214-2
2	Packaging In The Environment	Geoffrey M. Levy, Springer, Chapman and Hall, 1993	13: 9781461358909
3	The Packaging User's Handbook	F.A. Paine,Chapman and Hall, New Edition,1995	13: 978-0-7514-0151-6
4	Handbook of Packaging	F.A. Paine	-
5	Fundamentals of Packaging Technology	Walter Soroka, Institute of Packaging Professionals, Virginia	-

XV e-References:

1. https://www.youtube.com/watch?v=qAGCI0-pQ3E assessed on 3rd March 2024
2. https://www.youtube.com/watch?v=KMvRqygi04g assessed on 11th March 2024
3. https://www.youtube.com/watch?v=7yAjgT5NAkE assessed on 12th March 2024
4. https://www.youtube.com/watch?v=wugmX85ipRU assessed on 15th March 2024
5. https://www.youtube.com/watch?v=epAh6hHOq3c assessed on 15th March 2024
6. https://www.youtube.com/watch?v=I1E0RdHw9gU assessed on 15th March 2024
7. https://www.youtube.com/watch?v=CdTx-26q3M8 assessed on 15th March 2024
8. https://www.youtube.com/watch?v=LKW8G_AIYbw assessed on 16th March 2024
9. https://www.youtube.com/watch?v=-0w61b6wppg assessed on 18th March 2024
10. https://www.youtube.com/watch?v=jODl07akVHM assessed on 18th March 2024

XVI List of Major Equipment/Machineries with Specification:

1. Desktop computers with internet facility
2. Box Compression Testing Machine
3. Liquid Voumetric Filling Machine
4. Automatic Box Strapping Machine
5. Box Stapling Machine
6. Shrink Wrapping Machine
7. Pallet Stretch Wrapping Machine

XVII List of Industry Experts and Faculties who contributed for this curriculum:

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1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology.	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4	Dr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
5	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/MT/TX/AE/PK/MK
Course Category	:	GE
Course Code	:	CM291H
Course Title	:	Open Source Technologies

I Rationale:

Studying open-source tools like LaTeX, Canva, and Synfig provides a practical and cost-effective approach to develop essential skills for various professional and creative endeavors. LaTeX is used for document formatting, particularly in academic and scientific writing. Canva equips individuals with the ability to create visually appealing content for presentations, marketing materials, and social media, fostering creativity and design thinking. Synfig empowers users to produce animated multimedia content, supporting the growing demand for dynamic and engaging visual communication.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge to dvelop precise document with formatting, graphic design for visual communication, and animation creation for multimedia. content.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Design** an article using basic command of Latex.

CO2: **Use** Latex tags for Page formatting, tables, images, equations.

CO3: **Design** presentation using Latex Beamer.

CO4: **Create** Poster, Business Card,logo, invitation cards using Canva.

CO5: **Use** Synfig to design annimations.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Latex	1a	Chooose the correct document class to create a book in Latex a. Chapter b. Article c. Book d. Section	1.1	Installation of MikeTeX, Online Overleaf access, TEX and its offspring.	CO1
	1b	Select the syntax to divide the document in sections in latex. a. section{Name of section} b. document class{Section name} c. article{section} d. createSection {Name of section}	1.2	Creating a Title, Sections, Command names, and date arguments, Labelling Table of Contents.	
	1c	Identify the correct command to change the font colour. a. \textcolor b.\setcolor c. \color d. \fontcolor	1.3	Font Effects, Coloured Text, Font Sizes, Comments & Spacing Special Characters, Line breaking.	

	1d	Select the correct command to load packages in latex. a. \usepackage{} b. \setpackage{} c. \package{} d. \createpackage{}	1.4	Document Layout and Organization- Page Layout – Titles, Abstract Chapters, Sections, References, citation, Generating index, Loading packages.	
UNIT II: Page formatting in latex.	2a	Choose the correct option to create a numbered list in Latex. a. itemize b. enumerate c. ol d. ul	2.1	List-making environments, Table of contents, Adding tables, Figure handling , Adding Equations/mathematical expressions.	CO2
	2b	Select the command to set double column in Latex. a. \documentclass[twocolumn]{article} b. \[twocolumn]{article} c. \document[twocolumn]{article} d. \class[twocolumn]{article}	2.2	Parts of the document: Abstract, Chapters, Appendix, Paragraph formatting, Single and double column pages	
	2c	Select the command used to set the footer of a LaTeX document using the \texttt{fancyhdr} package. a)	2.3	Parts of the document: Customized head and foot lines, Page numbering, Fancy header	
	2d	Identify the LaTeX environment used to manually insert a bibliography when a bibliography management package not being used? a) \texttt{bibliography} b) \texttt{bibblock} c) \texttt{thebibliography} d) \texttt{biblio}	2.4	Inserting References: Inserting the Bibliography Styles.	

UNIT III: Latex Beamer	3a	Select beamer command to create a title page in a Beamer presentation. a) \texttt{\textbackslash maketitle} b) \texttt{\textbackslash titlepage} c) \texttt{\textbackslash beamer_title} d) \texttt{\textbackslash titlingpage}	3.1	Introduction to Beamer: The title page, Creating a table of contents, Adding effects ta a presentation.	CO3
	3b	Identify beamer command to change the font for the entire document to a specific size and style. a) \texttt{\textbackslash setfont{}} b) \texttt{\textbackslash usefont{}} c)	3.2	Highlighting important sentences/words. Fonts: Font sizes, Font types , Using Beamer's Fonts, Setting Beamer's Fonts. Columns	
	3c	Select package to be included to handle images in LaTeX. a) \texttt{\textbackslash usepackage {graphicx}} b) \texttt{\textbackslash usepackage {graphics}} c) \texttt{\textbackslash usepackage {imagex}} d) \texttt{\textbackslash usepackage {imaging}}	3.3	Adding tables, mathematical expressions, images to presentations.	

	3d	Choose the correct option to set the color theme to "dolphin" to match the "Berkeley" theme in Beamer presentation. a) \texttt{\textbackslashuse theme{Berkeley}\ textbackslash setcol ortheme{dolphin}} b) \texttt{\textback slash settheme {Berkeley} \textback slash usecolor theme{dolphin}} c) \texttt{\textback slash usetheme{Ber keley}\textbackslashus ecolortheme{dolphin} } d) \texttt{\textbacks lash usetheme {Berk eley}\textbackslashc olortheme{dolphin}}	3.4	Themes and colorthemes: Berkeley theme, Copenhagen theme, Using a colortheme.	
	4a	Identify the primary purpose of Canva templates. a) To download images b) To provide pre-designed layouts for various types of design projects c) To create animations d) To write code	4.1	Logging / Setup Canva Account, Layouts & Templates, the pre-designed layouts, Downloading the work.	

UNIT IV: Basics of Canva	4b	Select the purpose of shapes in Canva designs. a) To create text boxes b) To add visual elements and structure to a design c) To replace photos d) To write code	4.2	Working with text, Photo backgrounds & Shapes, Illustrations, icons and lines, Adding pages to a design.	CO4
	4c	Identify the correct option to add text to a Canva design. a) By clicking on the "Photos" section b) By selecting the "Text" tab and choosing a text box c) By uploading a text file d) By using the "Elements" section	4.3	Adding Images, photo filters, Text features, adding Charts, Album cover.	
	4d	Select is the purpose of a YouTube thumbnail. a) To summarize the video content in a single image b) To attract viewers and increase click-through rates c) To provide additional information about the video d) To create a playlist of videos	4.4	Youtube thumbnail, Twitter header, Facebook post, Ebook cover.	
	4e	Select the feature to add transitions between slides in Canva. a) Animation effects b) Slide sorter c) Background music d) Presenter view	4.5	Documents, Data and charts, Presentation slides.	

UNIT V: Itroduction to Synfig	5a	Select is the correct primary purpose of Synfig. a) Creating 3D animations b) Editing images c) Designing logos d) Producing 2D animations	5.1	Overview of Synfig, Installation of Synfig, Explore the user interface, keyframes.	CO5
	5b	Select the correct panel in Synfig to import and manage images. a) Toolbox b) Parameters c) Canvas d) Layer panel	5.2	Introduction to Layers, Using Pictures In Synfig, including the canvas, toolbox, and layer panel.	
	5c	Identify type of animation in Synfig to create movement in a shape that resembles a celestial object. a) Star animation b) Plant animation c) Basic bone animation d) Logo animation	5.3	Creating Animation Using Synfig: Logo animation, Cutout animation, Underwater annimation, Bouncing ball annimation, Creating star annimation, Plant annimation, Basic bone annimation.	
	5d	Choose the correct text animation option in Synfig to make the text appear as if it is being typed out letter by letter. a) Typewriter b) Write c) Scroll d) Fade In	5.4	Adding text to annimation, text annimation options.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Install Latex and Create a simple document using LaTeX.	2#	CO1
I	2	Design a simple LaTeX document with a title, author, date and add differnt font styles, sizes, and colors. Divide the document into sections and subsections. Add a table of contents and ensure it is updated correctly.	2	CO1
II	3	Develop ordered and unordered lists, nest the lists and customize the list symbols using Latex. Create a Latex document and insert images into the document.	2#	CO2
II	4	Create a Latex document and add a table with rows and columns,add captions. Design a Latex document with Mathematical expression, Equations and Formulas using inline and display math modes. Explore various mathematical symbols and notations. Experiment with complex mathematical equations and formulas. Utilize environments like `align` for multiline equations.	2#	CO2
II	5	Design a Latex document. Add citations to your document using the BibTeX or BibLaTeX system.Create a bibliography section and reference external sources.	2	CO2
II	6	Develop a Latex doument. Add lists of figures and tables. Ensure proper numbering and referencing.Use labels and cross-references for sections, equations, and figures. Verify that references are updated correctly.	2#	CO2
III	7	Create a simple Beamer presentation. Add multiple slides with titles and subtitles. Experiment with different slide themes.	2#	CO3
III	8	Create a simple Beamer presentation with a title, author, and date. Use the `frame` environment to add a slide. Add multiple slides with titles and subtitles. Experiment with different slide themes.	2	CO3
III	9	Insert Images and Tables in Beamer slides.Adjust the size and positioning of images. Create simple tables with rows and columns.Add headers and customize table styles.	2#	CO3

IV	10	Create a Canva account and explore the basic features of the platform. Familiarize with the dashboard and layout options. Design a social media post for a fictional event or promotion. Use Canva's templates, elements, and text tools.	2#	CO4
IV	11	Design an eye-catching Posters using Canva for a school event or project. Experiment with different fonts, colors, and layouts.	2#	CO4
IV	12	Design a canva poster, insert Photo, Enhance a photo using Canva's photo editing tools. Add filters, adjustments, and overlays.	2#	CO4
V	13	Install Synfig on computer. Explore the user interface, including the canvas, toolbox, and layer panel. Draw a simple shape (e.g., a circle or square) and animate its movement across the canvas.Experiment with keyframes to create basic animations.	2#	CO5
V	14	Create a simple Synfig application, Import external images (e.g., PNG, JPEG) into Synfig. Explore techniques for scaling, rotating, and animating imported images.	2#	CO5
V	15	Design Text Animation using Synfig: - Add text to the animation and explore text animation options. - Animate text appearing, moving, or changing color.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Not Applicable.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Latex	4	C	04	06	04	14
			O	00	00	00	0
2	Page formatting in latex.	8	C	02	06	06	14
			O	00	00	00	0
3	Latex Beamer	6	C	04	04	06	14
			O	00	00	00	0
4	Basics of Canva	6	C	02	06	06	14
			O	00	00	00	0
5	Itroduction to Synfig	6	C	02	06	06	14
			O	00	00	00	0
Total		30	C	14	28	28	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q 1 to Q 35	1R2	1R2	1U2	1U2	1U2	1A2	1A2	35/35	
	2R2	2U2	2U2	2U2	2A2	2A2	2A2		
	3R2	3R2	3U2	3U2	3A2	3A2	3A2		
	4R2	4U2	4U2	4U2	4A2	4A2	4A2		
	5R2	5U2	5U2	5U2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Proper Coding	10
2	Debugging	5
3	Output	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	3	3	3	3	-	-
CO2	-	-	-	3	3	3	3	-	-
CO3	-	-	-	3	3	3	3	-	-
CO4	-	-	-	3	3	3	3	-	-
CO5	-	-	-	3	3	3	3	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	LaTeX: A document preparation system, User's guide and reference manual	Leslie Lamport,Addison Wesley, 2nd edition, 1994	978-0201529838
2	The LaTeX Companion, 3rd edition (TTCT series)	Frank Mittelbach with Ulrike Fischer,Addison-Wesley Professional, 3rd edition, 2023	978-0-13-816648-9
3	LaTeX Beginner's Guide	Stefan Kottwitz, Packt Publishing, 1st edition, 2011	978-1847199867
4	Canva Tips and Tricks Beyond The Limits Paperback – Import	Koushik K , 11 December 2020, 1st Edition	978-1-393-25537-6
5	Synfig Studio (English version): 2D Animation	AMC College, First Edition , Advanced Micro Systems Sdn Bhd	978-967-2403-36-4

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3. https://web.mit.edu/rsi/www/pdfs/new-latex.pdf, accessed on 20th May , 2024
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XVI List of Major Equipment/Machineries with Specification:

1. Computer I3 or higher version
2. Desktop Computer: I3 or higher version.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M. V. Sarode	HoD, Computer engineering	Government Polytechnic, Nagpur
2	Dr. M. V. Sarode	HoD, Computer Engineering	Government Polytechnic, Nagpur
3	Dr U B Aher	Lecturer, Computer engineering.	Government Polytechnic, Nagpur
4	Mr. P. S. Thakre	Lecturer, Computer engineering.	Government Polytechnic, Nagpur
5	Dr K L Bawankule	Lecturer, Computer engineering.	Government Polytechnic, Nagpur
6	Dr. Rakesh Kadu	Assistant Professor, IT, RBU	Ramdeobaba College of Engineering Nagpur
7	Mr. Dipak Dhote	Operation Manager	IT-Network Infosystem Pvt Ltd.
8	Mrs. V. A. Raje	System analyst	MSBTE, RO, Nagpur

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HOD & Chairman PBOS, CM

(Dr. G. V. Gotmare)
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/AE/TX/CM/IT/AI/PK/MT
Course Category	:	GE
Course Code	:	MK291H
Course Title	:	Basic Mechatronics

I Rationale:

This curriculum includes basic concepts, principle of working and applications of various electronics and mechanical components that are being used for developing various circuits in industry. This curriculum is essential to provide students with a brief foundational knowledge in this interdisciplinary field. Mechatronics combines mechanical engineering, electronics, computer science, and control engineering to create innovative and efficient systems. This course enables diploma engineer to use various basic electronic and mechanical components for specific applications.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Integrate electronics and mechanical components to create functional mechatronics systems, such as robotics and automated machinery.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** specific basic electronics component for given electronics applications.

CO2: **Design** a logic circuit using various digital electronics components.

CO3: **Select** various transducers and sensors for different mechatronics based applications.

CO4: **Interface** microcontroller with peripheral devices.

CO5: **Use** actuators for various mechatronics based applications.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Basic Electronics	1a	Select the relevant diode for given application	1.1	PN junction diode: Symbol, Construction, working principle, V-I characteristics and applications, Special purpose diodes - Zener diode, LED, Photodiode (Symbol, working principle and applications)	CO1
	1b	Select the transistor for given application	1.2	NPN and PNP transistor: Symbol, Construction, Operating principle, Input-output characteristics, Operating regions of transistor, Applications of transistor as a switch, as an amplifier-circuit diagram and working principle	
	1c	Identify given blocks of regulated power supply with their functions.	1.3	DC regulated power supply: Need and block diagram. Regulators: Need for voltage regulators in power supplies, working of voltage regulator using Zener Diode	

UNIT II: Digital Electronics	2a	Convert the given number into specified number system	2.1	Introduction to digital systems: Number systems - binary, decimal, octal and hexadecimal conversion of one number system to other.binary addition and subtraction	CO2
	2b	Identify symbols and truth tables of given logic gates.	2.2	Logic Gates, Classification of gates: NOT, AND, OR, symbols, truth table, logic equations, universal logic gates - NOR, NAND, symbols, truth table, basic logic gates using universal gates, Exclusive OR/NOR gates	
	2c	Identify given combinational logic circuit	2.3	Combinational logic circuits, Design of half and full adder using k-map, Multiplexers and Demultiplexers: block diagram, truth table, logic expression and logic diagram of 2:1, 4:1, 8:1 MUX, 1:2, 1:4, 1:8 DEMUX	
	2d	Identify sequential logic circuit used for given application	2.4	Flip Flops - Symbols and truth table of D flip flop, T- flip flop, S R Flip Flop, J-K Flip Flop, Shift Register: Logic diagram, Truth Table of 4-bit shift registers (SISO, SIPO, PISO, PIPO), Counters - Asynchronous and synchronous counter	
ensors	3a	Identify type of given transducer	3.1	Definition of transducer, Classification – Active/Passive, Primary/Secondary, Electrical/Mechanical, Analog/Digital and their examples	

UNIT III: Transducers & S	3b	Select the relevant transducer for the given application	3.2	Selection Criteria for transducers Principle of working and application of i. Displacement transducers - LVDT, RVDT ii. Strain Gauge, Load cell, Cantilever arm	CO3
	3c	Select the relevant sensor for the given application	3.3	Definition of sensor, Types of sensor,Principle of working and applications of – i. Pressure Sensors - Bourdon Tube ii. Temperature Sensors - RTD, Thermistors. Iii. Photo sensors – Photodiode, LDR, LED iv. Proximity Sensors – Capacitive, Inductive	
UNIT IV: Microcontroller	4a	Identify type of given microcontroller	4.1	Introduction to 8051 Microcontroller : Architecture, Pin configuration, input-output ports, interrupts, types of microcontroller, Applications	CO4
	4b	Choose interfacing circuit to interface microcontroller with given peripherals	4.2	Interfacing of 8051 microcontroller with LED, switch, seven segment display	
tors	5a	Identify the given actuator with the help of features, specifications, sketch, working principle and applications.	5.1	Actuating Systems – Hydraulic, Pneumatic system, Features, specifications, sketch, working principle and applications of : Pneumatic Actuators - Direction Control Valves – Spool, Poppet, pilot operated, Directional Valves, Valve actuation symbols, Pressure Control Valves – Pressure regulating, Pressure Limiting, Cylinders – Single acting, Double acting	

UNIT V: Actua	5b	Select the relevant actuator for given application	5.2	Mechanical Actuators - Types of motion (Translational, Rotational), Kinematic Chains (Four bar chain, Slider-crank mechanism), Cams (Eccentric, Heart shaped, Pear Shaped), Cam followers, Gears (Gear trains, rack-and-pinion gears), Ratchet & Pawl, Bearings (Plain journal, Ball and roller bearings), Electrical Actuators – Stepper motor – Types (Variable reluctance, Permanent magnet, Hybrid Stepper motor), Stepper motor specifications, Stepper motor Control	CO5

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify and Test PN junction diode using digital multimeter Also Plot VI characteristics in forward biased mode.	2#	CO1
I	2	Build a circuit for transistor as an amplifier on a breadboard and observe it's input and output waveforms.	2#	CO1
I	3	Test performance of zener diode as a voltage regulator.	2#	CO1
II	4	Realize basic gates using NOR/NAND gate and verify truth table.	2#	CO2
II	5	Design the logic circuit for half adder and full adder using logic gates and verify its truth table	2#	CO3
II	6	Identify different pins of 8:1 multiplexer IC , apply input and measure the output. Relate practical output with it's truth table.	2#	CO4
III	7	Measure linear displacement using LVDT.	2#	CO4
III	8	Measure temperature using thermistor.	2#	CO4
III	9	Measure the stress & strain using strain gauges mounted on simply supported beam/cantilever beam.	2#	CO3
IV	10	Develop a program for interfacing LED with 8051 microcontroller	2#	CO4
IV	11	Develop a program for interfacing switch with 8051 microcontroller	2#	CO4
IV	12	Develop a program for interfacing seven segment display with 8051 microcontroller	2	CO4
V	13	Select actuator for given application with justification	2#	CO5
V	14	Develop small circuits using Cam followers, Gears, Ratchet & Pawl, Bearings	2	CO5
V	15	Build Electro-pneumatic circuits for given application	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Basic Electronics	6	C	4	4	6	14
			O	0	0	0	0
2	Digital Electronics	6	C	2	4	8	14
			O	0	0	0	0
3	Transducers & Sensors	6	C	2	4	8	14
			O	0	0	0	0
4	Microcontroller	6	C	2	4	8	14
			O	0	0	0	0
5	Actuators	6	C	4	4	6	14
			O	0	0	0	0
Total		30	C	14	20	36	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	1R2	1U2	1U2	1A2	1A2	1A2	35/35	
2	2R2	2U2	2U2	2A2	2A2	2A2	2A2		
3	3R2	3U2	3U2	3A2	3A2	3A2	3A2		
4	4R2	4U2	4U2	4A2	4A2	4A2	4A2		
5	5R2	5R2	5U2	5U2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-		-	-
CO2	3	-	1	1	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	1	1	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Principles Of Electronic Devices & Circuits	A.K.Theraja, B.L.Theraja, R.S.Sedha S. Chand and Co. Ltd., Reprint, 2005	10: 8121921996 13: 9788121921992
2	Principles of Electronics	Mehta, V.K. Mehta, Rohit, S.Chand, New Delhi, 2014	13: 9788121924504
3	Modern Digital Electronics	Jain R.P, McGraw-Hill Publishing, New Delhi, 2011	13: 9780070669116
4	A course in Electrical and Electronics Measurement and Instrumentation	A.K. Sawhney, Dhanpat Rai Publication, 10th Edition, 1994	13: 9788177001006
5	Mechatronics	Bolton W. Addison Wesley Longman Ltd.,U.S.A 1999	13: 9780582357051
6	Mechatronics	H.M.T. McGraw-Hill Education, New Delhi.2000	10: 0074636435

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2. https://www.electronics-tutorials.ws/accessed on 22nd May 2024
3. https://www.electronics-tutorial.net/analog-integrated-circuits/ accessed on 22nd May 2024
4. https://www.youtube.com/playlist?list=PLLy_2iUCG87BNHXRb6L2pWEpMcLoFaY_U, accessed on 22nd May 2024
5. https://electronicscoach.com/category/electronics-instrumentation, accessed on 22nd May 2024
6. https://www.falstad.com/circuit/ , accessed on 22nd May 2024
7. https://www.youtube.com/watch?v=AuZ00cQ0UrE, assessed on 22nd May 2024

XVI List of Major Equipment/Machineries with Specification:

1. Ammeter- 0-20 μA, 0-50 μA, 0-100 μA, 0-200 μA, 0-5 A, 0-10 A
2. Voltmeter- 0-5 V, 0-15 V, 0-30 V, 0-100 V
3. Digital Multi-meter 3 ½ digits
4. Cathode ray oscilloscope- 0 to 30 MHz
5. Function Generator – 0 -5 MHz.
6. Regulated Power Supply - 0-30 V

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr.G.K.Awari	I/C HOD, Mechatronics Engineering	Government Polytechnic, Nagpur
2	Ms.A.S.Aghav	Lecturer, Mechatronics Engineering	Government Polytechnic, Nagpur
3	Dr.Hemant B. Warkad	Junior Works Manager	OFA, Yantra India Ltd.,Nagpur
4	Dr.Sachin M.Kale	Lecturer in Electronics and Telecommunication	Government Polytechnic, Amravati
5	Prof.Vikas V.Mankar	I/C HOD, Electronics and Telecommunication	Priyadarshini Polytechnic, Nagpur

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	DIPLOMA IN CE/ME/EE/EC/PK/MT/MK/AE/TX
Course Category	:	GE
Course Code	:	AI291H
Course Title	:	Python Programming

I Rationale:

Python is commonly used for developing websites and software, task automation, data analysis, and data visualisation. Since it's relatively easy to learn, Python has been adopted by many non-programmers, such as accountants and scientists, for a variety of everyday tasks, like organising finances. Engineering students should know the basics of python programming in open-source environment. Python lab course is designed for students to enrich the knowledge of different Python terminology. After this course student can build basic programs using fundamental programming constructs like variables, conditional logic, looping, and functions. Also, students can work with user input to create fun and interactive programs.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Demonstrate proficiency in Python Programming.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Use** basic entities of python in programming.

CO2: **Use** Python data structures for implementing the programs.

CO3: **Develop** Python program using control statements.

CO4: **Develop** Python program for implementing Array and NumPy.

CO5: **Develop** python program to show use of function and modules.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Python	1a	Select the correct syntax from given data type.	1.1	Introduction to Python Programming, Variable and Input, Identifiers and Keywords, Integral Types, Floating Point Types.	CO1
	1b	Choose the correct data type for given variable.	1.2	String Data Type: Strings, Comparing Strings, Slicing and Striding Strings, String Operators and Methods.	
	1c	Identify the correct operator from given operator.	1.3	Operators and Expression in Python, Escape Character and Quotes, Type conversion in python.	
Sequencing in Python	2a	Select the correct method for performing given operation on List.	2.1	Introduction to List: Creating List, Access List Items, Change List Items, Add List Items, Remove List Items, List Methods.	CO2
	2b	Identify the correct Tuple method from given methods to perform given operation.	2.2	Introduction to Tuples: Creating Tuple, Access Tuple Items, Update Tuples, Join Tuples, Tuple Methods.	

UNIT II:	2c	Choose the correct output of Dictionaries program from given output.	2.3	Introduction to Dictionaries: Access Dictionary Items, Change Dictionary Items, Add Dictionary Items.	
UNIT III: Decision Making and Looping in Python	3a	Choose the correct syntax of If Else statement from given syntax.	3.1	Introduction to Decision Making in python programming, Introduction to If, If Else and Else if statement in Python and Neste If.	CO3
	3b	Identify the correct output of Loop from given output.	3.2	Introduction to While Loops: Syntax, working and use of While Loop, programs using While Loop.	
	3c	Select the correct syntax of For loop from given syntax.	3.3	Introduction to For Loop: Syntax, working and use of For Loop, programs using For Loop, Difference between While and For Loop.	
UNIT IV: Python Array and NumPy	4a	Choose the correct method from given methods for performing given operation on Array.	4.1	Introduction to Array: Creating Array, Access Array Items, Add Array Items, Remove Array Items.	CO4
	4b	Select the correct syntax of given statement from given syntax.	4.2	Sort Arrays, Array Methods. Syntax, working and use of break, pass and continue Statements.	
	4c	Suggest the correct method from given methods to perform given operation on NumPy.	4.3	Introduction to NumPy: Uses of NumPy, Array Creation using NumPy Object, NumPy Indexing & Slicing, NumPy Mathematical Functions.	
UNIT V: Python Function and Module	5a	Select the syntax of Function from given syntax.	5.1	Introduction to Python Function, Types of Function. Defining a Python Function, Syntax to Define a Python Function.	CO5
	5b	Choose the correct argument type of python function from given types	5.2	Types of Python Function Arguments: Positional or Required Arguments, Keyword Arguments, Default Arguments.	
	5c	Identify the correct Python Module from given Modules for performing given operation.	5.3	Introduction to Python Modules, Python Built-in Modules, Python User-defined Modules, Creating a Python Module.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Install Python IDE and study various notebooks available for python programming.	2#	CO1
I	2	Explore various option given in python IDE.	2	CO1
II	3	Execute given sample programs for getting familiarity with execution environment.	2#	CO2
II	4	Execute simple Python programs for identify the syntax error.	2	CO2
II	5	Develop & Execute small Python programs to create List.	2#	CO2
III	6	Develop & Execute small Python programs to create Tuple.	2#	CO3
III	7	Develop & Execute small Python programs to create Dictionary.	2#	CO3
III	8	Develop & Execute Python programs based on if else statement.	2#	CO3
III	9	Develop & Execute Python programs on while loop statement.	2#	CO3
III	10	Develop & Execute Python programs on for loop statement.	2#	CO3
IV	11	Develop & Execute programs for creation of Array.	2	CO4
IV	12	Develop & Execute programs for creation of Numpy.	2#	CO4
IV	13	Develop & Execute programs for performing different operation on Numpy.	2#	CO4
V	14	Develop & Execute programs create User Define Function.	2#	CO5
V	15	Develop & Execute programs create User Define Module.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Python	4	C	02	04	04	10
			O	00	00	00	00
2	Sequencing in Python	6	C	04	02	08	14
			O	00	00	00	00
3	Decision Making and Looping in Python	6	C	04	04	06	14
			O	00	00	00	00
4	Python Array and NumPy	8	C	04	04	08	16
			O	00	00	00	00
5	Python Function and Module	6	C	04	04	08	16
			O	00	00	00	00
6			C				
			O				
Total		30	C	18	18	34	70
			O	00	00	00	00

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q. 01 to Q.35	1R2	1U2	1U2	1A2	1A2	2R2	2R2	2U2	35/35
	2A2	2A2	2A2	2A2	3R2	3R2	3U2	3U2	
	3A2	3A2	3A2	4R2	4R2	4U2	4U2	4A2	
	4A2	4A2	4A2	5R2	5R2	5U2	5U2	5A2	
	5A2	5A2	5A2						

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Writing Program (Execution	5
2	Performance	10
3	Showing Execution Process and outcome	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	3	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	-	-	3	-	-	3	-	-
CO5	3	-	-	3	-	-	3	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Python Crash Course: A Hands-On, Project-Based Introduction to programming	Eric Matthes, Nostarch Press, 2nd Edition, 2019	13: 9781593279288
2	Learning Python	Mark Lutz, O'Reilly, 5th Edition, 2013	13: 9780596158064
3	Python Programming	Dr. A R Mahajan, Lambert Academia, 1st edition	13: 9786200652034
4	Head-First Python	Paul Barry, O'Reilly, 2nd Edition, 2016	13: 9781491919538
5	Learn Web Development with Python: Get hands-on with Python	Fabrizio Romano, Packt, 1st edition, 2018	13: 9781789953299

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4. https://nptel.ac.in/courses/106/106/106106145/ accessed on 25th Jan. 2024
5. https://www.udemy.com/course/python-the-complete-python-developer-course/ accessed on 2nd Jan. 2024
6. https://www.javatpoint.com/python-tutorial accessed on 20th Feb. 2024

XVI List of Major Equipment/Machineries with Specification:

1. Computer (Dual Core or above)
2. Network printer.
3. COLAB (Open Source)
4. Any Python IDE

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. A. R. Mahajan	HOD, Information Technology	Government Polytechnic, Nagpur
2	Dr. Paresh R. Kamble	Machine learning Specialist	Oz Sportz, Nagpur HQ-Reykjavik, Iceland
3	Dr. V. P. Balpande	Associate Professor	Priyadarshani College of Engineering, Nagpur
4	Mrs. Shifa Aziruddin	Lecturer in Information Technology	Government Polytechnic, Gondia
5	Mr. A. G. Barsagade	Lecturer in Information Technology	Government Polytechnic, Nagpur
6	Mr. R. L. Meshram	Lecturer in Information Technology	Government Polytechnic, Nagpur
7	Dr. S. s. Gharde	Lecturer in Information Technology	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/PK/AIML/MT/MK/AE/TX
Course Category	:	GE
Course Code	:	TR291H
Course Title	:	Agro & Rural Tourism

I Rationale:

Agro & Rural Tourism is main component of emerging rural tourism segment worldwide. Tourist are preferring to access the remote area for the leisure and self-connect purpose. Same time tourist are looking to connect with rural India and explore destination in there nearby area for weekend and weeklong duration. This course is a understanding on the concept of Agri and rural tourism management and how individual and use the concept to the business or career option.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Develop an agro tourism project.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** various types of tourism.

CO2: **Identify** the characteristiucs of rural India.

CO3: **Identify** the products of rural and agro tourism.

CO4: **Prepare** an itinerary and costing for rural and agro tourism visit.

CO5: **Prepare** an agro tourism project.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

** Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction	1a	Distinguish given types of tourism industry.	1.1	Concept of Tourism, Concept of Agro Tourism, Introduction of Tourism Industry: Domestic/ Inbound/ Outbound.	CO1
	1b	Identify the given componets of agro tourism.	1.2	Types of Tourism: Special Interest Tourism, Introduction of Agro Tourism industry.	

UNIT II: Rural India & Tourism products	2a	Identify the given characteristics of rural India.	2.1	Rural India and its characteristics, Rural, Community Based tourism.	CO2
	2b	Identify different products of rural India.	2.2	Different products and case studies, Culture of Rural India, Ethnic food and culinary tourism, art, craft of rural India.	
	2c	Identify different Agri and Farm Tourism Product.	2.3	Different types of Tourism Product associated with Rural, Agri and Farm Tourism Product and its component,	
	2d	Compare given agri tourisum products in in India and Abroad.	2.4	Tourism products related to Agri farm & Rural tourism products in India and Abroad.	
	2e	Identify different types of events related to rural India.	2.5	Type of Events related to agriculture, Rural and Farm culture. Associating Community with tourism.	
UNIT III: Tourism Product, Itinerary, Costing	3a	Prepare an itinerary for rural and agro tourism.	3.1	Itinerary Preparation	CO3
	3b	Estimate the cost for itinerary for rural and agro tourism.	3.2	Costing of the tourism products, Component supporting the costing of the products etc. Home stay & Rural Stay.	

UNIT IV: Sales & Marketing	4a	Classify the given products according to the target audience and market.	4.1	Classifcation of the product according to the target audience and market.	CO4
	4b	Differetiate between offline and online marketing and promotion.	4.2	Different offline and online marketing and promotional approach.	
	4c	Compare B2B and B2C market approach on given points.	4.3	B2B and B2C market approach.	
	4d	Identify the steps to Lead generation, and Lead conversation.	4.4	Lead generation, Lead conversation.	
	4e	Identify Do’s and Don't before, during and after the tours.	4.5	Do’s and Don't before, during and after the tours. Art to attract repeat customers.	
UNIT V: Tourist behavior	5a	Identify the behavioural characteristics of the tourist at the destination.	5.1	Behaviour of the tourist at the destinations.	CO5
	5b	Identify the behavioural characteristics of the staff at the destination.	5.2	Behaviour of tourism staff, Expectation and outcome of the tour, communication during the tour.	
	5c	Prepare feedback form.	5.3	Feedback and testimonials.	
	5d	Prepare documentation required for registration of agro tourism business.	5.4	Agro Tourism Registration Process, Documentation, Timeline & Fee.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Prepare a List of Best Rural Tourism Destination with Details.	2#	CO1
I	2	Present Best Tourism Activities for the Agro & Rural Tourism Setup.	2#	CO1
I	3	List down and present in class top 10 destination of Domestic Holidays for your family.	2#	CO1
I	4	List down and present in class top 10 destination of International Holidays for your family.	2#	CO1
II	5	Prepare a case study on rural and agro tourism of Vidarbh region.	2#	CO2
II	6	Prepare report on associating community with tourism.	2	CO2
III	7	Prepare an itinerary for agro tourism visit.	2#	CO3
III	8	Estimate the cost for the itinerary for agro tourism visit.	2#	CO3
IV	9	Prepare the Agro Tourism catalog for marketing activity.	2#	CO4
IV	10	Prepare a chart shdepecting the target audience and market.	2#	CO4
IV	11	Prepare a campaign for lead generation and lead conversion.	2#	CO4
V	12	Prepare a feedback form.	2#	CO5
V	13	Prepare documentation for registration of agro tourism business.	2#	CO5
V	14	Prepare Comparison Chart of 5 Best Agro Tourism Center of Vidarbha and Present in Class.	2	CO5
V	15	Prepare One District One Product list of Vidarbha.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction	4	C	4	4	6	14
			O	0	0	0	0
2	Rural India & Tourism products	6	C	2	6	6	14
			O	0	0	0	0
3	Tourism Product, Itinerary, Costing	6	C	2	6	6	14
			O	0	0	0	0
4	Sales & Marketing	8	C	2	6	6	14
			O	0	0	0	0
5	Tourist behavior	6	C	2	6	6	14
			O	0	0	0	0
Total		30	C	12	28	30	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q 1 to Q 35	1R2	1R2	1U2	1U2	1A2	1A2	1A2	35/35
	2R2	2U2	2U2	2U2	2A2	2A2	2A2	
	3R2	3U2	3U2	3U2	3A2	3A2	3A2	
	4R2	4U2	4U2	4U2	4A2	4A2	4A2	
	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Performance	10
2	Presentation	10
3	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	3	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	2	-	3	2	2	3	-	-
CO5	3	2	1	3	2	2	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Perspectives on Rural Tourism Geographies	R S Koster, Springer, 2019	13: 978-3-030-11950-8
2	Sustainable Rural Tourism in Himalayan Foothills	Suneel Kumar, Springer Cham, 2023	13: 978-3-031-40098-8
3	Rural Tourism: Need, Scope and Challenges in Indian Context	Kuldeep Singh, Arnab Gantait, Goldi Puri, G. Anjaneya Swamy 2016	13: 9788184354904

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2. https://www.rural.tourism.gov.in/images/pdf/National%20Strategy%20of%20Rural%20Tourism_May%202022.pdf assessed on 17th May 2024
3. https://maharashtratourism.gov.in/wp-content/uploads/2024/06/Agri-Tourism-Policy.pdf assessed on 17th May 2024
4. https://hwb.gov.wales/api/storage/3f708892-2cfe-4b78-bed2-2ec90ce5fc52/Section1-IntroducingTourism.pdf assessed on 17th May 2024

XVI List of Major Equipment/Machineries with Specification:

1. Interactive Smart Board

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. P.P. Virkhare	HOD, Travel and Tourism	Government Polytechnic, Nagpur
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5	Mr. Adityashekhar Gupta	Director	Horizon Holidays, Nagpur
6	Dr. Arvind Upasani	Visiting Lecturer	RSTM Nagpur University, Nagpur
7	Mr. Vikas Tembhare	Director	DTORR, Nagpur

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(Dr. G. V. Gotmare)
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Semester IV

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK205H
Course Title	:	Packaging Printing: Offset, Screen, and Digital Technology

I Rationale:

Printing plays a vital role in packaging by enabling product identification, delivering essential information, and attracting consumer attention. This course introduces students to three major printing technologies used in packaging: offset, screen, and digital printing. Offset printing is well-suited for medium to long production runs with consistent, high-quality output. Screen and digital printing offer flexibility for short runs and specialized applications. Through this course, students will gain a comprehensive understanding of the processes, capabilities, and applications of these technologies within the context of modern packaging requirements.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge of Offset, Screen, and Digital Technologies for packaging printing.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Use** graphics software for halftone conversion and color separation, while applying aesthetic principles and basics of printing technology.

CO2: **Perform** line composition and manual printing using letterpress types while demonstrating an understanding of the letterpress printing process and its applications.

CO3: **Design** artwork for folding cartons, perform pre-sensitized plate-making, and identify offset printing defects, demonstrating their understanding of offset printing principles.

CO4: **Prepare** screens, perform manual and semi-automatic screen printing, and identify printing defects while demonstrating an understanding of screen printing principles.

CO5: **Integrate** aesthetic principles in packaging design, understand the printing process workflow, and apply graphics software for halftone conversion and digital color separation, producing printed work that reflects their learning.

CO6: **Perform** 3D printing operation by generating a G-code using slicing software, operating a 3D printer to fabricate objects, and applying post-processing techniques to improve the final output.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction	1a	Justify the importance of aesthetics in packaging decoration and printing.	1.1	Aesthetics; definition, importance, elements of aesthetics for packaging decoration.	CO1
	1b	Compare Prepress, Press & post press operations.	1.2	Importance of Printing for packaging. Printing Process work flow in general - Prepress, Press & post press.	
	1c	Classify various printing processes.	1.3	Introduction to Various Printing processes, classification.	
	1d	Identify various elements of a given Printing Process.	1.4	Important terminologies; Image carriers, types of substrates, layout, artwork, line work and halftone work, scanning, colour separation, colour correction, registration, process inks, special colours, ink drying systems. Pre make-ready and make-ready.	
	1e	Justify the role of computer in printing.	1.5	Role of computer in Printing.	

UNIT II: Letterpress Printing	2a	Describe with justification the Letterpress printing process including its advantages and limitations.	2.1	Principle of Letterpress printing (LPP), advantages and limitations of this process.	CO2
	2b	Describe with justification preparaion of an image carrier for Letterpress printing.	2.2	Image carriers; Metal and wooden. Metal Type; block composition.	
	2c	Compare the given types of letterpress printing machines.	2.3	Printing machines; Construction & working of light platen and heavy platen machines. (brief)	
	2d	Compare die cutting, embossing and foil stamping on the basis of given points.	2.4	Other than printing applications of LPP machines, like die cutting, embossing and foil stamping.	
UNIT III: Offset Printing	3a	Describe with justification the Offset printing process including its advantages and limitations.	3.1	Offset Printing; Principle, overview of offset printing process, advantages & limitations and applications. Substrate types.	CO3
	3b	Compare the given plate making process.	3.2	Offset Image Carriers - Plate material, types of plates. Plate making process; Deep etch plate, Pre sensitized plates. Auto plate processor; construction and working, Computer to plate system (CTP); plate making process, advantages and limitations.	
	3c	Identify and Iluustrate the construction and working principles of given type of offset printing machine.	3.3	Offset printing machines (construction and working); Sheet fed offset - single colour, two colour, multicolour and perfecting press. Web fed offset printing machines - Inline, blanket to blanket and common impression press.	

	3d	Draw the printed folding carton manufacturing process chart.	3.4	Folding carton (printed) manufacturing process; Designing-plate making-printing-die cutting-finishing and packing.	
	3e	Identify the given defects in offset printing and write causes and suggest remedies to them.	3.5	Offset inks; types and their compositions. Process inks; concept. Offset Printing defects, causes and probable remedies.	
UNIT IV: Screen Printing	4a	Justify the Screen printing process and its advantages and limitations.	4.1	Principle of Screen printing, advantages & limitations and applications.	CO4
	4b	Identify the given image carrier materials.	4.2	Image carrier material; Types of - frames, fabrics and filaments, squeegees, clamps.	
	4c	Differentiate between given type of Stenciling Techniques.	4.3	Screen making or stencilling techniques: Direct, Indirect and Direct indirect methods.	
	4d	Identify various stenciling methods (direct, indirect, and directindirect) for screen making.	4.4	Screen Printing Process; Manual, Construction and working principles of - semi-automatic and automatic machines and their applications. Printing defects in screen printing, probable causes and remedies.	
	4e	Justify the given ink Screen Printing Ink formula.	4.5	Screen Printing Inks; composition or formulation of different types of inks and their applications.	
nd Elctrophotography	5a	Compare the given type of Inkjet Printing Process.	5.1	Inkjet Printing: Introduction to inkjet printing, drop on demand and continuous inkjet process, types of inkjet printers - thermal and piezoelectric.	
	5b	Justify the given applications of Inkjet Printing.	5.2	Applications of Inkjet Printing in both industrial and consumer markets. Advantages and limitations.	

UNIT V: Inkjet Printing ar	5c	Describe with justification Elctrophotographic concept, advantages and applications.	5.3	Electrophotography: Introduction, advantages and applications.	CO5
	5d	Compare single color digital press with multicolor.	5.4	Electrophotography Process (laser printing technology); Construction and working (steps).	
	5e	Justify Xerographic concept, advantages and applications.	5.5	Multicolour Digital Presses; Construction and working.	
UNIT VI:3D Printing	6a	Justify the 3D printing concept, advantages and applications.	6.1	3D Printing; Introduction, advantages and limitations.	CO6
	6b	Identify the material used in 3D Printing.	6.2	3D Printing; Material and machine - raw material, construction and working principle of the machine.	
	6c	Draw the flow chart showing entire 3D printing process and justify each steps.	6.3	3D Printing Process; 3D modelling (G-code generation & Modification), slicing and additive layering with Fused Deposition Modelling (FDM): Melting and extruding thermoplastic filament.	
	6d	Identify finished 3D printed product.	6.4	Post-processing: finishing steps, such as cleaning, curing, or painting, to achieve the desired look and functionality.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Use desktop computer & graphics software to convert a continuous tone image to a halftone image OR Line work to halftone work. Take printout of the work done and prepare a brief report.	2#	CO1
I	2	Perform digital color separation work using desktop computer & graphics editing software. Take printout of the work done and prepare a brief report.	2#	CO1
II	3	Prepare simple relief image carrier using metal types/wooden carving. Take printout of the work done and prepare a brief report.	2#	CO2
III	4	Design an artwork for the matter to be printed on folding cartons. Take printout of the work done. Prepare a short report on the process.	2#	CO3
III	5	Prepare a Pre-sensitized Plate for offset printing. Prepare a report of the process.	2	CO3
III	6	Print a job on a baby offset/model with the PS plate prepared in previous practical. Take manual print/proof of the word done.	2	CO3
III	7	Identify offset Printing defects. Collect samples and prepare report based on causes and remedies.	2#	CO3
IV	8	Prepare Screen by direct/ direct indirect/ indirect method of screen making. Prepare a report of the process.	2#	CO4
IV	9	Carry out Screen Printing manually / using semi-automatic screen printing machine (single color Job).	2#	CO4
IV	10	Carry out Screen Printing manually / using semi-automatic screen printing machine (multi-color Job).	2#	CO4
IV	11	Identify screen printing defects. Collect samples and prepare report based on causes and remedies.	2	CO4
V	12	Disassemble a Laser Printer to Identify its key components. Group activity; carefully disassemble a laser printer, observe the parts, and write a report on the major elements and their function.	2#	CO5

V	13	Disassemble a Inkjet Printer to Identify its key components. Group activity; carefully disassemble a laser printer, observe the parts, and write a report on the major elements and their function.	2	CO5
VI	14	Observe and analyze the working of a 3D Printer; Observe the 3D printer as it prints an object, noting the movements of the print head and the printing process.	2#	CO6
VI	15	Generate and modify G-Code for 3D Printing; Create and modify G-code for a simple 3D print job using slicing software to control print settings.	2#	CO6
VI	16	**3D Printing and post-processing finishing techniques:** Print a 3D object and apply post-processing techniques like sanding and support removal to enhance the final print.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1 Create a Glossary of Printing Terminology.

2 Prepare a report on Letterpress Printing, Visit a local letterpress printer, observe the activities and note the step-by-step process of how letterpress printing works including typesetting, inking, and impression.

3 Design a simple letterpress print layout. Find a local letterpress printing workshop or online resource. Design a Simple Letterpress Print Using software (or by hand), Focus on typography and layout, then research how this design could be produced using a traditional letterpress printer.

4 Analyse the Multicolour Offset Printing Process. Visit an offset printer or watch videos or read an article detailing the offset printing process. Write a summary, explaining the role of the plates, ink, water and press in creating high-quality prints.

5 Create an artwork for an Offset Printed Brochure. Design a simple brochure layout using graphic design software (e.g., Adobe Illustrator or Corel Draw or Page maker). Research how offset printing would be used to reproduce the same.

6 Conduct a case study on the Applications of Screen Printing in Various Industries. Research how screen printing is used in different industries such as packaging, fashion, advertising, and electronics. Create a presentation or report summarizing these applications.

7 Conduct a case study on digital printing technologies in terms of quality, cost, and environmental impact. Write a report on the pros and cons of each method for different use applications.

8 Explore a 3D Printer Applications. Visit a 3D printing facility. Document the printing process, including file preparation, G-code generation, and the actual printing of an object. Research on; different types of 3D printers, present applications and future scope.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction	6	C	2	4	6	12
			O	2	0	6	8
2	Letterpress Printing	6	C	2	4	4	10
			O	0	4	0	4
3	Offset Printing	10	C	2	8	6	16
			O	0	4	4	8
4	Screen Printing	9	C	2	4	6	12
			O	2	4	0	6
5	Inkjet Printing and Elctrophotography	6	C	2	4	4	10
			O	0	0	6	6
6	3D Printing	8	C	0	4	6	10
			O	0	4	4	8
Total		45	C	10	28	32	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	5R2	1R2	4R2	5	7
2	1U4	2U4	3U4	4U4	6U4			3	5
3	4U4	5U4	6U4	2U4	3U4			3	5
4	2A4	3U4	5A4	3A4	6A4			3	5
5	1A6	3A6	5A6					2	3
6	4A6	6A6	1A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	3	3	3	-	2	3	-
CO2	3	-	3	3	3	-	-	3	-
CO3	3	1	3	3	3	-	-	3	1
CO4	3	1	3	3	3	-	-	3	1
CO5	3	-	3	3	3	-	2	3	-
CO6	3	-	3	3	3	-	2	3	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
2	Letterpress Printing A Manual for Modern Fine Press Printers	Oak Knoll Press	13:9780712349123
3	Letterpress Now A DIY Guide to New & Old Printing Methods	Lark Crafts	13:9781454703297
4	Hand Book of Offset Printing Technology	Engineers India Research Institute	13:9788186732823 10: 8186732829
5	3D Printing Understanding Additive Manufacturing	Carl Hanser Verlag GmbH & Company KG	13:9781569907573 10: 1569907579
6	3D Printing For Dummies	Wiley	13:9781119386315 10: 1119386314
7	Fundamentals of Inkjet Printing The Science of Inkjet and Droplets	Stephen D. Hoath, Wiley, 14 March 2016	13:9783527337859 10:3527337857
8	The Digital Print	Jeff Schewe 2013, Pearson Education	13:9780133375749 10:0133375749

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XVI List of Major Equipment/Machineries with Specification:

1 Single color Semiautomatic Screen Printing Machine.

2 Models or small size Sheet fed Offset, Flexographic and Gravure Printing Machines.

3 Desktop computers & latest designing software - Photoshop / CorelDraw / Page Maker.

4 Color Laser Printer - A4 Size.

5 UV plate exposing machine.

6 3D Printer

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
2	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
3	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
5	Dr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
6	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
7	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
8	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

(Mr. Syed Imran Ahmed K.)
HOD & Chairman PBOS, PK

(Dr. G. V. Gotmare)
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Government of Maharashtra
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(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK206H
Course Title	:	Folding Cartons & Corrugated Boxes

I Rationale:

In the packaging industry, folding cartons and corrugated boxes are among the most widely used packaging solutions. To design, convert, and apply these effectively, it is essential to understand the raw materials—primarily paperboard and corrugated board—their properties, structure, and behavior during conversion processes. This course provides foundational knowledge of paperboard and corrugated board materials, their manufacturing and conversion techniques, structural design, and practical applications in packaging. It prepares students with the skills needed to work with various carton and box formats used across industries.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Comprehend the knowledge of papers and their conversion processes for packaging applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** the given types of paperboard materials used in folding cartons and appriciate sustainability.

CO2: **Evaluate** carton designs and test for balance between aesthetics and functionality.

CO3: **Apply** modern trends in carton manufacturing, such as laser cutting, by observing demonstrations

CO4: **Operate** machines for converting corrugated boards into boxes, and demonstrate sealing methods.

CO5: **Evaluate** testing methods and conduct compression tests on corrugated boxes.

CO6: **Evaluate** quality control measures and perform simple quality checks.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
4	-	4	2	10	5

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Material Selection for Folding Cartons	1a	Identify the given types of paperboard materials used in folding cartons.	1.1	Folding Cartons; Introduction. Raw material; Paperboards: SBS (Solid Bleached Sulfate), FBB (Food and Beverage Board), WLC (White Lined Chipboard), their composition and applications, Glue; composition.	CO1
	1b	Compare various coatings and laminates.	1.2	Board coating and lamination processes: UV coatings, aqueous coatings, PE laminates, and their applications.	
	1c	Calculate the given strength parameter using standard testing methods for Paperboards.	1.3	Grain direction, caliper selection and typical properties; whiteness, stiffness, Bursting Strength, GSM or Grammage, and Cobb, folding endurance test.	
	1d	Justify the importance of using Sustainable materials in folding carton manufacturing.	1.4	Sustainable materials: Recyclable, biodegradable, and compostable paperboards; concepts and importance.	

	1e	Justify the importance of FDA compliant packaging.	1.5	Food safety standards (FDA, EU) and compliance for food-grade packaging (folding cartons); glimpses.	
UNIT II: Structural Design and Prototyping of Folding Cartons	2a	Identify and sketch the structural elements of a folding carton.	2.1	Basic design elements: Tucks or tabs, flaps, locking mechanisms, and their impact on carton strength.	CO2
	2b	Justify the importance of using CAD tools in prototyping.	2.2	CAD tools (Introduction): ArtiosCAD, Packly, and prototyping techniques and there advantages.	
	2c	Apply the nesting concept for Folding Carton Manufacturing.	2.3	Die-line creation, nesting for material optimization, and common errors to avoid.	
	2d	Compare different folding carton styles.	2.4	Carton styles (features): Straight tuck end, reverse tuck end, crash lock (self-locking bottom), specialty cartons and their industrial uses.	
	2e	Justify the importance of branding elements and functional considerations in folding cartons designs.	2.5	Incorporating branding elements and functional considerations.	
Processes for Folding Cartons	3a	Compare different steps in folding carton manufacturing on given points.	3.1	Overview of folding carton manufacturing (steps): Material selection, Printing, die-cutting, folding, and gluing. Printing with offset press; overview.	CO3
	3b	Identify the given elements of a flat die and blanking tools.	3.2	Die-cut & punching; process steps. Flat die; construction, elements and their functions. Blanking tools.	
	3c	Justify the use of platen press for die cutting and punching.	3.3	Uses of platen press for die cutting & punching.	

UNIT III: Manufacturing	3d	Justify the importance of laser cutting process in folding carton manufacturing.	3.4	Laser cut cartons; Manufacturing process steps, advantages and limitations.	
	3e	Identify the elements of a tetra pack wall structure and style of cartons.	3.5	Tetra pak; Introduction, raw material, mfg. process , Tetra pack wall structure; functions of each element. Different styles of tetra pack cartons, their applications.	
UNIT IV: Raw Materials and Components for Corrugated Boxes	4a	Identify differences between folding cartons and corrugated boxes by categorizing samples.	4.1	Corrugated Fiberboard Box (CFB); Introduction, carton and box comparison. Raw material; Liner board, fluting medium and Adhesive. Corrugated Fiberboard and Solid fiberboard comparison.	CO4
	4b	Compare different types of corrugated boards and flutes by handling and investigation.	4.2	Types of flutes: their specifications and applications. Types of Corrugated fiberboards: Singe Facer, Single-wall, double-wall, triple-wall structure and applications.	
	4c	Justify the importance of the raw material used for glue formation.	4.3	Glue formulation; glue kitchen, raw material, glue making. Glue consumption.	
	4d	Justify the importance of various operations involved in corrugated box manufacturing (CFB).	4.4	Creasing, slotting, die-cutting, gluing, taping, and sealing operations with machines used.	
	4e	Compare Single-piece with two-piece blanks on given points.	4.5	Single-piece vs. two-piece blanks: Construction, applications, and benefits.	
r Corrugated	5a	Justify the importance of various structural design considerations for a corrugated board manufacturing.	5.1	Structural design considerations: Wall thickness, flutes type, and box dimensions. (Internal and Outer)	

UNIT V: Structural Design and Box Styles fo Packaging	5b	Compare various corrugated box styles on given points.	5.2	Corrugated box styles: RSC, HSC, die-cut boxes, and trays; advantages and limitations and applications.	CO5
	5c	Justify the importance of different styles of palletiziting corrugated boxes.	5.3	Corrugated Box Palletization- Brick Style, Other Styles, Advantages and Limitations.	
	5d	Justify the importance of modern software used for prototyping.	5.4	Software for prototyping; Introduction.	
	5e	Find out the strength of the corrugated board by given IS testing methods.	5.5	IS testing methods: BS, BCT, ECT, and RCT, Puncture Resistance, Cobb test.	
UNIT VI: Corrugated Box Manufacturing Processes	6a	Justify the importance of construction and working of single facer corrugator.	6.1	Board Making; Single facer corrugation unit - construction and working.	CO6
	6b	Compare different steps in CFB box manufacting on given points.	6.2	CFB Box Manufacturing steps; Board making – Printing – Slotting/die cutting- folding-gluing – bundling.	
	6c	Compare different steps in CFB box manufacting on given points and bundling & Strapping.	6.3	Flexographic printing: operational steps. Slotting & Die-cutting; process. Circular die; elements and functions of each element. Folding, gluing, and bundling process- steps. Box strapping process. (Strapping Machine)	
	6d	Justify the importance of various standard quality control tests.	6.4	Standard Quality control tests: Grammage, caliper, Box Compression Test, Cobb, Delamination resistance. Barcode Scanning – readability.	
	6e	Identify the defects in CFB Box manufacturing and Propose remedies.	6.5	Common Quality Issues; washboards, soft boards, and improper joints, fishtailing and delamination. Probable Causes and remedies.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify and compare various types of paperboards used in the production of folding cartons. Collect samples of three different types of cartons; compare the characteristics such as style of carton, board colour, texture, thickness and weight. (Part 1)	2#	CO1
I	2	Identify and compare various types of paperboards used in the production of folding cartons. Collect samples of three different types of cartons; compare the characteristics such as style of carton, board colour, texture, thickness and weight. (Part 2)	2#	CO1
I	3	Conduct tests to determine the grain direction of the paperboard. (Part 1)	2#	CO1
I	4	Conduct tests to determine the grain direction of the paperboard. (Part 2)	2#	CO1
I	5	Conduct the test to determine the whiteness of the paperboard. (Part 1)	2	CO1
I	6	Conduct the test to determine the whiteness of the paperboard. (Part 2)	2	CO1
I	7	Carry out the burst strength test and calculate the burst factor of the paperboard. (Part 1)	2#	CO1
I	8	Carry out the burst strength test and calculate the burst factor of the paperboard. (Part 2)	2#	CO1
I	9	Perform folding endurance test – for paperboard.(Part 1)	2	CO1
I	10	Perform folding endurance test – for paperboard.(Part 2)	2	CO1
II	11	Prepare a report on comparision of different folding carton styles by collecting any three samples. (Part 1)	2#	CO2
II	12	Prepare a report on comparision of different folding carton styles by collecting any three samples. (Part 2)	2#	CO2
II	13	Design a basic folding carton style. Draft the design on paperboard, ensuring correct dimensions and folding lines. Cut and fold the carton to demonstrate the style. (Part 1)	2#	CO2
II	14	Design a basic folding carton style. Draft the design on paperboard, ensuring correct dimensions and folding lines. Cut and fold the carton to demonstrate the style. (Part 2)	2#	CO2

III	15	Create a prototype of a folding carton based on the previous (Practical No - 2) design. Cut, crease, and fold the carton prototype. Glue or tape the carton as needed. Measure the internal and external dimensions of the same. (Part 1)	2#	CO3
III	16	Create a prototype of a folding carton based on the previous (Practical No - 2) design. Cut, crease, and fold the carton prototype. Glue or tape the carton as needed. Measure the internal and external dimensions of the same. (Part 2)	2#	CO3
III	17	Prepare a report on "Elements of a Flat Die" by observing a real flat die. (Part 1)	2#	CO3
III	18	Prepare a report on "Elements of a Flat Die" by observing a real flat die. (Part 2)	2#	CO3
VI	19	Conduct Cobb test to find out water absorptiveness of kraft paper/ paperboard/corrugated fiberboard. (Part 1)	2#	CO4
VI	20	Conduct Cobb test to find out water absorptiveness of kraft paper/ paperboard/corrugated fiberboard. (Part 2)	2#	CO4
VI	21	Exploring Corrugated Fiberboard Types. Identify and compare three different types of corrugated fiberboards. Inspect and compare them on the basis of Board thickness, Flute type and Flute count. (Part 1)	2#	CO4
VI	22	**Exploring Corrugated Fiberboard Types:** Identify and compare three different types of corrugated fiberboards. Inspect and compare them on the basis of Board thickness, Flute type and Flute count. (Part 2)	2#	CO4
V	23	Conduct Edge crush / Ring crush test/ Flat crush test to find out edge crush strength of corrugated fiber board. (Part 1)	2#	CO5
V	24	Conduct Edge crush / Ring crush test/ Flat crush test to find out edge crush strength of corrugated fiber board. (Part 2)	2#	CO5
V	25	Perform Puncture test to find out puncture resistance of paperboard/ corrugated fiber board. (Part 1)	2	CO5
V	26	Perform Puncture test to find out puncture resistance of paperboard/ corrugated fiber board. (Part 2)	2	CO5
V	27	Measure Internal and External Dimensions of a Regular Slotted Container (RSC) Box. (Part 1)	2#	CO5

V	28	Measure Internal and External Dimensions of a Regular Slotted Container (RSC) Box. (Part 2)	2#	CO5
VI	29	Operate Single Facer - Corrugated Board Making Machine. Set up the machine for two ply board production. Feed the material into the machine and execute the board-making process. (Part 1)	2#	CO6
VI	30	Operate Single Facer - Corrugated Board Making Machine. Set up the machine for two ply board production. Feed the material into the machine and execute the board-making process. (Part 2)	2#	CO6
VI	31	Operate creasing and slitting machine. Set up machine for a suitable job. Execute creasing and cutting operation. (Part 1)	2#	CO6
VI	32	Operate creasing and slitting machine. Set up machine for a suitable job. Execute creasing and cutting operation. (Part 2)	2#	CO6
VI	33	Identify and resolve common defects in box making. Collect and inspect boxes for common defects such as fishtailing, delamination, soft board, or poor slotting. Identify the causes of the defects and suggest corrective actions. (Part 1)	2#	CO6
VI	34	Identify and resolve common defects in box making. Collect and inspect boxes for common defects such as fishtailing, delamination, soft board, or poor slotting. Identify the causes of the defects and suggest corrective actions. (Part 2)	2#	CO6
VI	35	Operate Box Stapler and Strapping Machine to Seal and Reinforce Corrugated Boxes. (Part 1)	2#	CO6
VI	36	Operate Box Stapler and Strapping Machine to Seal and Reinforce Corrugated Boxes. (Part 2)	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Research and Select the Best Paperboard for Packaging: Select a product (e.g., food or cosmetic product) and determine the most suitable paperboard type (SBS, FBB, WLC, Kraft) for packaging. Justify your choice based on factors such as strength, printability, recyclability, and cost. Provide a detailed report on your findings.
2. Design a Folding Carton for a Product: Choose a product and design a suitable folding carton style (e.g., tuck-end, die-cut, snap-lock). Create a prototype or a CAD drawing of the carton and explain the design considerations, such as material, size, and ease of assembly. Submit a report on your design choices.
3. Study the Manufacturing Process of Corrugated Board: Research the corrugated board manufacturing process, including raw material selection, corrugation, gluing, and pressing. Focus on the differences between flute profiles (A, B, C, E). Write a report comparing the properties and uses of different flutes
4. Conduct a Burst Strength Test on Paperboard: Conduct the Burst Strength Test on various paperboard samples. Calculate the burst factor and analyze how different factors (e.g., board thickness, type) affect burst strength. Prepare a report on your findings and discuss the impact of burst strength on packaging durability.
5. Investigate Quality Control in Folding Carton Manufacturing: Select a folding carton sample and perform quality control checks such as BCT, ECT, and Grammage. Identify defects such as fishtailing or improper gluing, and propose corrective measures. Document your observations and suggest improvements.
6. Explore Sustainable Packaging Alternatives: Research sustainable packaging materials, such as biodegradable films, recycled paperboard, and plant-based plastics. Select one material for a product packaging solution. Compare its environmental impact with traditional materials and prepare a report on your findings.
7. Design a Corrugated Box for Shipping a Fragile Product: Design a corrugated box to ship a fragile product (e.g., glassware, electronics). Select the appropriate flute profile and discuss how the box design ensures protection. Create a prototype (or diagram) and justify your design choices based on product fragility and shipping conditions.
8. Study Die-Cutting and Slotting Machines for Packaging Production: Research die-cutting and slotting machines used in folding carton and corrugated box manufacturing. Explore how these machines work, their types, and their applications in the industry. Prepare a report on their construction, working principles, and efficiency in packaging production.
9. Investigate the Role of Automation in Packaging Production: Explore how automation improves the efficiency and quality of folding carton and corrugated box production. Focus on automated processes such as die-cutting, gluing, and packaging lines. Propose improvements for integrating automation into a packaging production line and summarize your findings in a report.

10. Analyze Defects in Packaging and Suggest Solutions: Select a packaging sample and identify defects like fishtailing, delamination, or weak joints. Conduct tests to assess the severity of the defects, and propose solutions or improvements to eliminate or reduce these issues. Prepare a report detailing your findings and corrective measures.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Material Selection for Folding Cartons	8	C	2	4	6	12
			O	2	0	6	8
2	Structural Design and Prototyping of Folding Cartons	12	C	0	4	6	10
			O	0	4	0	4
3	Manufacturing Processes for Folding Cartons	10	C	2	4	6	12
			O	2	4	0	6
4	Raw Materials and Components for Corrugated Boxes	8	C	2	4	6	12
			O	0	4	4	8
5	Structural Design and Box Styles for Corrugated Packaging	12	C	2	4	4	10
			O	0	0	6	6
6	Corrugated Box Manufacturing Processes	10	C	2	8	4	14
			O	0	4	4	8
Total		60	C	10	28	32	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	3R2	4R2	5R2	6R2	1R2	3R2	5	7
2	1U4	2U4	6U4	3U4	2U4			3	5
3	4U4	5U4	6U4	4A4	6U4			3	5
4	3U4	5A4	6A4	6A4	4U4			3	5
5	1A6	3A6	5A6					2	3
6	2A6	4A6	1A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	1	-	-	3	-
CO2	3	-	1	2	-	-	2	3	2
CO3	3	-	-	-	-	-	-	3	-
CO4	3	-	1	-	-	-	-	3	-
CO5	3	-	-	2	-	-	2	3	2
CO6	3	-	-	2	-	-	2	3	2

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Fundamentals of Packaging Technology	S. Natrajan, M. Govindrajan, B. Kumar, PHILPL, 2E, 2014.	13: 978-81-203-5054-0
2	Handbook on Pulp & Paper Industries	SIRI Board of Consultants & Engineers, SIRI Pub., 1990.	10: 81-85480-24-9
3	The Wiley Encyclopedia of Packaging Technology	Kit L. Yam,, John Wiley & Sons Inc.,3E, 2010.	13: 9780470541395
4	The Packaging Designers Book of Patterns	Laszlo Roth, George L/ Wybenga, Wan Nostrand, Reinhold, 1991.	10: 0-442-00524-5
5	Paper, Paper Converting, Plastics & Other Pkg. Ind.	R. K. Kush, SBP Pub. Co., 1995.	--
6	Handbook of Pulp & Paper Technology	Kenneth W. Britt, CBS Publishers, 2E, 2004.	13: 9788123911441, 10: 8123911440

XV e-References:

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XVI List of Major Equipment/Machineries with Specification:

1. Analog Substance Indicator/GSM Tester/ Electronic Weighing Machine.
2. Bursting Strength Tester.
3. Universal Testing Machine.
4. Compression Tester- ECT/FCT/RCT, etc.
5. Thickness Gauge.
6. Puncture Strength Tester.
7. Brightness Tester.
8. Folding Endurance Tester.
9. Sigle Facer- corrugattor machine
10. COBB Tester
11. Creasing and cutting machine
12. Portable staplers, Box stitching machine & Box strapping machine

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology.	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
5	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
-6	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

(Mr. I. A. K. Syed)
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(Dr. G. V. Gotmare)
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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK207H
Course Title	:	Plastic Package Manufacturing

I Rationale:

Packaging plays a vital role in our daily lives, serving a wide range of industries including food and beverages, healthcare, cosmetics, and consumer goods. In India, the plastic packaging sector is growing rapidly, highlighting the increasing importance of plastics in modern packaging solutions. With this rising prominence, it is essential to approach the plastics segment with both precision and care.

This course offers a comprehensive understanding of plastic processing methods, covering the transformation of various plastic materials, the machinery and equipment involved, their technical specifications, structural characteristics, and setup procedures. It is designed to equip students with the specialized knowledge and practical skills necessary to succeed in the dynamic field of plastic packaging.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Comprehend the knowledge of different plastic package manufacturing and conversion processes for packaging

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** plastic packages, flexible films and laminates.

CO2: **Implement** the processes of casting, orientation, coating and lamination.

CO3: **Use** extrusion moulding process for specified applications.

CO4: **Use** compression, transfer and rotational moulding processes for specified applications.

CO5: **Use** Injection and blow moulding processes for specified applications.

CO6: **Apply** thermoforming processes for specified applications.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
4	-	2	2	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Flexible Films and Laminates	1a	Classify given types of plastic packages.	1.1	Introduction to different form of plastics packages like flexible, semi rigid & rigid and their packaging applications in various sectors.	CO1
	1b	Select flexible material for given application.	1.2	Introduction to flexible packaging materials, types of flexible materials. Characteristics of different flexible materials, Selection of flexible materials.	
	1c	Identify the given layers in given laminate structure.	1.3	Structure of flexible materials in laminate form and elements of laminate structure, positioning of different elements of flexible material in the laminate structure.	
	1d	Identify the different converted form of composite laminates with their structure.	1.4	Converted forms of composite laminates.	

UNIT II: Casting, Orientation, Coating and Lamination	2a	Identify given casting equipment and tools in given type of machinery.	2.1	Introduction to Casting, Meaning and scope of Cast sheets/films, Process of sheet casting, Equipment's used in sheet casting, Casting of films and its process description, Advantages and application of cast films.	CO2
	2b	Select given equipment and process for orientation of film.	2.2	Introduction to Orientation, Meaning and scope of orientation of plastic films, Types of plastic film orientation, Advantages and application of oriented films, Bi-axial orientation, meaning and scope, Advantages of Bi-axial orientation, Applications of Bi-axially oriented films, Equipment's used in Bi-axial orientation, Process description of Bi-axial orientation machine.	
	2c	Compare given types coating methods on given points.	2.3	Introduction to Coatings, Multilayer flexible composites, Materials of Coating, Methods of coating- Flexographic Coating, Rotogravure Coating, Other coating methods such as Roll coater, Nip coater, Transfer Coater, Reverse rolls coater, Knife edge coater.	
	2d	Distinguish between given lamination processes.	2.4	Introduction to lamination, Materials of lamination, Lamination Processes- Wet lamination, Dry lamination, Heat lamination, Extrusion lamination, Parameters for laminates and multiplayer films, Applications of laminates in flexible packaging, Selection of suitable Coating and Lamination process, Advantages and disadvantages of different C-L processes.	

UNIT III: Extrusion and Coextrusion	3a	Compare given types of extrusion on given points.	3.1	Extrusion, Introduction, Extrusion meaning and scope, principle of extrusion, General extrusion process and types of extrusion, Forms of extruded products.	CO3
	3b	Use plastic extrusion machine for production of given products.	3.2	Plastic extrusion machine-working and constructional features, General specifications - Capacity, Main parts of extruder- Feed system, Heating system, Barrel, Material forcing system, Orifice and Die Head, Construction of single screw and twin screw barrel.	
	3c	Select given types of die for specified product.	3.3	Extrusion process of bars, tubes, tubular film, sheets, profile shapes, etc., Construction of die head for the above forms of extrusion, Types of die heads.	
	3d	Compare given types of coextrusion methods on given points.	3.4	Coextrusion, Introduction, Meaning and scope, Principle and process of coextrusion, Constructional features of coextrusion machine and die, Advantages and limitations of coextrusion, Coextrusion processes- Cast film coextrusion, cast sheet co-extrusion, Blown film coextrusion.	
	3e	Distinguish between given processes on given points.	3.5	Coextrusion coating, Coextrusion lamination, Comparison of coextrusion process with extrusion lamination and adhesive bonding, Generalize and packaging applications of coextrusion.	

UNIT IV: Compression, Transfer and Rotational Molding	4a	Select compression moulding for specified applications.	4.1	Compression Molding, Introduction, Principle of compression molding, Process description and constructional features of compression molding machine, Compression molding die and its construction, Advantages and applications of compression molding.	CO4
	4b	Compare given types of moulding on given points.	4.2	Transfer Molding, Introduction, Principle of transfer molding, Transfer molding die and its construction, Comparison of Transfer molding and compression molding processes, Merits and de-merits of transfer molding over compression molding, Applications of transfer molding.	
	4c	Select rotational moulding for specified applications.	4.3	Rotational Molding, Introduction, Outline of process, Principle of rotational molding, Constructional features of rotational molding machine, Mold construction and mold rotation, Molding process of rotational molding, Applications of rotational molding.	
	5a	Identify given components of injection moulding.	5.1	Injection Molding, Outline of process, principle of injection molding, Constructional features of Injection molding machine, Main parts of injection molding machine, Description of barrel construction and different material feed mechanisms used in injection molding machine, Constructional features of die movement.	

UNIT V: Injection and Blow Molding	5b	Identify the causes of given types of defects in injection moulding.	5.2	Mould design and runner system, mold venting, Shrinkages in molding, Mould heating and cooling, Part ejection, Complete operation and Process description of injection molding, Applications of injection molding process and range of injection molded products, Possible molding defects in Injection molding.	CO5
	5c	Select blow moulding process for specified applications.	5.3	Blow Molding, Outline of blow molding process and principle of blow molding, Constructional features of blow molding machine, Blow molding mould, Mould movement, Description of material injection system in blow molding mold.	
	5d	Compare given types of blow moulding processes on given points.	5.4	Mold heating, Part blowing operation, Part ejection, Types of Blow molding operations- Injection blow molding, Extrusion blow molding, Stretch blow molding, Advantages and limitations of above types of blow molding processes.	
forming	6a	Identify given elements of thermoforming.	6.1	Outline the process of thermoforming, principle and Characteristics features of thermoforming, Elements of thermoforming, Machine variables- Sheet clamping, Heating, cooling, Mould design, Trimming, Part ejection.	
	6b	Select mould configuration of specified applications.	6.2	Types of thermoforming molds - Male and Female molds. Mold design, Mould venting system, and Mould draft, Mould configurations.	

UNIT VI: Thermof	6c	Distinguish between given thermoforming processes.	6.3	Process description of thermoforming, Methods of thermoforming- Vacuum forming, Pressure forming, Matched mold forming.	CO6
	6d	Compare given types of thermoforming processes.	6.4	Processes of thermoforming - One step forming and multi-step forming, Drape forming, snap back forming, Plug assist forming, Various Polymers molded in thermoforming process.	
	6e	Select given type of thermoforming for specified applications.	6.5	Applications of thermoforming, Other Applications of thermoforming like shrink wrapping, skin packaging, process descriptions and uses in the engineering and packaging fields.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify flexible, semirigid and rigid plastic packages by collecting them from nearby stores/shops.	2#	CO1
I	2	Identify Plastic Films and Multilayer Laminates Through Handling and Visual Inspection of Collected Samples	2#	CO1
II	3	Prepare a Report on Plastic Sheet Manufacturing Using a Sheet Casting Machine Through Online Video Observation	2#	CO2
II	4	Prepare a Report on Biaxial Orientation of Film Using a Tenter Machine Through Online Video Observation	2#	CO2
II	5	Operate Flexographic OR Rotogravure Coating machine for coating application on substrates and prepare a report on it.	2	CO2
III	6	Operate / Demostrate Extrusion blow Molding machine to produce Plastic Cans. prepare a report on it.	2#	CO3
III	7	Prepare a Report Based on the Observation of Plastic Bag or Film Manufacturing Using a Blown Film Extrusion Machine During an Industry Visit or Through an Online Video	2#	CO3
III	8	Prepare a Report Based on the Observation of PVC or Agricultural Pipe Production Using an Extrusion Blow Molding Machine During an Industry Visit or Through an Online Video	2	CO3
IV	9	Prepare a Report Based on the Observation of Manufacturing Rotational Molded Products (e.g., Water Tanks, Garden Toys) Using a Rotational Molding Machine During an Industry Visit or Through an Online Video	2#	CO4
IV	10	Operate a Compression Molding Machine to Manufacture Parts Such as Caps or Plastic Plates and Prepare a Report	2#	CO4
V	11	Prepare a Report on the Operation of a Blow Molding Machine for Manufacturing Products Such as Plastic Bottles and prepare a report on it.	2#	CO5
V	12	Operate / Demostrate Injection Molding machine to produce plastic soap case and prepare a report on it.	2#	CO5

V	13	Identify Manufacturing Defects in Plastic Articles Produced by Injection Molding Using Collected Samples or During an Industry Visit, and Prepare a Report	2	CO5
VI	14	Operate a Pressure or Vacuum Thermoforming Machine to Produce a Blister Packs and Prepare a Report. Part 1	2#	CO6
VI	15	Operate a Pressure or Vacuum Thermoforming Machine to Produce a Blister Packs and Prepare a Report. Part 2	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare a report on different types of plastic molding techniques.
2. Explore the use of flexible packaging in industries like food, pharmaceuticals, and cosmetics. Perform market study and write a report on it.
3. Prepare a report on the role of laminate structure layers like barrier films, adhesives, and sealants are combined to create multi-layer laminates.
4. Collect the different plastic packages with different packaging types (e.g., chips bags, pharmaceutical blister packs, plastic can, Water bottles etc) for hands-on analysis and prepare a details report with its manufacturing process.
5. Prepare a report on working principle, applications, and advantages of compression moulding in the plastics industry and write a report.
6. Analyse the process of transfer moulding and compression moulding, focusing on precision molding, learn about the differences between processes and prepare a report.
7. Prepare a report on rotational molding process and its applications in creating hollow plastic products.
8. Explore the Injection molding with its basic principles, machine components, and applications in creating intricate plastic parts. Prepare a report on it.
9. Prepare a report by learning the blow molding techniques like extrusion, injection, and stretch blow molding for making bottles and containers.
10. Prepare a report on use of casting process in producing large, flat sheets or intricate designs in plastics also Learn how biaxial orientation improves the strength and clarity of films like PET and BOPP.
11. Prepare a report on coating and lamination operation perform by various methods also prepare a report on how materials like PVDC and acrylic coatings enhance barrier properties.
12. Explore how single-layer and multi-layer films are produced through extrusion and coextrusion techniques. Prepare a report.
13. Prepare a report on how plastics are shaped into trays, clamshells, and other semi-rigid packages by Thermoforming technique.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Flexible Films and Laminates	10	C	6	4	0	10
			O	2	0	4	6
2	Casting, Orientation, Coating and Lamination	12	C	2	4	10	16
			O	0	4	6	10
3	Extrusion and Coextrusion	12	C	2	4	6	12
			O	0	0	6	6
4	Compression, Transfer and Rotational Molding	10	C	2	4	4	10
			O	0	4	0	4
5	Injection and Blow Molding	10	C	0	4	6	10
			O	2	4	0	6
6	Thermoforming	10	C	2	4	6	12
			O	0	8	0	8
Total		64	C	14	24	32	70
			O	4	20	16	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	6R2	1R2	5R2	5	7
2	1R4	1U4	2U4	1A4	2U4			3	5
3	2A4	3U4	4U4	4U4	5U4			3	5
4	4A4	5U4	6U4	6U4	6U4			3	5
5	2A6	3A6	2A6					2	3
6	5A6	6A6	3A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	3	3	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	-	-	2	-	-
CO5	3	-	-	3	-	-	2	-	-
CO6	3	-	-	3	-	-	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Handbook of Plastic Processes	Charles A. Harper, John Wiley & Sons, Inc., 1E, 2006.	13:978-0-471-662556 10: 0-471-66255-0
2	Plastics in packaging	A.S. Athaley, Tata McGraw-Hill, 1E, 1992.	10: 0-07-460014-7
3	Rigid and Semirigid Plastic containers	J. H. Boriston, Longman Group Limited, 1E, 1994.	10: 0-582-01491-3
4	Handbook of package engineering	Joseph F. Hanlon , Robert J. Kelsey, Hallie Forcinio, CRC Press, Taylor & Francis Group, Third Edition, 1998.	13:978-1566763066 10: 1566763061
5	Advances in Plastic Packaging Technology	John Briston, Pira International, 1E, 1993	13: 9780902799967 10: 0902799967
6	Plastics in Flexible Packaging	A. S. Athalye, Multi-Tech Publishing Co., 1E, 1992	
7	Plastics Packaging	Susan Selke, John Culter, Ruben Hernandez, Hanser Gardner Publications, Inc, 2Es, 2004.	13:978-1569903728 10: 1569903727

XV e-References:

1. https://egyankosh.ac.in/bitstream/123456789/10704/1/Unit-2.pdf, Assessed on 18/10/2024
2. https://gcwgandhinagar.com/econtent/document/1586852707Plastics.pdf, Assessed on 18/10/2024
3. https://www.sorbentsystems.com/FlexiblePackageDesignGuide.pdf, Assessed on 18/10/2024
4. https://geminigroup.net/wp-content/uploads/2018/12/Plastic-Extrusion-Design-Guide.pdf, Assessed on 18/10/2024
5. https://www.dynisco.com/userfiles/files/Introduction_To_Extrusion.pdf, Assessed on 18/10/2024
6. https://personal.egr.uri.edu/vms/ISE%20240/Polymer_processing_VMS08.pdf, Assessed on 18/10/2024
7. https://crescent.education/wp-content/uploads/2019/02/MODULE-I-Injection-Molding-Process.pdf, Assessed on 18/10/2024
8. https://sinotech.com/wp-content/uploads/Sinotech_Digital-Asset_Thermoforming.pdf, Assessed on 18/10/2024
9. http://www.industrialextrusionmachinery.com/plastic_extrusion_co_extrusion.html, Assessed on 18/10/2024

XVI List of Major Equipment/Machineries with Specification:

1. Injection molding machine.
2. Extrusion blow molding machine.
3. Model – Vaccum Thermoforming machine, Model – Rotational Molding
4. Portable / labscale Flexographic or gravure coating machine
5. Plastic Lamination machine.
6. Compression Molding machine.
7. Plastic Shring wrapping Machine.
8. Extrusion Molding Machine
9. Model – Pressure Thermoforming machine.
10. Labscale / portable Compression molding machine

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. A. P. Pardey	Sr. Lecturer, Paper technology	Government Polytechnic, Nagpur.
3	Mr. Subhash N. Madhugiri	Head of Department, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Lecturer in Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
5	Mr. Milind S. Deshpande	Lecturer in Mechanical Engineering	Government Polytechnic, Arvi.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.

(Mr. Syed Imran Ahmed K.)
HOD & Chairman PBOS, PK

(Dr. G. V. Gotmare)
Member Sectretary PBOS, PK

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
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COURSE CURRICULUM

Program	:	DIPLOMA IN PK
Course Category	:	DSE
Course Code	:	PK208H
Course Title	:	Production Managememt & Q. A.

I Rationale:

The course on Production Management and Quality Assurance (QA) is designed for diploma-level students, focusing on the challenges faced by modern manufacturing industries. Technicians must tackle issues in production methods, planning, and scheduling while applying industrial engineering techniques to optimize resources—man, machine, and material. Understanding work-study and work measurement is essential for improving efficiency. Given global competition and changing trade policies, maintaining strict quality standards is vital for business survival. Whether in manufacturing, design, testing, or service, a quality-focused mindset is necessary across all

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

To apply the knowledge of Packaging Technology

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** basic principles of a plant layout & factors affecting selction of a plant location.

CO2: **Demonstrate** the ability to apply production planning and control principles.

CO3: **Demonstrate** the ability to apply inventory management concepts and maintenance strategies.

CO4: **Apply** basic principles of work study and method study to enhance productivity.

CO5: **Identify** various aspects of Qulaity and conduct Quality Circle sessions.

CO6: **Apply** basic knowledge of different aspect of statistical quality control tools and draw various control charts.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Plant Location & Layout	1a	Justify the importance of plant and plant location	1.1	Defination of plant and plant layout, Importance of plant location.	CO1
	1b	Identify the various types of plant layout.	1.2	Types of layout such as product layout, functional layout and mixed layout.	
	1c	Justify the selection of given plant layout.	1.3	Criterion for selection of product layout, functional and mixed layout.	
	1d	Compare different typoes of plant layout	1.4	Objectives, advantages and application of product, functional and mixed layout	
: Production, Planning & Control	2a	Identify the given tyeps of production.	2.1	Definition of production, Types of production - Job production, batch production, mass production and its examples.	CO2
	2b	Justify the importance of PPC.	2.2	Production planning and control (PPC), its operational objective and functions.	
	2c	Idenitify the various steps in production procedure.	2.3	Production procedure. Its various steps.	

UNIT II	2d	Justify the need and obejctives of PPC.	2.4	Need and objectives of production, planning and control.	
UNIT III: Inventory Control & Machine Maintenance	3a	Justify the need and importance of inventory.	3.1	Inventory - definition, types of inventory, need of inventory.	CO3
	3b	Distinguish between given Inventory cost components.	3.2	Inventory cost components; order cost and purchase cost.	
	3c	Solve the given numericals on EOQ and ABC analysis.	3.3	Inventory replenishment models; Economic Order Quantity - concept and definitionSimple numericals on Economic Order Quantity and ABC analysis.	
	3d	Justify the importance of maintenance.	3.4	Maintenance; concept and definition and objectives.	
	3e	Compare different types of maintenance.	3.5	Types of maintenance such as break down, preventive and scheduled maintenance.	
UNIT IV: Productivity & Work Study	4a	Justify the need of productivity.	4.1	Productivity; concept and definition, need of productivity improvement.	CO4
	4b	Justify the importance of work study.	4.2	Work study; concept and definition, importance, its components.	
	4c	Justify the objectives method study.	4.3	Method study: concept and definition, objectives, steps used for method study.	
	4d	Justify the importance of work measurement.	4.4	Work measurement: concept and definition, objectives. Allowances; concept and definition, types of allowances.	
	4e	Calculate the given parameters based on given data.	4.5	Estimation of normal time and standard time numericals, merit rating and standard allowance.	

UNIT V: Standards and Different Aspects of Quality	5a	Justify standards and identify the given types of standards.	5.1	Standards; concept and definition of standards. Types of standards - Basic, applied, dimensional, performance or quality, test methods. Technical terms & symbols, codes of practice. Advantages of standards for production & testing.	CO5
	5b	Compare the various given terms in Quality.	5.2	Quality; concept and definition, Terms; quality of design, quality of conformance, quality of performance, reliability, quality circle, quality audit, quality mindedness, TQM.	
	5c	Justify the importance of quality cost and value engineering.	5.3	Quality cost and Value and value engineering. (concept only)	
	5d	Justify the importance of Inspection.	5.4	Inspection: concept and definition, importace and methods.	
	5e	Distinguish between Inspection & quality control.	5.5	Qulaity Control: concept and definition, objectives of QC.	
UNIT VI: Statistical Quality Control	6a	Justify the importance of statistical quality control in production.	6.1	Statistical Qulaity Control; definition and importance. Objectives of S.Q.C.	CO6
	6b	Justify the impornace of given concepts in inspection, sampling and normal distribution curve.	6.2	Inspection by attributes and variables. (concept). Acceptance sampling and sampling plan. Normal distribution curve, O.C. Curve. (basics)	
	6c	Calculate the values of Mean, Range, Standard Deviation and variance.	6.3	Process capability of a machine; Calculation of Mean, Range, Standard Deviation and variance.	
	6d	Draw control charts and find conclusion.	6.4	Control charts- introduction and objectives. Charts for variable; X-bar, R chart. Control charts for attributes- P chart, C chart (Simple Numerical).	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Draw a plant layout by visiting a nearby industry. Or by studying a plant layout using online modes and write a report on it.	2#	CO1
I	2	Prepare a report on various important aspects in selection of plant location for a packaging/food industry.	2	CO1
II	3	Draw a process layout of any one packaging industry.	2#	CO2
II	4	Prepare a report on benefits of good Production Planning and Production Control.	2#	CO2
III	5	Perform ABC Analysis by categorizing given inventory into A,B and C type of items.	2#	CO3
III	6	Determine the Economic Order Quantity for a given problem and plot Inventory replenshiment diagram.	2#	CO3
III	7	Prepare a report on derivation of formulae for Normal Time and Standard Time.	2#	CO3
IV	8	Perform a work study on any one product manufacturing process.	2#	CO4
IV	9	Perform a Motion Study for a given task.	2#	CO4
V	10	Prepare a chart showing different ISO standard with respect to Quality Control.	2	CO5
V	11	Perform Brainstorming session on any one hypothetical problem through a Quality Circle.	2#	CO5
VI	12	Compute basic SQC parameters like - Mean, Range, Standard Deviation and Variance with suitable values.	2#	CO6
VI	13	Draw control chart (X-bar and R chart). The examples should simulate real life industrial situations.	2#	CO6
VI	14	Draw control chart (P and C chart). The examples should simulate real life industrial situations.	2#	CO6
VI	15	Draw OC Curve for the given example.	2	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Conduct a case study on any one plant layout of any industry. Include; process flow chart, manpower required and how the layout is ideal for that indsutry i.e factors responsible for site selection. And write a report.
2. Conduct a comparative case study on product layout and process layout. Include; actual site visits or use internet based information. And write a report.
3. Conduct a case study on Production Planning an Production Control. Include; types of production with exaples, prduction procedure flow chart with its description, objectives of PPC and benefits of a good PPC. And write a report.
4. Conduct a case study on Inventory control. Include; concept, types of inventories, benefits of good inventory control, Inventory cost relationship and simple numericals on EOQ and ABC analysis. And write a report.
5. Conduct a case study on Types of Maintenance in any Industry/ Co.. Include; Preventive Maintenance, Corrective Maintenance, Predictive Maintenance and Condition-Based Maintenance, their advantages and disadvantages. And write a report.
6. Conduct a case study on Functions of a Quality Control Department in any one Company. Include; Overview of QC dept., Quality Management and Qulaity Control Procedure, Certificate of conformance, Quality circles, qulaity midendness, quality audit, Inspection and testing etc. And write a report.
7. Conduct a case study on Satastical Quality Control in a Company. Include; Introduction, objectives of SQC, Inspection, sampling plan, tests, calculations of mean, range, standard deviation, variance. Control Charts like Xbar, R chart, P and C charts. And write a report.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Plant Location & Layout	6	C	02	08	00	10
			O	00	04	00	04
2	Production, Planning & Control	8	C	02	08	00	10
			O	02	04	00	06
3	Inventory Control & Machine Maintenance	8	C	04	04	06	14
			O	00	08	00	08
4	Productivity & Work Study	6	C	00	04	06	10
			O	00	00	06	06
5	Standards and Different Aspects of Quality	9	C	00	04	06	10
			O	00	08	00	08
6	Statistical Quality Control	8	C	02	08	06	16
			O	02	00	06	08
Total		45	C	10	36	24	70
			O	4	24	12	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	3R2	6R2	2R2	6R2	5	7
2	1U4	2U4	6U4	3U4	5U4			3	5
3	1U4	3U4	6U4	2U4	5U4			3	5
4	2U4	4U4	5U4	1U4	3U4			3	5
5	3A6	4A6	6A6					2	3
6	5A6	6A6	4A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	3	-	3	-	-	-	3	-
CO5	3	3	-	3	1	-	1	3	-
CO6	3	3	-	3	-	-	-	3	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Industrial Engg. and Production Management	M.Telsang, S.Chand & Co., 2010	10: 81-219-1773-5
2	Product Design & Manufacturing	Chitale & Gupta, Prentice Hall of India, 2005	10: 81-203-2636-9
3	Production Technology	R.K.Jain & Gupta, Khanna Publication, 1981.	13: 978-81-7409-099-1
4	Quality Control	Paranthaman TTTI, Tata McGraw Hill, 2000	10: 0-07-451620-5
5	Statistical Quality Control	M.Mahajan, Dhanpat Rai & Sons, 2012	13: 9788177000399, 10: 817700039X

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3. http://en.wikipedia.org/wiki/ABC_analysis, assessed on 23 June 2024
4. http://www.slideshare.net/akshay_005/abc-analysis, assessed on 23 June 2024
5. http://en.wikipedia.org/wiki/Inventory_control, assessed on 23 June 2024

XVI List of Major Equipment/Machineries with Specification:

1. Timed flow Liquid filler working model.
2. Thickness Tester.
3. GSM Tester

XVII List of Industry Experts and Faculties who contributed for this curriculum:

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSE
Course Code	:	PK209H
Course Title	:	Maintenance in Packaging

I Rationale:

Modern manufacturing industries have complex production processes. A technician entering into such field comes across various problems involving production processes, methods, planning, scheduling, etc. One has to effectively use the industrial engineering techniques to optimize the resources such as man, machine and material for performance enhancement. Therefore, the knowledge of work-study & work measurement is very essential.Maintenance is a vital area in industry. Defective or faulty products badly affect productivity of the plant.The course contents are designed by considering maintenance of packaging machines. Packaging machines run by electrical drives, with mechanical / pneumatic / hydraulic operated mechanisms. Electronic sensors, actuators and PLC are the backbone of these drives.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge of Packaging Technology and Theory of Machines**.**

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** the need of maintenance.

CO2: **Classify** various types of maintenance

CO3: **Justify** the importance of scheduled plan maintenance.

CO4: **Distinguish** maintenance of various packaging machines.

CO5: **Analyze** maintenance records of various packaging machines.

CO6: **Identify** maintenance schedule of various packaging machines.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Maintenance	1a	Justify the importance of maintenance.	1.1	Maintenance; Definition, Objective / need of maintenance.	CO1
	1b	Compare the different types of maintenance.	1.2	Types of maintenance, their advantages and comparison.	
	1c	Justify the importance of MRO.	1.3	M.R.O. (Maintenance, repairs and overhauling); concept and importance.	
	1d	Identify the given hazards due to lack of maitenance.	1.4	Hazards due to lack of maintenance.	
enance of Packaging Machines	2a	Identify various packaging machine	2.1	Types of packaging machines.	CO2
	2b	Justify need of multidisciplinary requirements of packaging machines.	2.2	Operating principles of packaging machines;	
	2c	Identify the concept of reliability, maintainability, availability and MTBF	2.3	Basic concept of reliability, maintainability and availability and failure rate, Mean time between failure, Bath Tub Curve, basic numericals.	

UNIT II: Mainte	2d	Justify economics in maintenance engineering	2.4	Define cost of maintenance,	
	2e	Describe with justification life of components.	2.5	Concept of Life of components and reliability of components and its numericals	
UNIT III: Maintenance of Mechanical Elements/Components	3a	Describe lubricants and wear & tear.	3.1	Define Lubrication, Objective of Lubrication. Define wear and tear of machine components.	CO3
	3b	Describe with justification importance of history sheet and components needing mechanical maintenance	3.2	Importance of history sheet.	
	3c	Justify the importance of history sheet.	3.3	Identification of components needing maintenance.	
	3d	Analyse Determinations of mechanical machine components require maintenance	3.4	Concept of Power transmission, bearings, clutches pumps, valves, compressors, mechanical actuators, and motion/force transmitting mechanisms.	
	3e	Identify various power tools.	3.5	Power tools used in maintenance	
V: Maintenance of Electrical & Electronic Components	4a	Identify electrical & electronic components needing maintenance.	4.1	Define components of machine, justify Need of maintenance in electrical drives.	CO4
	4b	Describe need of maintenance for electrical drives & elements.	4.2	Various types of sensors, Life and reliability of electronic elements, physical requirements of components.	
	4c	Describe physical requirements for electrical and electronic elements.	4.3	List the requirements for sensors, application of sensors in packaging industry.	
	4d	Describe cleaning requirements for sensors and maintenance need for insulators.	4.4	Types of sensors and their cleaning requirements. Insulator maintenance.	

UNIT I	4e	Analyse reliability and life prediction for electronic components.	4.5	Describe reliability and Basic Numericals on reliability and maintability.	
UNIT V: Maintenance of Hydraulic and Pneumatic Components	5a	Identify elements/accessories of hydraulic and pneumatic systems & actuators, function & importance of elements.	5.1	Define Hydraulic system and pneumatic system, Need of hydraulic and pneumatic system in packaging machinery.	CO5
	5b	Describe hydraulic and pneumatic system in packaging machinery.	5.2	Justify Importance of filters and other accessories in hydraulic & pneumatic systems in packaging machines.	
	5c	Describe importance of accessories/ actuators in hydraulic & pneumatic systems and maintenance need for it.	5.3	Pneumatic and hydraulic actuators and maintenance requirements.	
	5d	Distinguish maintenance requirements of hydraulic and pneumatic systems.	5.4	compare hydraulic and pneumatic drive	
	5e	Analyse basic problems on hudraulic drive	5.5	Numericals on Hydraulic principle	

UNIT VI: Productivity and Cost Considerations	6a	Describe productivity and associated terms.	6.1	Define Productivity and maintenance productivity, need for cost consideration in packaging	CO6
	6b	Identify cost related to maintenance and life cycle cost.	6.2	Four types of Cost in Maintenance - I. Cost to replace or repair. II.Losses of output. Direct and indirect cost of maintenance. III.Delayed shipment. IV.Scrap and rework.	
	6c	Distinguish Productivity, maintenance productivity.	6.3	Interrelation between maintenance & productivity.	
	6d	Analyse the process to minimize total maintenance cost.	6.4	Life cycle cost.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the hazards due to lack of maitenance in any type of packaging machine.	2#	CO1
II	2	Identify the mechanical componets and carry out planned maintenance on given assemblies of box compression machines write steps to be followed during maintenance.	2#	CO2
III	3	Identify the mechanical components of UTM which needs maintenance/ lubrication by going through manufacturers's manual.	2	CO3
III	4	Carry out scheduled maintenance on given assemblies of universal testing machine and prepare a report of it.	2#	CO3
IV	5	Carry out electrical maintenance on corrugator by going through manufacturer's manual, check electrical connection carefully, verify phase and earth if any write a report.	2#	CO4
IV	6	Dissemble flutter roller assembly , replace resistance of corrugated roller, assemble it and write a report on it.	2#	CO4
IV	7	Carryout minor electrical maintenance on various machines available in the department,Carefully go through assigned task Check electrical connections carefully, verify phase and earth if any.Write a report.	2#	CO4
IV	8	Find out exact fault in the machine, Replace/repair electrical on-off switches, push buttons and toggle switches, etc. Write a report.	2	CO4
V	9	Visit to a packaging industry and analyze maintenance record,Collect information on breakdown, preventive and scheduled maintenance & collect various formats used, Observe repeated types of fault and its frequency, prepare a report on it.	2#	CO5
V	10	Study the type of fault and remedial action taken, Compile the information of time requires for rectification every time, Calculate production loss, replacement cost, scrap or	2	CO5
V	11	Measure capacitance of capacitor using LCR meter and calculate equivalent capacitance in series and parallel circuit.	2 #	CO5

V	12	Plot the B-H loop of a Ferro-magnetic core material.	2#	CO5
V	13	Measure the inductance of a given coil. Use fundamentals of electricals to solve electrical engineering problems	2#	CO5
VI	14	Operate CRO to measure amplitude, time period, frequency, phase difference for sinusoidal wave forms.	2#	CO6
VI	15	Find current response of pure resistive circuit. Use fundamentals of electricals to solve electrical engineering problems	2#	CO6
VI	16	Find current response of pure Inductive/capacitive circuit. Use fundamentals of electricals to solve electrical engineering problems	2	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/ Affective Domain)

1. Prepare a detailed report on M.R.O. (Maintenance, repairs and overhauling) of any type of packaging Machine.
2. Perform a market survey on different types of lubrications used in maintenance of machines.
3. Perform maintenace of a sensors used in packaging machine and prepare a detailed report.
4. Perform maintenace of a electrical drives used in packaging machine and prepare a detailed report.
5. Perform maintenace of a hydraulic componets used in packaging machine and prepare a detailed report.
6. Perform maintenace of a pneumatic componets used in packaging machine and prepare a detailed report.
7. Prepare a detailed report on life cycle cost of packaging Machine.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Maintenance	6	C	04	04	06	14
			O	02	04	00	6
2	Maintenance of Packaging Machines	8	C	02	04	06	12
			O	02	04	00	6
3	Maintenance of Mechanical Elements/Comp onents	8	C	02	08	00	10
			O	00	06	06	12
4	Maintenance of Electrical & Electronic Components	8	C	04	10	00	14
			O	04	04	00	8
5	Maintenance of Hydraulic and Pneumatic Components	7	C	00	04	04	8
			O	00	04	00	4
6	Productivity and Cost Considerations	8	C	02	04	06	12
			O	00	00	04	4
Total		45	C	14	34	22	70
			O	8	22	10	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	2R2	3R2	4R2	6R2	4R2	1R2	2R2	5	7
2	1R4	1U4	2U4	1U4	2U4			3	5
3	5A4	3U4	5U4	4U4	5U4			3	5
4	53U4	4U4	6U4	4R4	6A4			3	5
5	1A6	2A6	3U6					2	3
6	4U6	6A6	3A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of Equipments	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Problem Finding	5
2	Performance and Trouble shooting	10
3	Result/conclusion	5
4	Viva Voce	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	2	-	-	3	2	-
CO4	3	-	-	2	-	1	3	-	-
CO5	3	-	-	2	-	1	3	2	-
CO6	-	1	1	-	1	-	3	2	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Maintenance Engineering and Management	R. C. Mishra, K. Pathak, PHI learning private limited second edition, April 2012.	13: 978-81-203-4573-7
2	Oil Hydraulic systems,Principles and maintenance	S.R.Mujumdar, Tata McGgraw-Hill publishing company limited, 2006. (Thirteenth Reprint)	10: 0-07-463748-7
3	Fundamentals of Automation Technology	F. Ebel, S. Idler, G. Prede, D. Scholz, 2008.	

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2. http://een.iust.ac.ir/profs/esmaeilzadeh/instrumentation/Practical%20Instrumentatio n%20for%20Automation%20and%20Process%20Control-IDC.pdf, on 23
3. https://www.youtube.com/watch?v=Drs4ii3Jtww&list=PLuj5YwfYIVm-eKrphHMwXy3TC9gghLYGW assessed on 28 June 2024
4. https://www.youtube.com/watch?v=UoBkdCMMeEA&list=PLuj5YwfYIVm-eKrphHMwXy3TC9gghLYGW&index=2 assessed on 28 June 2024
5. https://www.youtube.com/watch?v=Uvdx5UrtSBA&list=PLuj5YwfYIVm-eKrphHMwXy3TC9gghLYGW&index=4 assessed on 28 June 2024
6. https://www.youtube.com/watch?v=CgCY764eRRs&list=PLuj5YwfYIVm-eKrphHMwXy3TC9gghLYGW&index=7 assessed on 28 June 2024
7. https://www.youtube.com/watch?v=kIXfDqa25RU&list=PLbMVogVj5nJQBOIBP4eAQSqkFvZ9vDuSb
8. https://www.youtube.com/watch?v=f58SW0Hwcf0 ASSESSED ON 28 June 2024
9. https://www.youtube.com/watch?v=Au6GGv93R5E assessed on 28 June 2024

XVI List of Major Equipment/Machineries with Specification:

1. Bursting Tester.
2. Box Compression Machine.
3. Universal Testing Machine.
4. Vibration Tester
5. Corrugating machine.
6. Injection Molding Machine.
7. Extrusion Blow Molding Machine.
8. Semiautomatic Screen Printing Machine

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
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2	Mr. S.N. Madhugiri	Ex. Head of Department, Packaging Technology	Government Polytechnic, Nagpur
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5	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	SEC
Course Code	:	PK252H
Course Title	:	Packaging Label Design Software

I Rationale:

The integration of computers and software has revolutionized the role of printers and prepress operators, empowering them to create visually appealing and impactful designs. This subject focuses on electronic methods of page creation, design, and editing, emphasizing hands-on practice with industry-standard tools such as CorelDRAW, Illustrator, and specialized packaging software. By leveraging these tools creatively and with an aesthetic sensibility, students gain the skills needed to meet the evolving demands of the printing industry and produce designs that stand out.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Design labels for various types of containers using designing software.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Design** various types of labels using Corel Draw.

CO2: **Design** a logo using various tools in Corel Draw.

CO3: **Draw** key line structure of various types of folding cartons using Adobe Illustrator.

CO4: **Design** various types of labels using Adobe Illustrator.

CO5: **Design** folding carton for various dimensions using package making software.

CO6: **Analyze** final output of design in package making software.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	4	-	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	50	20	50+	20	-	-

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to CorelDRAW	1a	Identifiy key features of CorelDRAW	1.1	Overview of CorelDRAW software and its applications in graphic design. Key features of CorelDRAW, including vector-based editing and its role in professional design work.	CO1
	1b	Identify the interface components of CorelDRAW.	1.2	CorelDRAW Workspace Overview: Interface: Title Bar, Toolbars, Property Bar, and Color Palette. Overview of the Drawing Page and Document Window. Rulers and Status Bar for precise design.	
	1c	Assess the importance of using CorelDRAW.	1.3	Basic Tools in CorelDRAW: Overview of basic tools: Line, Rectangle, Circle, Polygon, Spiral, Star, and Triangle. Purpose and functionality of each tool.	

UNIT II: CorelDRAW Menu Bars and Features	2a	Recall the functions of menus	2.1	CorelDRAW Menu Bar Overview: File, Edit, View, Layout, Arrange, and Effect menus. Importance of each menu in design workflows.	CO2
	2b	Compare the functionalities of the Arrange menu and the Effect menu.	2.2	Advanced Menu Features: Layout Menu: Understanding alignment, spacing, and layout adjustments. Arrange Menu: Grouping, ungrouping, and layering objects. Effect Menu: Applying transformations and interactive effects.	
	2c	Combine multiple menu options to achieve a cohesive design workflow.	2.3	Exploring Text and Table Menus Text Menu: Formatting text, applying fonts, and adjusting size. Table Menu: Creating and managing tables within designs.	
	2d	Evaluate the efficiency of CorelDRAW's menus in managing complex designs.	2.4	Exporting and Importing Designs: Overview of import/export options for compatibility with other software.	
UNIT III: Label Designing in CorelDRAW	3a	Identify tools in CorelDRAW used for measuring dimensions.	3.1	Understanding Label Design: Importance of labels in packaging and branding. Observing sample labels: Shapes, layouts, font styles, and dimensions.	CO3
	3b	Apply design principles to plan the layout of a label.	3.2	Label Design Elements: Key components of a label: Text, shapes, colors, and layout. Understanding design principles for creating effective labels.	
	3c	Assess the effectiveness of a label in conveying product information and branding.	3.3	Measurement and Dimensioning: Importance of accurate dimensions in label design. Tools and techniques for measuring and setting up dimensions in CorelDRAW.	

UNIT IV: Introduction to Adobe Illustrator	4a	Describe with justification tools available in the Illustrator toolbox.	4.1	Overview of Adobe Illustrator as a vector-based design software. Key differences between Adobe Illustrator and CorelDRAW. Applications of Adobe Illustrator in professional design workflows.	CO4
	4b	Identify the interface components of Adobe Illustrator.	4.2	Adobe Illustrator Workspace Overview: Explanation of the interface: Toolbars, Property Bar, and Artboard. Overview of the Color Palette, Layers Panel, and Control Panel.	
	4c	Analyze how the toolbox tools interact to create vector-based designs.	4.3	Tools in Adobe Illustrator: Overview of Selection Tools, Drawing Tools, Type Tools, and Transformation Tools. Understanding the role of each tool in creating vector-based designs.	
UNIT V: Advanced Features and Menus in Adobe Illustrator	5a	Identify the purpose of the Effect and View menus.	5.1	Menu Bar Overview in Adobe Illustrator: Detailed explanation of File, Edit, Object, Type, and Select menus. Importance of each menu in managing and editing designs.	CO5
	5b	Compare the Effect menu in Adobe Illustrator with similar features in CorelDRAW.	5.2	Specialized Menus: Effect Menu: Applying visual effects and transformations. View Menu: Adjusting visibility, guides, and grids for precise design. Window Menu: Managing panels and workspace customization.	
	5c	Evaluate the effectiveness of Adobe Illustrator's menus in handling intricate design tasks.	5.3	Carton Layout Design in Adobe Illustrator: Overview of creating keyline structures for cartons. Role of accurate dimensions and layout in carton design.	

UNIT VI: Package Design Software and Applications	6a	Identify popular software used for package design, such as ArtiosCAD and Esko.	6.1	Software for Package Design: Overview of popular package design software: ArtiosCAD, Esko, CorelDRAW, and Adobe Illustrator. Applications of these tools in printing and packaging industries.	CO6
	6b	Identify the tools and features in package design software used for creating carton layouts.	6.2	Comparative Analysis of Package Design Software: Comparison based on tools, menus, user-friendliness, and specific applications. Key differences in operating ease and design capabilities.	
	6c	Describe with justification the differences between Straight Tuck Folding Cartons and Regular Slotted Containers (RSC).	6.3	Carton Types and Keyline Structures: Overview of Straight Tuck Folding Cartons and Regular Slotted Containers (RSC). Importance of observing shape, layout, and print elements in carton design.	
	6d	Assess the suitability of a specific software for a given packaging design project.	6.4	Text Design in Packaging: Role of font styles, sizes, and alignment in packaging text design. Importance of clear and aesthetically pleasing text layouts.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Explore the CorelDRAW Interface and Tools. (CorelDRAW)	2#	CO1
I	2	Create Basic Shapes and Apply Fill & Outline. (CorelDRAW) - Practice them three times.	2#	CO1
I	3	Use the Text Tool to Add and Format Label Text, align it, fix in dimensions. (CorelDRAW)	2#	CO1
I	4	Align, Group, and Arrange Label Elements (Text, shapes, pics). (CorelDRAW)	2#	CO1
I	5	Use Layers to Organize a Label Design. (CorelDRAW)	2#	CO1
II	6	Draw Custom Shapes and Use the Bezier Tool - practice for three jobs. (CorelDRAW)	2#	CO2
II	7	Apply Color Modes- Color Separation (CMYK) for Printing Output. (CorelDRAW)	2	CO2
II	8	Design a Barcode for a Label. (CorelDRAW)	2#	CO2
II	9	Use Gradients, Transparency, and Drop Shadows. (CorelDRAW)	2#	CO2
II	10	Create a Simple Product Label Layout. (CorelDRAW)	2	CO2
III	11	Create and Apply a Label Dieline Template for folding cartons. (CorelDRAW)	2#	CO3
III	12	Design a Multi-Product Label Set (Variant Colors). (CorelDRAW)	2#	CO3
III	13	Prepare a Print-Ready Label with Bleed & Crop Marks. (CorelDRAW)	2	CO3
III	14	Final Project: Design a Complete Package Label with Branding, Dieline, and Legal Info (Part 1). (CorelDRAW)	2#	CO3
III	15	Final Project: Design a Complete Package Label with Branding, Dieline, and Legal Info (Part 2). (CorelDRAW)	2#	CO3
IV	16	Explore Illustrator Interface, Tools, and Artboards.(Adobe Illustrator)	2#	CO4
IV	17	Draw and Modify Basic Shapes for Label Elements.(Adobe Illustrator)	2#	CO4
IV	18	Add and Format Text Using Character and Paragraph Tools.(Adobe Illustrator)	2#	CO4
IV	19	Use Layers, Groups, and Alignment for Layout Structure.(Adobe Illustrator)	2#	CO4

IV	20	Create Custom Shapes Using Pen and Shape Builder Tools.(Adobe Illustrator)	2#	CO4
V	21	Apply Swatches, Gradients, and Color Modes (CMYK).(Adobe Illustrator)	2#	CO5
V	22	Use Grids and Guides to Build a Structured Label.(Adobe Illustrator)	2#	CO5
V	23	Design a Simple Product Label with Typographic Focus.(Adobe Illustrator)	2#	CO5
V	24	Place and Trace Images for Branding or Decorative Elements.(Adobe Illustrator)	2	CO5
V	25	Create and Apply a Packaging Dieline for Layout. (Adobe Illustrator)	2#	CO5
VI	26	Add Barcode, Net Content, and Compliance Icons on product. (Adobe Illustrator)	2	CO6
VI	27	Apply Clipping Masks and Transparency Effects on same product. (Adobe Illustrator)	2#	CO6
VI	28	Export a Print-Ready Label with Bleeds and Crop Marks. (Adobe Illustrator)	2	CO6
VI	29	Design a Mockup of the Label on a Packaging Template. (Adobe Illustrator)	2#	CO6
VI	30	Final Project: Professional Packaging Label with Branding, Artwork, and Export Setup. (Adobe Illustrator)	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to CorelDRAW	5	C	0	0	0	0
			O	0	0	0	0
2	CorelDRAW Menu Bars and Features	5	C	0	0	0	0
			O	0	0	0	0
3	Label Designing in CorelDRAW	5	C	0	0	0	0
			O	0	0	0	0
4	Introduction to Adobe Illustrator	5	C	0	0	0	0
			O	0	0	0	0
5	Advanced Features and Menus in Adobe Illustrator	5	C	0	0	0	0
			O	0	0	0	0
6	Package Design Software and Applications	5	C	0	0	0	0
			O	0	0	0	0
Total		30	C	0	0	0	0
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

-----NA-----

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	10
2	Regular Lab Performance	10
3	Record/Journal Submission (Quality of work / Neatness)	10
4	Viva Voce (During Sessions)	10
5	Internal Practical Test (Mock)	10
	TOTAL	50

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	3	-	-	3	2	-
CO2	3	-	2	3	-	-	3	2	2
CO3	3	-	-	3	-	-	3	-	2
CO4	3	-	2	3	-	-	3	2	-
CO5	3	-	2	3	-	-	3	2	2
CO6	3	-	-	3	-	-	3	-	2

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Corel Draw Training guide	BPS Publications Prof.Satish Jain M. Geetha	13: 978-93-8728-4005
2	Adobe Illustrator book for beginners	Richard Steve 2020-2021 Kindle Unlimited	--
3	Corel Draw 2018	D.T. editorial services	13: 978-93-88425-28-5
4	Adobe Illustrator visual quick start guide	Kindle Edition Lisa Fridsma	--

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2. https://product.corel.com/help/CorelDRAW/540223850/Main/EN/Documentation/wwhelp/wwhimpl/common/html/wwhelp.htm#href=workspace-
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6. https://vividesigning.com/basic-tools-and-their-uses-in-adobe-illustrator/ assessed on 5th Aug 2024
7. https://www.youtube.com/watch?v=knsWvfAjdN8 assessed on 5th Aug 2024
8. https://www.youtube.com/watch?v=IaDNbtoxgfY assessed on 5th Aug 2024
9. https://www.youtube.com/watch?v=A4_t7ogZWKY assessed on 5th Aug 2024
10. https://www.youtube.com/watch?v=e4IioYJuQiI&list=PL1xItk77U3vGmFUirHzv-i8GxrJqbkk82 assessed on 5th Aug 2024

XVI List of Major Equipment/Machineries with Specification:

1. Desktop Computers
2. Printer
3. Internet connection
4. Corel, Adobe Illustrator , Package Making software for 15 Computer Syetems.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. A. P. Pardey	Sr. Lecturer, Paper Technology	Government Polytechnic, Nagpur.
3	Mr. Subhash N. Madhugiri	Head of Department, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Lecturer in Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
5	Mr. Milind S. Deshpande	Lecturer in Mechanical Engineering	Government Polytechnic, Arvi.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali M. Zeeshan M.S.M	Assistant Professor	Anjuman College of Engineering and Technology, Nagpur.

(Mr. I. A. K. Syed)
HOD & Chairman PBOS, PK

(Dr. G. V. Gotmare)
Member Sectretary PBOS, PK

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/AE/CM/TX/PK/MT/TR/AI/MK
Course Category	:	VEC
Course Code	:	VE252H
Course Title	:	Yog and Meditation

I Rationale:

The biggest challenge to student success is stress management, health management, sleep difficulties and depression. World Health Organization (WHO) emphasizes yog and meditation to prevent physical and mental stress. The prime objective of this course is a holistic development of mind and body by incorporating four primary components: physical exercises, breathing exercises, deep relaxation techniques and meditation. The daily practice of the course will prepare student to gain more physical, mental and emotional strength. This course supports the requirements of the National Education Policy (NEP).

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Practice Yog and Meditation in daily life.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Improve** Physical strength, balance and flexibility.

CO2: **Enhance** concentration and retain memory.

CO3: **Increase** energy flow within body and develop positive attitude.

CO4: **Support** stress management, mental health and ensure quality sleep.

CO5: **Develop** healthy eating habits and physical & mental hygiene.

CO6: **Maintain** a balanced metabolism and boost immunity.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
--	-	2	2	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	25	10	25	10	25	10

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Introduction to Yog (Anatomy of Body) and know importance of Yog. Measure weight & height. Calculate BMI (Body Mass Index).	1#	CO1
I	2	Practice Sharirsanchalan, Padasanchalan. Practice basic asana: Uttitvivekasana (Standing Poses :Minor Exercises of Hands and Leg).	1#	CO1
I	3	Repeat day two. Practice Sharirsanchalan of Back (Reclining poses: Minor excercise of Back). Practice Pavanamuktasana.	1#	CO1
I	4	Repeat day two & three. Practice Ashtanga Yog (Yama, Niyam, Asan, Pranayam, Pratyahar). Prepare a Diet Plan for self. Ashtanga Yog in details.	1#	CO1
I	5	Repeat day two, three & four. Practice Sharirsanchalan of Stomach and Bhuja.	1#	CO1
I	6	Repeat day two. Practice Standing Poses Asana: Tadasana,Vrukshasana, Trikonasan, Hastapadasan.	1#	CO1
I	7	Repeat day three. Practice Reclining Poses Asana:Pavanamuktasana,Noukasana. Sandhisanchalana of neck,heap,	1#	CO1
I	8	Repeat day seven. Practice Sandhisanchalana of neck & heap.	1#	CO1

I	9	Repeat day eight. Practice Reclining Poses Asanas: Setubandhasana,Chakrasana,Halasana.	1#	CO1
I	10	Repeat day five. Practice Seated Poses Asanas : Padmasana, Aakarnadhanurasana, Ardhtitali, Purnatitali.	1	CO1
I	11	Repeat day two. Practice 12 poses of Surya Namaskara slowly with pace.	1#	CO1
I	12	Repeat day two. Practice 12 poses of Surya Namaskara in continuation (maximum repeatation as per capacity)	1	CO1
I	13	Practice Sandhisanhalan of feet, neck, hands, joints eyes etc. Practice Seated Poses asanas :Padmasana, Pacchimottanasana, Vakrasana, Gomukhasana	1	CO1
II	14	Introduction of Pranayama and know its benefits. Practice Dirghashwasan, Anulom Vilom and Agnisara.	1	CO2
II	15	Repeat day fourteen. Practice Kapalbharti and Nadi Shodhan Pranayama.	1	CO2
II	16	Practice Sharirsanchalan. Repeat day fifteen. Practice 5 types of Nadi Shodana Pranayama.	1	CO2
II	17	Repeat Sharirsanchalana and day sixteen. Practice Shitali Pranayama, Sitakari Pranayama, Sadanta Pranayama.	1#	CO2
III	18	Repeat Sharirsanchalana. Practice basic Pranayamas. Introduction to Bandhas and know about Mulbandha, Jalandhar Bandha.	1	CO3
III	19	Repeat Sharirshanchalan and day eighteen. Practice Udiyana bandha and Maha bandha.	1	CO3
III	20	Repeat day sixteen. Practice Bhastrika Pranayam:type 1 and 2.	1	CO3
III	21	Repeat Sharirsanchalan and day 20. Practice Bhastrika Pranayam:type 3, 4 and 5.	1	CO3
IV	22	Repeat Sharirsanchalan and day 21. Practice Ujjaiyi Pranayam.	1#	CO4
IV	23	Repeat Sharirsanchalan and day 19, 20, 21 and 22. Practice Vyaghrasana.	1	CO4
IV	24	Repeat Sharirsanchalana and Suryanamaskara. Introduction to meditation and know about benefits of meditation. Practice concentration on Breathing (Inhalation & exhalation).	1#	CO4
V	25	Repeat day 24. Pratice Savasana (Relaxation Technique)	1#	CO5
V	26	Practice Sharirsahchalana. Know bout balancing techniques of body. Practice Mayurasana.	1	CO5
V	27	Repeat Sharirsanchalan and 12 poses of Suryanamaskara.	1	CO5

V	28	Introduction to Body Purification Method: Neti and know the steps & benefits of Neti.	1	CO5
VI	29	Practice Purification Method :Perform Neti,Jala Neti (Note: Should be done in the presence of guide)	1	CO6
VI	30	Measure weight. Recalculate BMI	1#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare a report on daily practice of yog and meditation by you. Attach Google tag photographs in the report.

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Body alignment for each flow	5
2	Breathing	5
3	Performance Flow and Sequencing	5
4	Attendance	10
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Content	10
2	Report Writing	10
3	Viva-voce	5
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	2	-	2	-	-
CO5	3	-	-	3	2	-	2	-	-
CO6	3	-	-	3	2	-	2	1	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Sulabh Sanghik (Part 1)	Janardhan Swamy Yogabhyasi Mandal, Ramnagar, Nagpur	-
2	Sulabh Sanghik (Part 2)	Janardhan Swamy Yogabhyasi Mandal, Ramnagar, Nagpur	-
3	Surya Namaskar (JSYOG)	Janardhan Swamy Yogabhyasi Mandal, Ramnagar, Nagpur	-
4	Pranayam Book (JSYOG)	Janardhan Swamy Yogabhyasi Mandal, Ramnagar, Nagpur	-

XV e-References:

1. https://yoga.ayush.gov.in/public/assets/front/pdf/CYP-2023-English.pdf assessed on 27th May 2024
2. https://jsyog.org/yogasana/ assessed on 27th May 2024
3. https://jsyog.org/pakshik-yog-varg/ assessed on 27th May 2024
4. https://yoga.ayush.gov.in/Publications/index.php?bt=2 assessed on 27th May 2024
5. https://yoga.ayush.gov.in/public/assets/IDY_ebook.pdf assessed on 27th May 2024

XVI List of Major Equipment/Machineries with Specification:

1. Yoga and Meditation Kits
2. Weighing machine
3. Measuring tape
4. Yoga mats

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. M.B.Daigavane	Principal	Government Polytechnic, Nagpur
2	Mrs. Santoshee Soni	Yoga Trainer	Janardan Swami Yogabhyasi Mandal, Nagpur
3	Ms. Nandini Menjoge	Yoga Trainer	Janardan Swami Yogabhyasi Mandal, Nagpur
4	Dr G.V. Gotmare	Member Secretory Borad of Studies	Government Polytechnic, Nagpur
5	Dr. Megha Bhelande (Machale)	Lecturer in English	Government Polytechnic, Nagpur.

(Dr. G. V. Gotmare)
HOD & Chairman PBOS, COMMON

(Dr. G. V. Gotmare)
Member Sectretary PBOS,

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GE Courses

Sem: IV

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in ME/EE/EC/IT/MT/TX/AE/PK/CM/MK/AI
Course Category	:	GE
Course Code	:	CE292H
Course Title	:	Basic Surveying

I Rationale:

The outcomes aim to develop essential surveying skills, crucial for accurate data collection and land measurement. Identifying signs and symbols helps in understanding survey plans. Measuring line lengths with proper equipment ensures precision. Taking bearings using a Prismatic Compass is fundamental for directional accuracy. Plotting alignments with a Plane Table Survey enhances the ability to represent field data visually. Finally, conducting levelling tasks ensures elevation measurements are correctly taken for various engineering or construction applications. These skills are critical for effective surveying, contributing to precise planning, design, and implementation of infrastructure projects.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Carry out surveys of small area**.**

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** the signs and symbols used in surveying.

CO2: **Measure** the length of lines using given equipment.

CO3: **Take** bearings of the lines using Prismatic Compass.

CO4: **Plot** alignments of open traverse or boundaries of close traverse using Plane table survey.

CO5: **Carry** out levelling for given task.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

** Online Objective type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Surveys	1a	Classify given type of survey based on purpose and instrument used.	1.1	Definition of Survey, Objects of survey, Types of survey, Use of survey, Principles of survey, Instruments used in surveying and levelling	CO1
	1b	Identify conventional signs and symbols in the given map.	1.2	Conventional signs and symbols used in survey maps	
urements	2a	Identify given linear distance measuring instruments.	2.1	Study and use of instruments for linear measurements- Metric chain, Measuring Tapes and its types, Ranging rod, Arrow, Peg, Digital tape, Methods of linear measurements- By pacing, by speedometer, by chaining, by digital tape. DDM, ODM, EDM.	
	2b	Describe given method of ranging.	2.2	Ranging- Direct and indirect ranging and procedure, Line Ranger, Code of signals used in ranging, Concept of Leader and Follower.	

UNIT II: Linear Meas	2c	Distinguish between given chaining procedures.	2.3	Chaining Procedure on plane and sloping ground. Correction of linear measurement for incorrect length of chain/tape.	CO2
	2d	Identify the instruments used for offset.	2.4	Taking offsets, Instruments used in taking offsets – Cross staff & Optical square; Types of offsets-Long and Short offsets, Perpendicular and Oblique offsets, Degree of precision in taking offset.	
	2e	Compute area of field from given data.	2.5	Chain & Cross Staff survey-Noting on page of field book, Precautions in booking field notes, Recording the observation. Calculation of Areas from cross staff survey	
UNIT III: Chain and Compass Traversing	3a	Convert WCB to RB and vice versa to find included angle.	3.1	Technical Terms –True bearing, Magnetic bearing, and Arbitrary bearing, Whole Circle Bearing, Quadrantal Bearing /Reduced Bearing, Conversion of bearings.	CO3
	3b	Identify the given components of Prismatic compass.	3.2	Prismatic Compass – Component parts, construction and use.	
	3c	Determine included angles of traverse using given Compass survey data.	3.3	Fore bearing, Back bearing, finding Included angles from bearings and calculation of bearings from included angles.	
	3d	Select a method of plotting traverse for plotting a traverse based on given data.	3.4	Traversing – Methods of plotting a traverse and closing error, Graphical adjustment for closing error.	

UNIT IV: Levelling and Contouring	4a	Identify given components of a level and levelling staff.	4.1	Levels and Staff- Dumpy level – Components, Construction, Fundamental axes and their relationships Line of sight, Line of Collimation, Axis of bubble tube. Temporary adjustments of dumpy level. Types of levelling Staff – Ordinary, Telescopic and Folding type	CO4
	4b	Interpret given sight from the stated conditions.	4.2	Technical Terms used in levelling– Level surface, Level line, Horizontal line, Vertical line, Datum surface, Reduced level, Bench mark and its types. Foresight, Back sight, Intermediate sight, Change point, Height of collimation. Recording in Level book. Height of collimation. Recording in Level book.	
	4c	Compute reduce levels from the given data using HI and rise and fall method.	4.3	Methods of Reduction of level – Height of instrument method and Rise and Fall method. Arithmetical checks,	
	4d	Classify given type of levelling.	4.4	Classifications of levelling - Simple, Differential, Profile, Cross sectional, fly levelling, Plotting of Profile level and cross section using level data	
	4e	Interpret the given contour map.	4.5	Contouring- Tech. Terms – Contour, Contour Interval, Horizontal Equivalent., Uses of Contour Maps Characteristics of contours, Method of locating contours, Indirect method of contouring, Interpolation of contours.	

UNIT V: Plane table survey	5a	Identify given accessory of plane table and its use.	5.1	Principles of Plane Table Survey, It's Merits and Demerits, Site conditions where Plane Table Survey is used. Accessories required, Temporary adjustments of plane table: Levelling, Centering and Orientation, Use of Telescopic Alidade.	CO5
	5b	Compare the given methods of plane table surveying.	5.2	Methods of Plane Table surveying – Radiation, Intersection and Traversing.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Draw Conventional signs and symbols used in maps or plans to represent survey data.	02#	CO1
II	2	Measure distances on plane or sloping ground using given metric chains steel or metallic tape, line ranger under direct ranging conditions.	02#	CO2
II	3	Measure distances on plane or sloping ground using given metric chains steel or metallic tape, line ranger under indirect ranging conditions.	02#	CO2
II	4	Set out the perpendicular offsets using optical square or open cross staff from a given point on the chain line as well as from a given point on the side of chain line to the chain line.	02#	CO2
II	5	Find area of a given field using Chain and cross staff survey.	02#	CO2
III	6	Observe fore and back bearings of given lines using prismatic compass, Record these in field book and calculate included and excluded angles from recorded bearings.	02#	CO3
III	7	Carry out Chain and compass survey for 5 sided traverse and record the measurements and observations in the field book and Plot the traverse surveyed. (Part -I).	02#	CO4
III	8	Carry out Chain and compass survey for 5 sided traverse and record the measurements and observations in the field book and Plot the traverse surveyed. (Part -II).	02#	CO4
IV	9	Carry out differential levelling to find Reduce levels of given points using Height of Instrument method as well as by Rise and Fall method.	2#	CO4
IV	10	Carry out Profile levelling by taking spot levels at 15 m interval and plot the profile of given alignment 300 m in length.	2	CO4
IV	11	Perform contouring by direct method for a plot of 100m x 100 m and plot the contours by method of interpolation. (Part -I).	2#	CO4

IV	12	Perform contouring by direct method for a plot of 100m x 100 m and plot the contours by method of interpolation. (Part -II).	2#	CO4
V	13	Identify the given accessory of plane table and its use in plane table survey.	2	CO5
V	14	Perform plane table survey of a given area by method of radiation.	2#	CO5
V	15	Perform plane table survey of a given area by method of intersection.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Surveys	3	C	02	00	04	6
			O	0	0	0	0
2	Linear Measurements	6	C	04	02	06	12
			O	0	0	0	0
3	Chain and Compass Traversing	8	C	02	06	12	20
			O	0	0	0	0
4	Levelling and Contouring	9	C	04	08	10	22
			O	0	0	0	0
5	Plane table survey	4	C	02	04	04	10
			O	0	0	0	0
Total		30	C	14	20	36	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q 1 to Q 35	1R2	2R2	2R2	3R2	4R2	4R2	5R2	35/35
	2U2	3U2	3U2	3U3	4U2	4U2	4U2	
	4U2	5U2	5U2	1A2	1A2	2A2	2A2	
	2A2	3A2	3A2	3A2	3A2	3A2	3A2	
	4A2	4A2	4A2	4A2	4A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Identifying the required instuments	5
2	Performance	7
3	Recording the observations, Calculations and preparing Drawings	8
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-
CO2	3	2	-	3	-	-	-	-	-
CO3	3	2	-	3	-	-	-	-	-
CO4	3	-	-	3	-	-	-	-	-
CO5	3	2	-	3	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Surveying and Levelling	N. N. Basak Tata McGraw Hill Education Pvt. Ltd.	13: 978-0-07-460399-4
2	Surveying and Levelling	R. Agor. Khanna Publishers	13: 978-81-7409-235-9
3	Surveying Vol. 1	Dr. B. C. Punmia, Laxmi Publisher.	10: 81-7008-853-4
4	Surveying and Levelling	R. Subramaniam. Oxford Higher Education, Oxford Uni. Press.	10: 0198085427
5	Surveying Theory and Practice	S.S. Bhavikatti, I K International Publishing House Pvt Ltd	10: 9380578253

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7. https://drive.google.com/file/d/11LaDLk2-d3xH3wL7j2vxVUmBYx77RMFP/view?pli=1 accessed on 24 th Dec. 2024

XVI List of Major Equipment/Machineries with Specification:

1. Chains, Tape, Cross staff, Optical square, Line ranger.
2. Prismatic Compass.
3. Dumpy Level, Auto Level and levelling staves.
4. Plane Table and its accessories.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. D. K.Parbat	HOD, Civil Engineering.	Government Polytechnic, Nagpur
2	Dr. A. W. Pawde	HOD, Civil Engineering.	Government Polytechnic, Nagpur
3	Dr.D. N. Kongre	Lecturer, Civil Engineering.	Government Polytechnic, Nagpur
4	Er. G. B. Takey	Retd. Superintending Engineer	P. W. D., Govt. of Maharashtra
5	Dr. Abhay Shende	Principal	J L Priyadarshani College of Engineering
6	Dr. V. Kondekar	HOD, Civil Engineering.	Government Polytechnic, Sakoli

(Dr. D. K. Parbat)
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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in AI/AE/CE/CO/EE/EC/IT/MK/MT/PK/TX
Course Category	:	GE
Course Code	:	ME292H
Course Title	:	Workshop Technology

I Rationale:

The subject of workshop technology aims to impart knowledge and skill components in the field. It deals with different hand and machine tools essential for manufacturing simple metal components and articles.Additionally, it aims to provide a basic introduction to recent trends in modern manufacturing techniques.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Select the machine tool and process according to industrial application.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Use** Hand tools, gauging and measuring instruments for various applications.

CO2: **Select** metal forming Processes for the various manufacturing application.

CO3: **Perform** the metal joining operations.

CO4: **Perform** the different metal cutting operations.

CO5: **Use** advance machining procesess like CNC machine, Robot and Adaptive manufacturing.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Safety practices in Basic operations and measuring Instruments	1a	Follow safety practices in basic operations.	1.1	Safety Practices, Causes of accidents, General safetyrules, Safety signs and symbols, First Aid.	CO1
	1b	Identify different hand tools for the basic operations.	1.2	Use hand tools like Suface plate, Rules,Tapes and squares, Bench Tools, Machinist's Hammers, Screw Drivers, Punches, Chisels, Scrapers, files, Pliers and Cutters, Wrenches, Hacksaw, Bench Vice, Hand Drill, Taps and die.	
	1c	Choose gauging and measuring instruments for given applications.	1.3	Demostrate proficiancy in handling Semi–Precision Tools: Calipers, Depth Gauge, Feeler gauge. Precision Tools: Micrometers,Vernier Calipers, Vernier Height Gauge, Telescopic Gauge, Hole Gauge, Bevel Protractor, Dial Indicator, Gauge Blocks and Surface plate.	

UNIT II: Basic Metal forming process	2a	Select the relevant forming process.	2.1	Types of forming process, Drop forging: Introduction to forging, upset forging, Press forging, open die and closed die forging operations.	CO2
	2b	Choose the correct comparision between various rolling and forging process on the given points.	2.2	Rolling: Principle of rolling, hot and cold rolling, Tyoes of rolling mills and Industrial applications.	
	2c	Suggest various press tool operations for given component.	2.3	Press tool:Various operations performed on press,press tool, simple,progressive and forming dies.	
	2d	Select various industrial application for forging and press shop.	2.4	Applictions of forging and press work in Automobile manufacturng and sheet metal industry.	
UNIT III: Metal joining process	3a	Select the proper welding process for the given component.	3.1	Welding Processes: Principal of welding, classification of welding processes, welding postion and techniques, welding symbols and safety measures in welding.	CO3
	3b	Select the gas welding process and its industrial application.	3.2	Gas welding: gas welding equipments, oxy-acetylene welding, types of flames, Gas cutting, industrial applications.	
	3c	Identify various resistance welding and arc welding processes.	3.3	Principal,details of types of process like spot,projection and seam welding and its industrial applications.Arc welding: arc welding equipments, flux shielded metal arc welding, TIG and MIG welding.	
	3d	Choose correct comparision of soldering and brazing process.	3.4	Soldering and brazing process, Comparison, merits, demerits and Industrial applications of processes in electronic, Electrical and Automobile industry.	

UNIT IV: Metal cutting processes and Machine tools	4a	Identify different machine tools with respect to its principal of operation.	4.1	Classification of machines with respect to principal of operation for lathe machine, drilling, shaping and Milling machines.	CO4
	4b	Select the main operations on lathe machine and drilling machine.	4.2	Types of lathe machine operations like turning, facing, taper turning, threading. Drilling operaions like Drilling, reaming, boring.	
	4c	Choose the main operations on shaper machine and milling machine.	4.3	shaper operations like slotting, groving, Milling operations like Plain milling, face milling, side milling.	
	4d	Select the tools and equipment for different machine tools.	4.4	Types of lathe and drill tools. Types of shaper and milling machine tools.	
	4e	Suggest various industrial applications for lathe, drilling and milling machine.	4.5	Applictions of lathe, drilling and milling machine in manufacturing industry.	
UNIT V: Advances in manufacturing	5a	Select advanced machining processes.	5.1	Overview of traditional machining vs. advanced machining processes. Introduction to additive manufacturing, CNC machining and Robotics.	CO5
	5b	Identify the principal of CNC machine and types of CNC.	5.2	Basic principles of CNC machine operation, including axes, coordinates, and tool paths and types of CNC.	
	5c	Select the types of Robot and suggest the applications of CNC and Robots in industry.	5.3	Fundamental concepts and principles of robotics, types of robot. Applications of CNC and Robot in various industries such as manufacturing, agriculture and Automobile.	
	5d	Identify the applications of additive manufacturing in mechanical engineering.	5.4	Principal of additive manufacturing and types. Applications of additive manufacturing in automobile industry and consumer goods.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the safetymeasures for the given any four basic operations.	2	CO1
I	2	Use Hand drill, taps and dies for the threading operation	2#	CO1
I	3	Select the gauges and measuring instrument and measure the dimensions	2	CO1
II	4	Prepare bill of material for given press work job (individually)	2	CO2
II	5	Identify the various hand tools, machine tools and equipment used in Press machine shop, write specifications, details, applications and safety rules of above tools.	2#	CO2
II	6	Interpriate the drawing and plan sequence of operations for the giveny forging job	2#	CO2
II	7	Produce a bolt head/cold chisel/hook using forging oprations.Identify the various machine components, hand tools equipments and safty rules used in forging shop.	2	CO2
III	8	Perform soldering/brazing operations.	2#	CO3
III	9	Perform the metal joining process for the given job and list the tools,equipments and safety rules for the process .	2	CO3
III	10	Interpriate the given drawing and plan sequence of operations for gas welding job.	2#	CO3
III	11	Prepare any weld joint (like lap or butt joint) involving arc welding as per the given drawing (Job to be prepared by group of 2 to 4 students depending on volume of work).Operation involve: measuring and marking, cutting, welding, and finishing.	2#	CO3
IV	12	Collect information of cutting fluid and cutting tool materials used in manufacturing industry and their application	2	CO4
IV	13	Perform job with drilling, boaring reaming and counter sinking operation as per the drawing	2#	CO4
IV	14	Read and interpret job drawing and plan sequence of operations for the giveny lathe machine job.	2#	CO4

IV	15	Set and mount the tool workpiece and select the cutting parameters for machining operations.	2#	CO4
IV	16	Perform job on lathe containing the operations like face and plain turning (Group of 2 to 4 students) (Part I) Marking, cutting and facing.	2#	CO4
IV	17	Perform Turning and finishing operation on lathe (Part II) as per drawing.	2#	CO4
V	18	Identify the various components of CNC milling machine and list the tools.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Safety practices in Basic operations and measuring Instruments	4	C	02	04	04	10
			O	0	0	0	0
2	Basic Metal forming process	5	C	04	04	06	14
			O	0	0	0	0
3	Metal joining process	7	C	04	06	06	16
			O	0	0	0	0
4	Metal cutting processes and Machine tools	9	C	04	08	06	18
			O	0	0	0	0
5	Advances in manufacturing	5	C	04	04	04	12
			O	0	0	0	0
Total		30	C	18	26	26	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q. 1 to Q. 35	1R2	1U2	1U2	1A2	1A2	2R2	2R2	35/35
	2U2	2U2	2A2	2A2	2A2	3R2	3R2	
	3U2	3U2	3U2	3A2	3A2	3A2	4R2	
	4R2	4U2	4U2	4U2	4U2	4A2	4A2	
	4A2	5R2	5R2	5U2	5U2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Job drawing, selection of equipment , writing procedure	5
2	Performance	10
3	Job / Result	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	2	-		-	-
CO5	3	-	-	3	2	-	2	-	-
CO6	3	-	-	3	2	-	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Elements Of Workshop Technology Vol II	S K Hajra Choudhury, A K Hajra Choudhury, Nirjhar Roy, Media Propoters & Publisher Pvt. Ltd.	13: 978-8-185-09915-6.
2	Manufacturing Technology: Foundry, Farming and Welding - Volume 1	P. N. Rao, McGraw Hill Education; Fifth Edition, 2018	13: 978-9353160500
3	Manufacturing Technology: Metal Cutting & Machine Tools - Volume 2	P. N. Rao, McGraw Hill Education; Forth Edition, 2018	13: 978-9353160524
4	Recent Advances in Materials and Manufacturing Technologies	Dr. P. Nageswara Rao and Dr. D. Venkateswarlu, Trans Tech Publications Ltd.	13: 978-3-0357-1432-6

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2. https://www.youtube.com/watch?v=2CIcvB72dmk, Accessed on 27/5/2024
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4. https://www.youtube.com/watch?v=-w7E88zox6w,Accessed on 27/5/2024
5. https://www.youtube.com/watch?v=DGsV6RhBnbM,Accessed on 27/5/2024
6. https://youtu.be/KmvoxqnFoxQ?si=e8WTmNA6_NRwdSRP,Accessed on 27/5/2024
7. https://youtu.be/EHvO-MlzAIM?si=kMzfRMxRJTsB5u5u,Accessed on 27/5/2024

XVI List of Major Equipment/Machineries with Specification:

1. Centre lathe machine
2. Bench Drilling Machine
3. Mini forging press
4. Mini press too
5. Column and knee type milling machine along with dividing head
6. Oxyacetelyne gas welding equipment
7. CNC Lathe/Milling machine
8. 3-D Printer st up

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Prof. A. R. Umale	HOD Mechanical Engineering (Section A)	Government Polytechnic, Nagpur
2	Prof. A. A. Jagdale	HOD Mechanical Engineering (Section B)	Government Polytechnic, Nagpur
3	Prof. N. J. Burbure	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
4	Prof. V. U. Datir	Workshop Suprintendent	Government Polytechnic, Nagpur
5	Prof. G. H. Dahole	I/C HOD Mechanical Engineering	Government Polytechnic, Gondia Government
6	Prof. G. F. Potbhare	Principal	NIT polytechnic Nagpur
7	Prof. A. R. Sheiikh	Director	A R Automation, Jafar Nagar, Nagpur

(Prof. A. R. Umale)
HOD & Chairman PBOS, ME

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Member Secretary PBOS, ME

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	DIPLOMA IN CE/ME/EC/CM/IT/AE/PK/MT/TX/MK/AI
Course Category	:	GE
Course Code	:	EE292H
Course Title	:	Electrical Machines

I Rationale:

The "Electrical Machines" course equips diploma engineering students from non-electrical branches with essential knowledge of basic electrical machines, fostering interdisciplinary skills. By understanding principles, operations, and applications of electrical machines such as AC/DC motors, transformers, and modern machines, students gain industry-relevant competency to effectively interact with electrical systems in diverse engineering domains. This minor diploma enhances employability, bridging knowledge gaps and enabling collaboration in multi-disciplinary projects.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge of basic electrical machines.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** DC machine for given application.

CO2: **Select** the transformer for given application.

CO3: **Suggest** the relevant three phase induction motor (IM) for different applications.

CO4: **Use** the relevant single phase induction motors for various applications.

CO5: **Use** BLDC and Stepper motors for various applications.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: DC Machine	1a	Classify given types of machine.	1.1	Introduction to DC and AC machines, Laws related to DC and AC machines, Classification of AC machines and DC machines, Differences between AC and DC machines.	CO1
	1b	Identify the given parts and materials for DC machine.	1.2	Construction, different parts of D.C. machines and thier functions, different materials used for parts.	
	1c	Suggest the given machine for given application.	1.3	Types of dc motor, its connection diagram and application, Types of dc generator, its connection diagram and application.	
nsformers	2a	Compare given transformers on the basis of given points.	2.1	Define transformer, working principle of transformer, construction parts and their fuctions, types of transformer, comparison between shell and core type.	

UNIT II: Tra	2b	Calculate basic parameters of single phase transformer from given data.	2.2	Different material used in construction, emf equation, voltage transformation ratio, application of single phase transformer.	CO2
	2c	Suggest transformer for given application.	2.3	Three phase transformer, its connection and application.	
UNIT III: Three-phase Induction Machine	3a	Compare the given types of three phase induction motors on given points.	3.1	Construction and working of 3 phase induction motor. Working principle, production of rotating magnetic field, synchronous speed, rotor speed and slip, types of three phase induction motor and its comparison.	CO3
	3b	Select induction machine for specified application.	3.2	Torque-Slip, Torque-Speed characteristic of three phase squirrel cage induction motor and its application, Induction generator principle and applications.	
	3c	Select given type of alternator for specified application.	3.3	Three phase alternator: construction, principle, types based on rotor construction and its application.	
UNIT IV: Single-phase Induction Motor	4a	Classify given types of single phase motors.	4.1	Double field revolvong theory, principle of making these motors selfstarting. Classification of single phase motors.	CO4
	4b	Compare the given types of single phase induction motor on the basis of given points.	4.2	Capacitor start induction run motor, capacitor start capacitor run motor, permanent capacitor motor and its connection and application.	
	4c	Suggest the application of given motor.	4.3	Universal motor its connection and application.	
r Machines	5a	Suggest the application of given motor.	5.1	Brushless DC motor (BLDC): Contruction, operation and applications.	
	5b	Suggest the application of given motor.	5.2	Stepper motor: Contruction, operation, types and applications.	

UNIT V: Othe	5c	Apply the concept of rermote operation of electrical machines for specified application.	5.3	Role of IoT in monitoring and controlling electric machines, smart sensors, data acquitions and remote diagnostics in electric machines. Energy conservation in electrical machines, remote operation of electric machines.	CO5

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the different parts of DC machine.	2#	CO1
I	2	Start DC shunt motor by using three point starter and to reverse the direction of rotation of motor.	2#	CO1
II	3	Identify the different types of transformer and its construction parts.	2#	CO2
II	4	Calculate voltage ratio and current ratio of single phase transformer.	2#	CO2
II	5	Find the regulation and efficiecy of single phase transformer by direct loading.	2	CO2
III	6	Identify the different parts of squirrel cage induction motor.	2#	CO3
III	7	Connect and run three phase induction motor by using DOL or autotransformer starter and reverse direction of rotation.	2#	CO3
III	8	Control the speed of the given three phase squirrel cage using stator voltage control or frequency control method.	2#	CO3
IV	9	Identify different windings and components of single phase induction.	2#	CO4
IV	10	Start and run single phase induction motor also reverse the direction of rotation.	2#	CO4
IV	11	Perform load test on single phase induction motor.	2#	CO3
IV	12	Connect to start and reverse the direction of rotation of universal motor.	2#	CO4
V	13	Connect to start and run the stepper motor.	2	CO5
V	14	Control the speed and reverse the direction of the BLDC motor.	2#	CO5
V	15	Prepare a report on role of IoT in monitoring and control of electrical machines.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	DC Machine	6	C	02	04	06	12
			O	00	00	00	0
2	Transformers	6	C	04	04	06	14
			O	00	00	00	0
3	Three-phase Induction Machine	7	C	02	06	08	16
			O	00	00	00	0
4	Single-phase Induction Motor	6	C	04	06	06	16
			O	00	00	00	0
5	Other Machines	5	C	04	04	04	12
			O	00	00	00	0
Total		30	C	16	24	30	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q. 01 to Q.35	1R2	1U2	1U2	1A2	1A2	1A2	2R2	2R2	35/35
	2U2	2U2	2A2	2A2	2A2	3R2	3U2	3U2	
	3U2	3A2	3A2	3A2	3A2	4R2	4R2	4U2	
	4U2	4U2	4A2	4A2	4A2	5R2	5R2	5U2	
	5U2	5A2	5A2						

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	-	-	-	-	-
CO5	3	-	-	3	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Text Book on Laboratory Courses in Electrical Engineering	S.G.Tarnekar and P.K.Kharbanda, S.Chand & Company Ltd., Third, 1990	13: 978-8121901048
2	A Textbook of Electrical Technology Vol-I	B.L.Theraja, A.K.Theraja, S.Chand & Co Ltd., Reprint, 2006	10: 81-219-2440-5
3	Principles Of Electrical Machines	V.K Mehta, Rohit Mehta, S Chand; Reprint Edn. 2014	13: 978-8121921916

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5. https://www.youtube.com/watch?v=A9sRsIghUxY ,accessed on 10th May , 2024
6. https://library.automationdirect.com/basic-electrical-theory/ , accessed on 10th May , 2024

XVI List of Major Equipment/Machineries with Specification:

1. Three phase squirrel cage induction motor.
2. DC shunt motor.
3. Single phase transformer.
4. Single phase induction motor.
5. Universal motor.
6. BLDC motor.
7. Stepper motor.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. M. C. Musale	I/c HoD, Electrical Engineering	Government Polytechnic, Nagpur
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3	Mrs. Divya Piparode	Sr. Engineer	Powergrid Corporation of India, Nagpur
4	Mr. M. N. Gawande	Lecturer, Electrical Engineering	Government Polytechnic, Gondia
5	Dr. G. V. Gotmare	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur
6	Mr. A. P. Dasarwar	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/CM/IT/PK/AIML/MT/MC/AE/TX
Course Category	:	GE
Course Code	:	EC292H
Course Title	:	Principle of Communication Engineering

I Rationale:

Electronics Communication is a field that deals with the transmission of information through electronic means. The communication plays in various aspects of modern life, ranging from personal interactions to global connectivity in business, science, and entertainment. Electronic communication technologies facilitate this connectivity by enabling real-time exchange of information via various mediums such as radio, television, telephone, and the internet.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use basic principles of electronics communication engineering for communication system.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Set** up a communication link between transmitter & receiver.

CO2: **Use** a digital modulation technique for a digital communication system.

CO3: **Measure** the performance of a communication system for a given application.

CO4: **Identify** components in a communication system model and test the functions.

CO5: **Determine** an antenna type from the radiation pattern.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Fundamentals of Communication	1a	Appy a given type of communication link between transmitter & receiver.	1.1	Introduction to basic electronic communication system. Block Schematic and elements of communication systems. Types of electronics communication: Simplex, half duplex & full duplex. Signals: Analog & Digital signals. Applications of communication system in many different areas. Simplex, half duplex & full duplex. Signals: Analog & Digital signals. Applications of communication system in many different areas	CO1
	1b	Identify the frequency range for given aplication in electromagnetic spectrum.	1.2	Electromagnetic spectrum-different bands & their corresponding frequencies and applications.	
	1c	Justify the need of modulation in a given communication system.	1.3	Definition of modulation, Necessity of Modulation, Types of modulation: AM-Amplitude modulation, FM-Frequency modulation, PM-Phase modulation (Only definition & waveforms).	

	1d	Compare given types of Noises on a given points.	1.4	Definition of Noise, Origin of Noise, Types of Noise.	
	1e	Analyse the different sections of transmitter & receiver.	1.5	Transmitters & Receivers: Low level & high level AM transmitters, TRF & Super heterodyne receivers.	
UNIT II: Digital Communication	2a	Use a given digital modulation technique for a given digital communication system.	2.1	Elements of Digital Communication system with its block diagram: source, transmitter, channel, receiver. Advantages & disadvantages of digital communication.	CO2
	2b	Compare Analog and Digital Communication on a given points.	2.2	Communication channel, characteristics: bit rate, baud rate. Comparison between Analog and Digital Communication. Sampling theorem, Nyquist rate.	
	2c	Identify the given blocks in digital modulation techniques	2.3	Basic Digital Modulation Techniques:-Amplitude Shift Keying(ASK), Frequency shift keying(FSK) ,Binary Phase shift ,keying(BPSK). (Only definition & waveforms)	
[: Basic communication systems.	3a	Evaluate the performance of a given communication system for a given application.	3.1	Microwave & waveguide components used: Microwave frequency spectrum and band designation, Rectangular and circular waveguides and their applications. Waveguide Components-H- Plane Tee, E-Plane Tee, E-H Plane Tee. (construction & their Properties only).	
	3b	Identify a given type of radar system for a given application.	3.2	Radar system & its types:Basic Principles of Radar, Basic Radar system, Pulsed radar systems & CW Doppler radar, Radar antenna scanning methods-Horizontal nodding, Helical, Spiral. Advantages, disadvantages & applications of radar systems.	CO3

UNIT III	3c	Compare a given types of optical fibers on a given points.	3.3	Optical Fiber communication: Block diagram of optical Communication, Advantages,disadvantages & applications of optical fiber communication. Basics of Optical fiber structure, Types of optical fibers.	
UNIT IV: Advanced Communication systems	4a	Identify a given components in a given communication system model and test the functions.	4.1	Satellite communication: Introduction of satellites communication, General structure of a satellite communication system.Advantages of satellite communication, Satellite orbital terms: Apogee, Perigee, Major axis, Minor axis, Angle of inclination , Ascending Node, Descending node , Line of nodes, Prograde orbit, Retrograde orbit.	CO4
	4b	Identify the given link model for a given satellite communication system.	4.2	Satellite system link model: Satellite uplink model, Satellite transponder, Satellite downlink model, Inter-satellite link.	
	4c	Choose a given type of Cellular system for given applications.	4.3	Mobile communication: Introduction to wireless communications. A basic Cellular System, Operation of Cellular system, Terms in Wireless communication system: base Station, Control Channel, forward channel, reverse channel, Mobile Station, Mobile Switching centre.	
	4d	Classify the given types of GSM Channel types.	4.4	GSM- Digital Cellular Mobile Standard: Global System for mobile (GSM):-Services and Features, GSM System Architecture, Radio subsystem, GSM channel types.	

UNIT V: Antenna & wave propagation	5a	Compare resonant & non-resonant antenna on a given points.	5.1	Definition of antenna, types of antennas; resonant & non-resonant antenna. Definitions of: Directive gain directivity, Power gain, Antenna resistance, Antenna efficiency, Band width, Beam width.	CO5
	5b	Select the antenna type from the given radiation pattern.	5.2	Directional high frequency antenna: Folded dipole antenna, Yagi-uda antenna; construction & radiation pattern.	
	5c	Predict the process of propagation of wave.	5.3	Propagation of waves, Ground waves, Sky waves, Space waves, Tropospheric propagation.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Set up a simplex and half duplex communication link between transmitter & receiver.	2#	CO1
I	2	Generate amplitude modulated (AM) waveforms for various value of modulating voltages (undermodulation, perfect modulation & over modulation).	2#	CO1
I	3	Generate frequency modulated (FM) waveform for various values of amplitude & frequency of modulating signals.	2#	CO1
II	4	Test the sample and hold circuit for various sampling frequencies to check the sampling theorem.	2#	CO2
II	5	Test the performance of ASK/FSK/PSK modulator and demodulator.	2#	CO2
III	6	Measure the output power in different arms of E-plane Tee / H-plane Tee / magic Tee.	2	CO3
III	7	Set the model of MTI radar for demonstration and observe the detection of object in range.	2	CO3
III	8	Use optical fiber as a communication channel to transmit an analog signal.	2#	CO3
III	9	Use optical fiber as a communication channel to transmit a digital signal.	2#	CO3
IV	10	Identify the various components in satellite communication model and test the functions.	2#	CO4
IV	11	Connect the satellite system model to set direct communication link and observed the communication established to transfer audio signal.	2#	CO4
IV	12	Identify different sections and components of mobile phone such as ringer section , dialer section, receiver section, transmitter section, camera, microphone, speaker , flashlight.	2#	CO4
IV	13	Use the CRO to observe the audio signal in mobile system using mobile kit.	2	CO4
V	14	Determine the radiation pattern of the given Yagi-Uda antenna.	2#	CO5
V	15	Determine the radiation pattern of the given dipole antenna.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Fundamentals of Communication	6	C	04	06	04	14
			O	0	0	0	0
2	Digital Communication	5	C	02	06	04	12
			O	0	0	0	0
3	Basic communication systems.	7	C	02	08	06	16
			O	0	0	0	0
4	Advanced Communication systems	7	C	02	08	06	16
			O	0	0	0	0
5	Antenna & wave propagation	5	C	04	06	02	12
			O	0	0	0	0
Total		30	C	14	34	22	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q. 1 to Q. 35	1R2	1R2	1U2	1U2	1U2	1A2	1A2	35/35
	2R2	2U2	2U2	2U2	2A2	2A2	3R2	
	3U2	3U2	3U2	3U2	3A2	3A2	3A2	
	4R2	4U2	4U2	4U2	4U2	4A2	4A2	
	4A2	5R2	5R2	5U2	5U2	5U2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment,Writing observation table, etc	5
2	Performance of the practical	10
3	Taking observations, Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	1	-	-		-
CO2	3	-	-	-	1	-	-	-	-
CO3	3	-	2	2	-	2	2	-	-
CO4	3	-	2	2	-	2	2	-	-
CO5	3	-	2	2	-	2	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Electronic Communication System.	George Kennedy McGraw-Hill, 5th Edition,2011.	13: 978-0071077828
2	Principles of Communication Engineering.	Anokh Singh S.Chand & Co ltd,5th Edition, New Delhi-1999	13: 978-812190476
3	Digital Communication	John Proakis and Masoud Salehi, McGraw-Hill Higher Education, Fifth Edition, 2007	13: 978-0072957167
4	Electronic Communication systems	Kennedy, Davis, Tata McGraw-Hill,FourthEdition,2000	10: 0-07-463682-0
5	Satellite Communication	D.C. Agarwal, Khanna publishers, Fifth Edition, 2009	10: 81-7409-144-0
6	Wireless Communication	Theodore S. Rappaport, Prentice Hall Of india, 5th Edition 2011	13: 9788131731864
7	Antenna Theory: Analysis and Design	Constantine A. Balanis Wiley-Student, New Delhi, India,4th Edition,2015.	13: 978-1118642061

XV e-References:

1. http://www.pa2old.nl/files/am_fundamentals.pdf,accessed on 30th May2024.
2. https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-ec11/ ,accessed on 2nd May 2024.
3. https://www.youtube.com/watch?v=xltpukBncs8 accessed on 11th March 2024
4. http://www.nptelvideos.in/2012/12/digital-communication.html accessed on 2nd March 2024.
5. http://nptel.ac.in/courses/117104127 , accessed on 20th May,2024.
6. https://www.youtube.com/watch?v=exxj8S-tPgs accessed on 27th June, 2024.

XVI List of Major Equipment/Machineries with Specification:

1. Ammeter MI 0-5-10
2. Voltmeter MI 0-150-300 V
3. CRO (Cathode Ray Oscilloscope)
4. Digital Multimeter
5. Connecting wires
6. Trainer kits

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. R.V.Yenkar	Head of Electronics & Telecomm Engineering	Government Polytechnic, Nagpur
2	Dr. V.H.Mankar	Head of Electronics & Telecomm Engineering	Government Polytechnic, Nagpur
3	Dr. D. N. Bhange	Lecturer in Electronics & Telecomm Engineering	Government Polytechnic, Nagpur
4	Mrs.U.M. Ramteke	Lecturer in Electronics & Telecomm Engineering	Government Polytechnic, Nagpur
5	Mr.Sandip V. Darwhekar	Director	Beta Computronics Pvt. Ltd. Nagpur
6	Mrs. Gazala Ali	HOD, Electronics	Anjuman Polytechnic, Nagpur.

(Dr. R. V. Yenkar)
HOD & Chairman PBOS, EC

(Dr. G. V. Gotmare)
Member Sectretary PBOS, EC

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/AE/TX/PK//MT/MK
Course Category	:	GE
Course Code	:	IT292H
Course Title	:	Web Designing

I Rationale:

Web Page Design is used to develop online applications for various organizations such as organizational and educational websites, virtual learning environments, business applications in various fields such as products, sales, banking railways reservation, services etc. Web pages are categorized into two namely: static and dynamic web page. This course introduces web page design using HTML5 and also give emphasis on learning Cascading Style Sheets (CSS) which is a style sheet language used for describing the presentation of a document written in a markup language for formatting and styling of content.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Develop and maintain websites and web applications

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Design** the web page using basic tags of HTML.

CO2: **Develop** web page using list and hyperlinks.

CO3: **Develop** web pages using images, colors and backgrounds.

CO4: **Design** HTML forms using table and frames.

CO5: **Create** a Webpage using Cascading Stylesheets.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to HTML	1a	Select correct defination from given statement.	1.1	Introduction of HTML	CO1
	1b	Identify structure of the given HTML page	1.2	Terminologies used in Web Design: World Wide Web (www), Web Pages, Web Site, Web Browsers, Web Servers and types of sites. Static vs. dynamic web sites, Search Engine.	
	1c	Identify use of attributes in given HTML tag.	1.3	Web page structure: DOCTYPE, HTML, TITLE, HEAD, BODY and other meta tags with attributes.	
	1d	Compare block level and text level tags on given points.	1.4	Block Level Elements: Headings, Paragraphs, Breaks, Divisions, Centered Text, Block Quotes, Preformatted text, types of Address, HR tag. Horizontal RuLe.	
	1e	Select the procedure of using the given Text level tag and use of special characters in web page.	1.5	Text Level Elements: Bold, Italic, Teletype, Underline, Strikethrough, Superscript, Subscript, DIV tag, displaying special characters, comments.	

UNIT II: Lists and Links	2a	Compare different types of given list.	2.1	Lists: Ordered Lists, Unordered Lists, Definition Lists, Nested Lists.	CO2
	2b	Compare different types of given Links.	2.2	Links: Absolute, Relative and Inline links, use image as link, link to an email address, button as link, types of links, linking various documents for internal and external links, to link different web page of same site, link different location on the same web page, a specific location on different web page of same site, to specific section within the document, inserting E-mail link.	
UNIT III: Images, Colors and Background	3a	Compare different types of image formats on basics of given point.	3.1	Image: Types of image format, jpg, bmp, png gif etc. IMG tag, alternate text, image alignment, HSPACE, VSPACE, height and width of images.	CO3
	3b	Identify given types of attributes of body tag.	3.2	Colors and Backgrounds: The text color, color attribute of FONT tag, text attribute of BODY tag. bgcolor attribute of BODY tag, Backgrounds: Inserting image as page background, background attributes of BODY tag.	
UNIT IV: Table, Frames and Forms	4a	Select appropriate tag on given table with attributes to organize data on a web page and table setting.	4.1	Table: Table tag with attributes. TABLE, <tr>, <th>, <td> tags. Border, cell spacing, cell padding, width, align, bgcolor attributes. Adding captions: CAPTION tag	CO4
	4b	Identify given types of table attributes.	4.2	Formatting contents in the table cells: align, valign, bgcolor, height, width. Spanning rows and columns: rowspan and colspan attributes.	
	4c	Identify the given type of 'frame' with examples and procedure to organize display as per given screen layout using frames.	4.3	Frames: Types of Frames with their attributes, Creating frames: FRAMESET tag – rows, cols attributes, FRAME tag – name, frame border, margin height, margin width, src.	

	4d	Identify the given attribute/elements of form tag	4.4	Forms: Creating basic form: FORM tag, action and method attributes, Form fields: Single line text field, password field, multiple line text area, radio buttons, and check boxes.	
UNIT V: Cascading Style sheets	5a	Identify CSS code for the given type of formatting on a web page with different CSS properties.	5.1	Cascading Style Sheets: Different types of Style Sheets, Benefits of using CSS. Adding style to the document: Linking to style sheets, Embedding style sheets.	CO5
	5b	Select the procedure to create CSS for applying the given presentation scheme on a web page.	5.2	Style sheet properties: Font, text, box, color and background properties; Creating and Using a simple external CSS file; Using the internal and inline CSS; background and color gradients in CSS Setting font and text in style sheet using table layout.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Design a Web page using basic HTML tags -<HTML>, <HEAD>, <TITLE>, <BODY>.	2#	CO1
I	2	Create a web page which display a string "Welcome to GP nagpuri" in all < h1> to <h6> header tags.	2#	CO1
I	3	Create a web page for displaying a paragraph using block level tags, HR tags.	2#	CO1
I	4	Create a web page using text level tags.	2#	CO1
II	5	Design a web page for implementing ordered list and unordered list.	2#	CO2
II	6	Design a web page for implementing: Ordered list within unordered list,Unordered list within ordered list, Ordered list within ordered list,Unordered list within unordered list.	2#	CO2
II	7	Create a web page to link: A different web page of same site,A different location on the same web page, A Specific location on different web page of same site.	2#	CO2
II	8	Create web page to link: An external page of different web site,To an e-mail ID.	2#	CO2
III	9	Create a webpage which includes photos and align with the ALT property on the left, right, and center.Create a webpage to set picture in left, right, and middle alignment.	2#	CO3
III	10	Insert images on web page using various attributes and set image as background.	2#	CO3
III	11	Create a web page to implement Table.	2#	CO3
III	12	Create table within table and also insert an image within the data elements of the table.	2#	CO3
IV	13	Create a web page to implement frame tags.	2	CO4
IV	14	Create a webpage using form with all its elements.	2#	CO4
V	15	Develope a program to create a web page to demonstrate CSS using internal and external CSS.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to HTML	6	C	02	04	00	6
			O	00	00	00	0
2	Lists and Links	6	C	02	06	00	8
			O	00	00	00	0
3	Images, Colors and Background	6	C	02	06	08	16
			O	00	00	00	0
4	Table, Frames and Forms	6	C	06	10	08	24
			O	00	00	00	0
5	Cascading Style sheets	6	C	04	06	06	16
			O	00	00	00	0
Total		30	C	16	32	22	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q. 1 to Q. 35	1R2	1U2	1U2	2R2	2U2	2U2	2U2	35/35	
	3R2	3U2	3U2	3U2	3A2	3A2	3A2		
	3A2	4R2	4R2	4R2	4U2	4U2	4U2		
	4U2	4U2	4A2	4A2	4A2	4A2	5R2		
	5R2	5U2	5U2	5U2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Activities/ Writing program	5
2	Performance/Execution of program	10
3	Viva Voce	10
4		
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	-	-	3	-	3	-	-
CO2	3	3	-	-	3	-	3	-	-
CO3	3	3	-	-	3	-	3	-	-
CO4	3	3	-	-	3	-	3	-	-
CO5	3	-	-	-	3	-	3	-	-
CO6	3	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Teach yourself HTML & CSS in 24 hours	Julie C. Meloni, 9th Edition	13: 9789332535992
2	HTML & CSS: The Complete Reference	Thomas A. Powell, 5th Edition	13: 9780070701946
3	HTML & CSS: Design and Build Web Sites	Jon Duckett	13: 9781118206911

XV e-References:

1. https://edu.gcfglobal.org/en/basic-html/links-and-images-in-html/1/ accessed on 5th aug 2024
2. https://www.w3schools.com/html/ , accessed on 5 aug 2024
3. https://www.codecademy.com/learn/learn-html , accessed on 18th Aug 2024

XVI List of Major Equipment/Machineries with Specification:

1. Computer (Dual CORE and above) with Internet connection.
2. Windows 7 or 8 or latest (Professional Edition/Academic edition)

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. A. R.Mahajan	HoD Information Technology	Government Polytechnic, Nagpur
2	Mr. Dipak Dhote	Operations manager	IT-Network Infosystem Pvt Ltd. Nagpur
3	Mr. Rajesh Kadu	Assistant Professor	Ramdeobaba College of Engineering Nagpur
4	Mrs. V. A. Raje	System Analyst	MSBTE, RO, Nagpur
5	Dr. S. S. Gharde	Lecturer in IT	Government Polytechnic, Nagpur

(Dr. A. R. Mahajan)
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Member Secretary PBOS, IT

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/PK/IT/CM/MK/AI/AE/TX
Course Category	:	GE
Course Code	:	MT292H
Course Title	:	Testing of Materials

I Rationale:

A "Testing of Materials" course is crucial for metallurgy diploma students in India as it provides foundational knowledge in assessing material properties essential for quality control and engineering applications. Understanding testing methods, such as tensile, hardness, and impact tests, equips students to ensure material reliability and safety in various industries. This course bridges theoretical knowledge with practical skills, enhancing their ability to address real-world challenges in metallurgy

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Conduct Metallurgical Testing and Inspection procedures

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** different parts of testing equipments

CO2: **Select** destructive and NDT methods of testing

CO3: **Recommend** suitable test for different applications.

CO4: **Prepare** sample for different tests to be carried out

CO5: **Operate** various Testing equipments

CO6: **Perform** different NDT tests

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25	10	-	-

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Scope Of Testing	1a	Compare Mechanical, Physical and Chemical properties of given metals.	1.1	The scope and need of testing Mechanical, Physical and Chemical properties of metals.	CO1
	1b	Identify elastic and plastic bodies	1.2	Concepts of Stress, strain, elastic and plastic bodies strain under axial load in tension and compression	
	1c	Prepare various reports on testing	1.3	Types and Forms of various Testing Results	
	1d	Compare different Standardizing agencies	1.4	Standardizing Agencies: SAE, AISI, ASTM, BIS, IS	
II: Mechanical Testing	2a	Sketch a standard Tensile Specimen	2.1	Tensile test: Scope and applicability. Modulus of elasticity / Young's modulus	CO2
	2b	Use Hook's law to find Youngs modulus	2.2	Specification of testing specime. Effect of important variables, Hook's law	
	2c	Calculate proof stress for given material	2.3	Yield stress and proof stress determinations, calculation of true and engineering stress – strain	

UNIT	2d	Use of UTM machine for tensile test of given sample	2.4	Types of tensile testing machine & their construction: Universal testing machine, Extensometer and recorders	
UNIT III: Hardness Test	3a	Justify the need of hardness testing in industrial application	3.1	Scope and applicability of hardness test.	CO3
	3b	Use MOH'S scale to compare hardness of different minerals	3.2	Scratch and wear hardness test- moh's scale	
	3c	Identify different hardness Testers	3.3	Rockwell test: procedure, effect of variables in rockwell hardness tester	
	3d	Compare given hardness test on the basis of given following points	3.4	Vickers hardness test- Procedure, derivation of VHN, effect of variables, applications, advantages and limitations	
	3e	Determine brinell hardness values for given samples	3.5	Brinell hardness test: Procedure, derivation of BHN, effect of variables, applications, advantages and limitations	
UNIT IV: Service Tests	4a	Identify type of fractures for given material	4.1	Charpy and Izod impact tests: standard samples used, test procedure.	CO4
	4b	Compare ductile and brittle fracture on the basis of given points	4.2	Effect of variables.: Role of temperature and stress concentration factors like holes, cracks etc	
	4c	Select suitable Impact tests for given test sample to detect fracture	4.3	Fatigue test: concept of fatigue, loading condition to cause fatigue. Study of S-N Curve Scope and applicability of fatigue test Machine for fatigue test on metals, general procedure	
ventional Non-ve Testings	5a	Justify the need for NDT in metallurgy industry	5.1	Concept of non destructive testing Need of Non-destructive test, Types of non-destructive test	CO5
	5b	Select suitable NDT for proper application	5.2	Methods of Examination for defects: Visual examination, Penentrant tests, Hammer tests etc	

UNIT V: Con Destructi	5c	Suggest suitable NDT method for magnetic materias	5.3	Method based on magnetic analysis: Magnetic particle method, yoke type
	5d	Use ultrasonic testing machine on given test sample to determine	5.4	Ultrasonic Testing: Fundamentals, Equipments, procedure and applications. Interpretation of results

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Prepare samples for different types of testing of materials	2#	CO1
I	2	Follow safety rules in Testing Laboratory in metallurgical plant/industry	2#	CO1
I	3	Identify ductile and or brittle failure for given material observing type of fracture occured	2#	CO1
II	4	Identify various parts of Brinell hardness Tester	2#	CO2
II	5	Operate Brinell hardness tester to MeasureHardness for given materials	2#	CO2
III	6	Operate vickershardness testingmachine for given materials to find hardness values	2#	CO3
III	7	Measure Hardness by Rockwell hardness Tester for given materials	2#	CO3
IV	8	Perform Crack detection using dye penetrant test for given material	2#	CO4
IV	9	Determine Impact strength for given material by Charpy impact tester	2#	CO4
IV	10	Determine Impact strength for given material by Izod impact tester	2#	CO4
IV	11	Operate standard fatigue testing Machine to determine fatigue in given metals and draw SN curve for the same	2	CO4
V	12	Perform Scratch and wear hardness test for given materials using moh's scale	2#	CO5
V	13	Perform Crack detection using dye penetrant test for given material	2#	CO5
V	14	Conduct Magnetic Particle Crack detection test for given material	2#	CO5
V	15	Operate U.T.M to determine Tensile strength and other given parameters for given steel bars. Prepare various results obtained from test.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Scope Of Testing	4	C	02	04	06	12
			O	0	0	00	0
2	Mechanical Testing	8	C	04	08	06	18
			O	00	00	0	0
3	Hardness Test	8	C	04	08	06	18
			O	0	0	0	0
4	Service Tests	6	C	04	08	0	12
			O	0	0	0	0
5	Conventional Non-Destructive Testings	6	C	02	08	0	10
			O	0	0	0	0
6			C	00	00	00	0
			O	00	00	00	0
Total		32	C	16	36	18	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C O
Q. 1 to Q. 35	1R2	1U2	1U2	1A2	1A2	1A2	2R2	35/35
	2R2	2U2	2U2	2U2	2U2	2A6	2A6	
	2A6	3R2	3R2	3U2	3U2	3U2	3U2	
	3A6	3A6	3A6	4R2	4R2	4U2	4U2	
	4U2	4U2	5R2	5U2	5U2	5U2	5U2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	PERFORMANCE/report writing/submission	15
2	Viva Voce	10
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	3	3	-	3	-	-
CO2	3	3	3	3	3	-	3	-	-
CO3	3	3	2	3	3	-	3	-	
CO4	3	3	3	3	3	2	3	-	-
CO5	3	3	3	3	3	2	3	-	-
CO6	3	3	3	3	3	2	3	-	

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Testing of Materials	Prof. A.V.K. Suryanarayana. BS Publications/BSP Books , 2nd Edition, 2013	13:978-81-7800-134-0
2	The Testing of Engineering Materials	H. E. Davis, G. E. Troxell , Mcgraw Hill Publishing Company, Fourth Edition,1982	10: 81-7409-026-6
3	Mechanical Metallurgy	George Dieter, McGraw Hill Education; Third Edition, July 2017.	13: 978-1259064791

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2. https://www.youtube.com/watch?v=UsoDrzBewIc,ASSESSED ON 14 MAY 2024
3. https://www.youtube.com/watch?v=5cNWF61Tmj0&list=PLyAZSyX8Qy5AePdV6vbGP4OJQOpbga-0Q,ASSESSED ON 14 MAY 2024
4. https://www.youtube.com/watch?v=TedpFxML8wQ , ASSESSED ON 14 MAY 2024

XVI List of Major Equipment/Machineries with Specification:

1. Standard specimen of steel, MS bar, plates etc
2. UTM 60-100 tonnes capacity
3. Rockwell hardness tester, Brinell, Vickers hardness testers
4. Impact testing machines
5. Fatigue testing machine

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Shri.K.L. Meshram	HOD, Metallurgical Engineering	Government Polytechnic, Nagpur
2	Miss.V.C. Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
3	Shri.S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Durg.
4	Dr. Y.Y. Mahajan	Assistant Professor Metallurgy & Material Science	VNIT, Nagpur
5	Shri.D.P Mukherjee	Works Manager (Rtd.)	Ordnance factory Ambhajhari, Nagpur

(Mr. K. L. Meshram)
HOD & Chairman PBOS, MT

(Dr. G. V. Gotmare)
Member Sectretary PBOS, MT

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/IT/MT/PK/CM/AE/AI/MK
Course Category	:	GE
Course Code	:	TX292H
Course Title	:	Dyeing and Printing

I Rationale:

This course is designed for the students of other than Textile department. The Dyeing and Printing course explores the art and science of coloration and decoration in Textiles. Students learn traditional and digital techniques understanding color theory, dye chemistry and printing processes.Bymastering dyeing and printing, students enhance textile products astheticand functional value.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply dyeing and printing on textile material.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Classify** the pretreatment process.

CO2: **Identify** the type of dye used for cotton material.

CO3: **Select** dye for protein and synthetic fibre

CO4: **Use** different methods of printing.

CO5: **Develop** print by diffrent styles of printing on textiles.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Pretreatment for dyeing and Printing	1a	Identify flow chart of given wet procesing sequence.	1.1	Importance of Textile wet processing and Pretreatment Process, flowchart and objectives of each process.	CO1
	1b	Classify the given pretreatment process.	1.2	Classification of singeing machine, desizing, bleaching process. chemicals used in desizing process, scouring process,bleaching and mercerisation process.	
UNIT II: Dyeing of celllulosic fibres	2a	Classify the given type of dye for cotton material	2.1	Object of dyeing, Classification of Dyes, Common terms used in dyeing, dyeing assistants, Mechanism of dyeing. Natural Dyes and its importance	CO2
	2b	Apply the given dye on cotton/ viscose material.	2.2	Dyes for cellulosic material- Direct Dyes, Reactive dyes and Vat Dyes. Properties, types, parameters affecting dyeing quality, dyeing procedure.	

UNIT III: Dyeing of protein and synthetic fibre.	3a	Select the given dye for protein fabric.	3.1	Dyes for protein fibres, Classification of Acid dyes and basic dyes, Properties, dyeing procedure of silk and wool fibre.	CO3
	3b	Apply disperse dye to dye given fabric.	3.2	Classification of disperse dyes and cationic dyes, Properties, dyeing procedure of polyester, acetate and acrylic fibre.	
UNIT IV: Methods of printing	4a	Compare dyeing with printing on given parameters.	4.1	Objects of printing, difference between dyeing and printing, preparation of printing paste, sequence of printing. Ingredients in printing paste.	CO4
	4b	Use given printing method to print the fabric.	4.2	Methods of printing- Block, stencik, duplex, screen,transfer printing, rolle printing machiner, rotary sreen and flat bed screen printing machine.	
UNIT V: Styles of Printing	5a	Suggest different styles of given printing.	5.1	Styles of printing- Direct, discharge and resist printing.	CO5
	5b	Use dyes to print given fabric	5.2	Printing procedure of cotton and polyester.After treatment to printed goods.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Use chemicals to desize the grey fabric.	02#	CO1
I	2	Use chemicals to scour the given fabric.	02#	CO1
I	3	Use chemicals to bleach the given cotton fabric.	02#	CO1
I	4	Apply caustic treatment to mercerise the cotton fabric.	2	CO1
II	5	Use pretreated samples to dye with given natural dye.	02#	CO2
II	6	Use direct dye to dye given cellulosic material.	02#	CO2
II	7	Use reactive dye to dye given viscose/cotton material	02#	CO2
II	8	Use vat dye to dye given cotton material	02#	CO2
III	9	Use acid dye to dye protein material.	2	CO3
IV	10	Prepare printing paste for given textile material and write the functions of each ingredient.	02#	CO4
IV	11	Apply block print on given material.	02#	CO4
IV	12	Apply screen print on given material.	2	CO4
V	13	Prepare printing paste and print given fabric with direct style of printing.	02#	CO5
V	14	Apply tie and dye printing technique.	02#	CO5
V	15	Prepare printing paste and print given fabric with resist style of printing.	02#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Pretreatment for dyeing and Printing	8	C	6	8	6	20
			O	0	0	0	0
2	Dyeing of celllulosic fibres	6	C	2	6	6	12
			O	0	0	0	0
3	Dyeing of protein and synthetic fibre.	6	C	2	4	6	12
			O	0	0	0	0
4	Methods of printing	6	C	2	6	6	14
			O	0	0	0	0
5	Styles of Printing	4	C	2	4	4	10
			O	0	0	0	0
Total		30	C	14	28	28	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	-----NA-----	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	
Q .01 TO Q.35	1R2	1R2	1R2	1U2	1U2	1U2	1U2	35/35
	1A2	1A2	1A2	2R2	2U2	2U2	2U2	
	2A2	2A2	2A2	3R2	3U2	3U2	3A2	
	3A2	3A2	4R2	4U2	4U2	4U2	4A2	
	4A2	4A2	5R2	5U2	5U2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Procedure	5
2	Performane	10
3	Result	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	3	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	-	-	3		-	3	-	-
CO5	3	-	-	3		-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Chemical Processing of Textiles	NCUTE Publication	-
2	Technology of Printing Vol. IV	V.A.Shenai, Sevak Publication, 2003	13: 9783659686047
3	Dyeing and Chemical Technology of Textile Fibres	E R Trotman, John Wiley & Sons Inc; 6 Sub edition, 1985	13: 978-047180910
4	Chemical Technology in Pre-Treatment processes of Textiles	S.R.Karmakar, Elsevier Science, 1 Edition, 1999	13: 9780444500601
5	Technology of Textile Processing	V. A. Shenai, Sevak Publication, Vol X, 1987	OCLC:313590523

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2. https://www.researchgate.net/figure/Types-of-dyes-used-for-the-dyeing-of-protein-fibers_fig3_351022496,assessed on 18th September 2024
3. https://www.slideshare.net/DuraisamyRamesh1/printing-methods-styles,assessed on 18th September 2024
4. https://www.slideshare.net/DuraisamyRamesh1/printing-methods-styles, assessed on 18th September 2024

XVI List of Major Equipment/Machineries with Specification:

1. Beaker dyeing machine
2. Beaker dyeing machine
3. Induction
4. Steel utensil
5. Pipete
6. Glass beaker
7. Screen
8. Block
9. Weighing balance

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr C.P.Kapse	I/C HOD Textile Manufacture	Government Polytechnic, Nagpur
2	Dr. S.G Gaikwad	Selection Grade Lecturer Textile Manufacture	Government Polytechnic, Nagpur
3	Prof L.S.Chakraborty	Lecturer Textile Manufacture	Government Polytechnic, Nagpur
4	Dr Ganesh Kakad	HOD Textile Engineeering	JDIT, Yavatmal
5	Mr Laxminarayan Kaushik	Director	LLP Professional, Nagpur
6	Prof. Harshal Ramteke	HOD Textile Technology	Sasmira, Mumbai
7	Prof S.S.Lawand	Selection Grade Lecturer Textile Manufacture	Government Polytechnic, Nagpur

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GOVERNMENT POLYTECHNIC, NAGPUR
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/PK/AI/MT/MK/TX
Course Category	:	GE
Course Code	:	AE292H
Course Title	:	Two Wheeler Technology

I Rationale:

There is an increased need of public transport. The public transport systems in cities and in rural area do not meet the requirement effectively. This has led to huge demand of two wheelers. Presently the two wheelers are used by a large section of society as personalized transport. In view of the growth, large employment potential in this field and the manpower required to cater to the same, this subject is included as an elective subject.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge of two wheeler to maintain and Repair vehicle.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** proper frame and chassis types and material for two wheelers.

CO2: **Diagnose** various problems in two-wheeler fuel and lubrication systems.

CO3: **Perform** repairs on transmission, steering, suspension and braking system.

CO4: **Maintain** the electrical systems and lightning system of a given vehicle.

CO5: **Identify** the significance of aerodynamics, aesthetics, ergonomics, safety.

CO6: **Identify** various advance mechanism used in Two wheeler.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2		4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objectice Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Frame and chassis	1a	Classify the frames with given parameters.	1.1	Frames: Single cradle frame, Double cradle frame, Tabular frame and its types, Engine based frame and Twin spar frame.	CO1
	1b	Compare the given two wheeler chassis on the given basis.	1.2	Chassis: Conventional chassis and monocoque or integral construction. Layout of Two wheeler vehicle.	
	1c	Select relevant frame materials for given vehicle application with justification.	1.3	Frame material and its properties: Alloy steel, aluminium alloy, carbon fiber.	
mission system	2a	Compare engine technology upgradation from BS IV to BS VI.	2.1	Basics of two wheeler engine, Engine technology upgradation (From BS IV to BS VI), Engine selection criteria, Valve operating mechanism.	
	2b	Select an air filter for given vehicle with justification.	2.2	Induction System: Air filter/Air cleaner: Function, types, construction and working.	

UNIT II: Fuel supply and er	2c	Identify an engine exhaust system component for given vehicle .	2.3	Exhaust System: Function, Construction. Basic Parts- Heat Diffuser, Header pipe, Muffler.	CO2
	2d	Draw the sketch of fuel supply system and describe it.	2.4	Fuel supply system: Block diagram, Construction & working of Carburetor System, Electronic fuel injection system as per BSVI Norms.	
	2e	Justify the application of lubrication system for the given two wheeler engine.	2.5	Lubrication system: Lubrication in four stroke engines of two wheeler.	
UNIT III: Comfort and Control system	3a	Identify the transmission system of the given vehicle on the given parameters.	3.1	Transmission system : Layout of transmission system in two wheeler, Construction and working of - Cable actuated wet multi- disc clutch, Centrifugal clutch, Chain drive, Continuous variable transmission (CVT), Gearbox- working of constant mesh gearbox, Gear shifting mechanism- hand and foot operated shifting mechanism.	CO3
	3b	Find effect of steering geometry relevant parameters for the given vehicle with sketch.	3.2	Steering system: Steering geometry and effects-Caster angle & Trail, Steering fork, Handlebar arrangement.	
	3c	Select the suspension system for the given application with justification.	3.3	Suspension System: Two wheeler suspension system- Spring and damper- swing arm and telescopic type. Monoshock suspension. Swing Arm type rear suspension of passenger Auto rickshaw.	
	3d	Compare the braking system of the given vehicle on the basis of given parametes.	3.4	Braking system: Drum brake and disc brake - Construction & Working. Brake control system- hand and foot operated brake, Braking system of Auto rickshaw.	

	3e	Select wheels and tires for the given vehicle with justification.	3.5	Wheels and tires selection criteria of wheels and tires and their specification for motorcycle scooter sports bike.	
UNIT IV: Electrical system	4a	Justify the working of the given ignition system with sketch.	4.1	Ignition system: a. Working of capacitive discharge ignition system. b. Procedure to check CDI system aggregates. c. Microprocessor control ignition system block diagram and working. d. Concept of twin Spark ignition system.	CO4
	4b	Select the procedure to check aggregates of CDI system with sketch.	4.2	Starting system: a. Kick start and button start arrangement. b. Components of starting system and their function DC motor battery rating for use in button start vehicle.	
	4c	Compare the engine starting system and their aggregates on the basis of the given parameters.	4.3	Charging system components of charging system schematic circuit and working of charging system.	
	4d	Determine the specification and features of the given dashboard oblique lighting system aggregate.	4.4	Lighting system and accessories: a. Specification and application of headlamp tail and number plate lamp purpose of using LED lights in tail lamp turn signal lamp side stand indicator lamp high beam indicator lamp neutral indicator lamp speedometer lamp on mobile charger point headlamp and tail lamp reflectors used in two wheelers. b. Dash units use of speedometer analogue and digital trip meter use of engine speed indicator/tachometer.	

UNIT V: Aerodynamic and safety aspects	5a	Draw sketch of the given aggregates of aerodynamic for the vehicle.	5.1	Aerodynamic as aspects:a-Headlamp shape sealed beam and conventional Tail lamp and indicator light arrangement body in closed and separate c-Shaped of attack in motorcycle.	CO5
	5b	Justify a mix of spectral even to the given vehicle handling sitting arrangement with sketch.	5.2	Ergonomic aspect: a. Seat arrangement for raider and pillion rider. b. Handle bar position.	
	5c	Identify significance of aesthetic aspects for relevant aggregates of the given vehicle with justification.	5.3	Aesthetic aspect: a. Headlamp fairing of motorcycle. b. Side panels for scooter scooter and motorcycle. c. Ground clearance d mudguard shape and position.	
	5d	Select the safety aspect of given two wheeler relay rider and justify it.	5.4	Safety expect: a. Crash bar saree guard. b. Driving habits. c. Drive gear jacket helmet day night.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Dismantle the given two wheeler vehicle.	02#	CO1
I	2	Identify the parts of the vehicle frame and chassis.	02#	CO1
I	3	Assemble the given two wheeler vehicle.	02#	CO1
II	4	Adjust Valve Clearance of the given engine using relevant tools.	02#	CO2
II	5	Service induction system of the given two wheeler petrol engine for emission control.	02#	CO2
II	6	Fine-tune idle speed of a two wheeler engine using the specified procedure.	02#	CO2
II	7	Lubricate the given two wheeler chassis.	2	CO2
III	8	Dismantle the given clutch assembly to check condition of components with reference to service manual.	2	CO3
III	9	Adjust the multi-plate clutch after assembly.	02#	CO3
III	10	Dismantle the gearbox of the given two wheeler	02#	CO3
III	11	Assemble the gearbox of the given two wheeler	02#	CO3
III	12	Service the brake system of the given two wheeler.	02#	CO3
III	13	Maintain ignition system of the given two wheeler.	2	CO3
IV	14	Check components of self- start system of the given two- wheeler engines.	02#	CO4
IV	15	Maintain wiring harness of the given two- wheeler.	2	CO4
V	16	Adjust handlebar for ergonomic position of given two wheeler.	02#	CO5
VI	17	Interpret the aerodynamic, ergonomic design and safety aspects of the given two or three wheelers.	2	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Frame and chassis	4	C	02	06	06	14
			O	0	0	0	0
2	Fuel supply and emission system	8	C	02	06	06	14
			O	0	0	0	0
3	Comfort and Control system	7	C	02	06	06	14
			O	0	0	0	0
4	Electrical system	7	C	02	06	06	14
			O	0	0	0	0
5	Aerodynamic and safety aspects	4	C	02	06	06	14
			O	0	0	0	0
Total		30	C	10	30	30	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q. 1 to Q. 35	1R2	1U2	1U2	1U2	1A2	1A2	1A2	35/35
	2R2	2U2	2U2	2U2	2A2	2A2	2A2	
	3R2	3U2	3U2	3U2	3A2	3A2	3A2	
	4R2	4U2	4U2	4U2	4A2	4A2	4A2	
	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of equipment.	5
2	Writing procedure and Performance.	10
3	Conclusion and Result.	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	2	-	3	-	3	-	-
CO2	3	-	2	3	3	-	3	-	-
CO3	3	-	2	3	3	-	3	-	-
CO4	3	-	-	3	3	-	3	-	-
CO5	3	-	-	3	3	-	3	-	-
CO6	3	-	-	3	3	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Two and Three Wheeler Technology	Panchal, Dhruv, U, PHI Learning Pvt. Ltd; New Delhi, 2015	13: 9788120351431
2	Two and Three Wheeler Technology	Ramlingham K.K, Scitech Publications (India) Pvt Ltd, 2010	13: 978-0-7680-0029-0 10: 8183712037
3	Automobile Engineering Vol. I	Dr. Kripal Singh, Standard Publishers Distributors, 13th Edition, 2013	13: 97881801419669
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8. https://www.youtube.com/watch?v=NJkU8wbjgjs&list=PLyqSpQzTE6
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XVI List of Major Equipment/Machineries with Specification:

1. Two wheeler vehicle- frames (Single cradle frame)
2. Two wheeler vehicle- frames (Double cradle frame)
3. Universal clutch holder
4. Working model of two wheeler transmission system (4 speed transmission)
5. Working model of two wheeler transmission system (4-forward and 1-Reverse transmission)
6. Two wheeler vehicle engine (4-stroke, single cylinder engine)
7. General purpose tools (Spanners, ings spanner and socket set.)-6mmto 32mm
8. Torque wrench range -10Nm to 200Nm.
9. Allen key set - star & hex
10. Feeler gauge set

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. G. K. Awari	HOD, Autombile Engineering	Government Polytechnic, Nagpur
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3	Dr. S. D. Thakre	Lecturer, Auomobile Engineering	Government Polytechnic, Nagpur
4	Dr. S.A. Telang	Lecturer, Auomobile Engineering	Government Polytechnic, Nagpur
5	Prof. J M Syed	Lecturer, Auomobile Engineering	Government Polytechnic, Nagpur
6	Mr. Promod Nichat	Rtd. Asst. General Manager	Ashok Layland, Chennai
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8	Dr. Suhas Kongre	Sr.Lecturer in Mechanical	ASTS Polytechnic, Wardha

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/IT/MT/TX/AE/CM/MK/AI
Course Category	:	GE
Course Code	:	PK292H
Course Title	:	Folding Cartons & Corrugated Boxes

I Rationale:

In the packaging industry, folding cartons and corrugated boxes are among the most widely used packaging solutions. To design, convert, and apply these effectively, it is essential to understand the raw materials—primarily paperboard and corrugated board—their properties, structure, and behavior during conversion processes. This course provides foundational knowledge of paperboard and corrugated board materials, their manufacturing and conversion techniques, structural design, and practical applications in packaging. It prepares students with the skills needed to work with various carton and box formats used across industries.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Comprehend the knowledge of papers and their conversion processes for packaging applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** the given types of paperboard materials used in folding cartons and appriciate sustainability.

CO2: **Evaluate** carton designs and test for balance between aesthetics and functionality.

CO3: **Apply** modern trends in carton manufacturing, such as laser cutting, by observing demonstrations

CO4: **Operate** machines for converting corrugated boards into boxes, and demonstrate sealing methods.

CO5: **Evaluate** testing methods and conduct compression tests on corrugated boxes and quality control measures and perform simple quality checks.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	2	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Material Selection for Folding Cartons	1a	Identify the given types of paperboard materials used in folding cartons.	1.1	Folding Cartons; Introduction. Raw material; Paperboards: SBS (Solid Bleached Sulfate), FBB (Food and Beverage Board), WLC (White Lined Chipboard), their composition and applications, Glue; composition.	CO1
	1b	Compare various coatings and laminates.	1.2	Board coating and lamination processes: UV coatings, aqueous coatings, PE laminates, and their applications.	
	1c	Calculate the given strength parameter using standard testing methods for Paperboards.	1.3	Grain direction, caliper selection and typical properties; whiteness, stiffness, Bursting Strength, GSM or Grammage, and Cobb, folding endurance test.	
	1d	Justify the importance of using Sustainable materials in folding carton manufacturing.	1.4	Sustainable materials: Recyclable, biodegradable, and compostable paperboards; concepts and importance.	

	1e	Justify the importance of FDA compliant packaging.	1.5	Food safety standards (FDA, EU) and compliance for food-grade packaging (folding cartons); glimpses.	
UNIT II: Structural Design and Prototyping of Folding Cartons	2a	Identify and sketch the structural elements of a folding carton.	2.1	Basic design elements: Tucks or tabs, flaps, locking mechanisms, and their impact on carton strength.	CO2
	2b	Justify the importance of using CAD tools in prototyping.	2.2	CAD tools (Introduction): ArtiosCAD, Packly, and prototyping techniques and there advantages.	
	2c	Apply the nesting concept for Folding Carton Manufacturing.	2.3	Die-line creation, nesting for material optimization, and common errors to avoid.	
	2d	Compare different folding carton styles.	2.4	Carton styles (features): Straight tuck end, reverse tuck end, crash lock (self-locking bottom), specialty cartons and their industrial uses.	
	2e	Justify the importance of branding elements and functional	2.5	Incorporating branding elements and functional considerations.	
anufacturing Processes for Folding Cartons	3a	Compare different steps in folding carton manufacturing on given points.	3.1	Overview of folding carton manufacturing (steps): Material selection, Printing, die-cutting, folding, and gluing. Printing with offset press;	CO3
	3b	Identify the given elements of a flat die and blanking tools.	3.2	Die-cut & punching; process steps. Flat die; construction, elements and their functions. Blanking tools.	
	3c	Justify the use of platen press for die cutting and punching.	3.3	Uses of platen press for die cutting & punching.	
	3d	Justify the importance of laser cutting process in folding carton manufacturing.	3.4	Laser cut cartons; Manufacturing process steps, advantages and limitations.	

UNIT III: Ma	3e	Identify the elements of a tetra pack wall structure and style of cartons.	3.5	Tetra pak; Introduction, raw material, mfg. process , Tetra pack wall structure; functions of each element. Different styles of tetra pack cartons, their applications.	
UNIT IV: Raw Materials and Components for Corrugated Boxes	4a	Identify differences between folding cartons and corrugated boxes by categorizing samples.	4.1	Corrugated Fiberboard Box (CFB); Introduction, carton and box comparison. Raw material; Liner board, fluting medium and Adhesive. Corrugated Fiberboard and Solid fiberboard comparison.	CO4
	4b	Compare different types of corrugated boards and flutes by handling and investigation.	4.2	Types of flutes: their specifications and applications. Types of Corrugated fiberboards: Singe Facer, Single-wall, double-wall, triple-wall structure and applications.	
	4c	Justify the importance of the raw material used for glue formation.	4.3	Glue formulation; glue kitchen, raw material, glue making. Glue consumption.	
	4d	Justify the importance of various operations involved in corrugated box manufacturing (CFB).	4.4	Creasing, slotting, die-cutting, gluing, taping, and sealing operations with machines used.	
	4e	Compare Single-piece with two-piece blanks on given points.	4.5	Single-piece vs. two-piece blanks: Construction, applications, and benefits.	
ing	5a	Justify the importance of various structural design considerations for a corrugated board manufacturing.	5.1	Structural design considerations; Wall thickness, flute types, box dimensions (Internal & Outer). Various box styles (RSC, HSC, die-cut, trays), and their applications.	

UNIT V: Corrugated Box Design and Manufacturi	5b	Justify the importance of different styles of palletiziting corrugated boxes.	5.2	Palletizing styles (Brick and others) – advantages & limitations; Introduction to prototyping software.	CO5
	5c	Identify CFB box manufacturing steps	5.3	CFB Box Manufacturing Steps: Board making, Printing, Slotting/Die-cutting, Folding, Gluing, Bundling, Strapping.	
	5d	Find out the strength of the corrugated board by given IS testing methods.	5.4	IS Testing methods: BS, BCT, ECT, RCT, Cobb, Puncture Resistance; Standard QC tests: Grammage, Caliper, BCT, Delamination, Barcode readability.	
	5e	Identify the defects in CFB Box manufacturing and Propose remedies.	5.5	Common Defects and Remedies in CFB Box Manufacturing; Issues like washboarding, soft boards, improper joints, fishtailing, delamination – causes and solutions.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify and compare various types of paperboards used in the production of folding cartons. Collect samples of three different types of cartons; compare the characteristics such as style of carton, board colour, texture, thickness and weight.	2#	CO1
I	2	Conduct tests to determine the grain direction of the paperboard.	2#	CO1
I	3	Conduct the test to determine the whiteness of the paperboard.	2	CO1
I	4	Carry out the burst strength test and calculate the burst factor of the paperboard.	2#	CO1
I	5	Perform folding endurance test – for paperboard.	2	CO1
II	6	Prepare a report on comparison of different folding carton styles by collecting any three samples.	2#	CO2
II	7	Design a basic folding carton style. Draft the design on paperboard, ensuring correct dimensions and folding lines. Cut and fold the carton to demonstrate the style.	2#	CO2
III	8	Create a prototype of a folding carton based on the previous (Practical No - 2) design. Cut, crease, and fold the carton prototype. Glue or tape the carton as needed. Measure the internal and external dimensions of the same.	2#	CO3
III	9	Prepare a report on "Elements of a Flat Die" by observing a real flat die.	2#	CO3
VI	10	Conduct Cobb test to find out water absorptiveness of kraft paper/ paperboard/corrugated fiberboard.	2#	CO4
VI	11	Explore Corrugated Fiberboard Types. Identify and compare three different types of corrugated fiberboards. Inspect and compare them on the basis of Board thickness, Flute type and Flute count.	2#	CO4
V	12	Conduct Edge crush / Ring crush test/ Flat crush test to find out edge crush strength of corrugated fiber board.	2#	CO5
V	13	Perform Puncture test to find out puncture resistance of paperboard/ corrugated fiber board.	2	CO5

V	14	Measure Internal and External Dimensions of a Regular Slotted Container (RSC) Box.	2#	CO5
VI	15	Operate Single Facer - Corrugated Board Making Machine. Set up the machine for two ply board production. Feed the material into the machine and execute the board-making process.	2#	CO6
VI	16	Operate creasing and slitting machine. Set up machine for a suitable job. Execute creasing and cutting operation.	2#	CO6
VI	17	Identify and resolve common defects in box making. Collect and inspect boxes for common defects such as fishtailing, delamination, soft board, or poor slotting. Identify the causes of the defects and suggest corrective actions.	2#	CO6
VI	18	Operate Box Stapler and Strapping Machine to Seal and Reinforce Corrugated Boxes.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Material Selection for Folding Cartons	6	C	2	6	4	12
			O	0	0	0	0
2	Structural Design and Prototyping of Folding Cartons	6	C	2	6	4	12
			O	0	0	0	0
3	Manufacturing Processes for Folding Cartons	6	C	2	6	4	12
			O	0	0	0	0
4	Raw Materials and Components for Corrugated Boxes	6	C	6	8	4	18
			O	0	0	0	0
5	Corrugated Box Design and Manufacturing	6	C	4	6	6	16
			O	0	0	0	0
Total		60	C	16	32	22	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q 1 to Q. 35	1R2	1U2	1U2	1U2	1A2	1A2	2R2	35/35
	2U2	2U2	2U2	2A2	2A2	3R2	3U2	
	3U2	3U2	3A2	3A2	4R2	4R2	4R2	
	4U2	4U2	4U2	4U2	4A2	4A2	5R2	
	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	1	-	-	-	-
CO2	3	-	1	2	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	1	-	-	-	-	-	-
CO5	3	-	-	2	-	-	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Fundamentals of Packaging Technology	S. Natrajan, M. Govindrajan, B. Kumar, PHILPL, 2E, 2014.	13: 978-81-203-5054-0
2	Handbook on Pulp & Paper Industries	SIRI Board of Consultants & Engineers, SIRI Pub., 1990.	10: 81-85480-24-9
3	The Wiley Encyclopedia of Packaging Technology	Kit L. Yam,, John Wiley & Sons Inc., 3E, 2010.	13: 9780470541395
4	The Packaging Designers Book of Patterns	Laszlo Roth, George L/ Wybenga, Wan Nostrand, Reinhold, 1991.	10: 0-442-00524-5
5	Paper, Paper Converting, Plastics & Other Pkg. Ind.	R. K. Kush, SBP Pub. Co., 1995.	--
6	Handbook of Pulp & Paper Technology	Kenneth W. Britt, CBS Publishers, 2E, 2004.	13: 9788123911441, 10: 8123911440

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XVI List of Major Equipment/Machineries with Specification:

1. Analog Substance Indicator/GSM Tester/ Electronic Weighing Machine.
2. Bursting Strength Tester.
3. Universal Testing Machine.
4. Compression Tester- ECT/FCT/RCT, etc.
5. Thickness Gauge.
6. Puncture Strength Tester.
7. Brightness Tester.
8. Folding Endurance Tester.
9. Sigle Facer- corrugattor machine
10. COBB Tester
11. Creasing and cutting machine
12. Portable staplers, Box stitching machine & Box strapping machine

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology.	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
5	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
6	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

(Mr. Syed Imran Ahmed K.)
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/MC/MT/PK/TX/AE
Course Category	:	GE
Course Code	:	CM292H
Course Title	:	Web Development

I Rationale:

Web Page Design is used to develop online applications for various organizations such as organizational and educational websites, virtual learning environments, business applications in various fields such as products, sales,banking railways reservation, services etc. Web pages are categorized into two namely: static and dynamic web page. This course introduces web page design using HTML5 and also give emphasis on learning Cascading Style Sheets (CSS) which is a style sheet language used for describing the presentation of a document written in a markuplanguage for formatting and styling of content.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use development tools and integrated development environments (IDEs).

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Design** a webpage using HTML formatting tags.

CO2: **Develop** web page using list and hyperlinks.

CO3: **Develop** web pages using images, colors and backgrounds

CO4: **Design** HTML forms using table and frames

CO5: **Develop** presentation schemes on content using CSS.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to HTML	1a	Identify the characteristics of the given type of web sites.	1.1	Introduction of HTML:- Definition,history,importance, characteristics.	CO1
	1b	Select structure of the given HTML page.	1.2	Terminologies used in Web Design: World Wide Web(www), Web Pages, Web Site, Web Browsers, Web Servers and types of sites. Static vs. dynamic web sites,Search Engine.	
	1c	Choose Head tag and body tag in the given web page code.	1.3	Web page structure: DOCTYPE, HTML, TITLE,HEAD, BODY and other meta tags with attributes.	
	1d	Select procedure of using the given block level tag on a web page.	1.4	Block Level Elements: Headings, Paragraphs, Breaks, Divisions, Centered Text, Block Quotes, Preformatted text, types of Address, HR tag. Horizontal Rule.	
	1e	Select the procedure of using the given Text level tag.	1.5	Text Level Elements: Bold,Teletype,Underline,Strikethrough ,Superscript, DIV tag, displaying special characters,comments.	
s	2a	Identify given type of List.	2.1	Lists: Ordered Lists, Unordered Lists, Definition Lists, Nested Lists.	

UNIT II: Lists and Links	2b	Select appropriate types of Links for given situation.	2.2	Links: Absolute, Relative and Inline links, use image as link,link to an email address, button as link, types of links,linking various documents for internal and external links, to link different web page of same site, link different location on the same web page, a specific location on different web page of same site, to specific section within the document, inserting E-mail link	CO2
UNIT III: Images, Colors and Background	3a	Select the proper image attribute for web page code.	3.1	Image: Types of image format, jpg, bmp, png gif etc.IMG tag, alternate text, image alignment, HSPACE,VSPACE, wrapping text, height and width of images,Image as a link, Inserting Images, formatting image for sizing, alignment. Border and using other attributes with IMG tag.	CO3
	3b	Identify process of using the given colors/images as page background on a web page.	3.2	Colors and Backgrounds: The text color, color attribute of FONT tag, text attribute of BODY tag. bgcolor attribute of BODY tag, changing link colors: link, alink,vlink, attributes of BODY tag, Backgrounds: Inserting image as page background, background attributes of BODY tag, creating solid color page background.	
V: Table, Frames and Forms	4a	Choose the proper table tags and table attributes for given table.	4.1	Table: Table tag with attributes. TABLE, <tr>, <th>,<td> tags. Border, cell spacing, cell padding, width, align,bgcolor attributes. Adding captions: CAPTION tag.	CO4
	4b	Select proper types of table attributes for given senario.	4.2	Formatting contents in the table cells: align,valign,bgcolor, height, width, nowrap attributes. Spanning rows and columns: rowspan and colspan attributes.	
	4c	Identify type of 'frame' with examples and procedure to organize display as per given screen layout using frames.	4.3	Frames: Types of Frames with their attributes, Creating frames: FRAMESET tag – rows, cols attributes, FRAME tag – name, frame border, margin height, margin width, src, resize, scrolling Attributes, Use of NOFRAMES tag, Frame targeting.	

UNIT IV	4d	Choose basic form using different form fields and Button tags.	4.4	Forms: Creating basic form: FORM tag, action and method attributes, Form fields: Single line text field, password field, multiple line text area, radio buttons, and check boxes. Pull down menus: SELECT and OPTION tags. Buttons: submit, reset and generalized buttons.Formatting technique: Using table to layout form.	
UNIT V: Cascading Style sheets	5a	Idnetify CSS code for the given type of formatting on a web page with different CSS properties.	5.1	Cascading Style Sheets: Different types of Style Sheets, Benefits of using CSS. Adding style to the document: Linking to style sheets, Embedding style sheets, Using inline style, Selectors: CLASS rules, ID rules.	CO5
	5b	Identify the procedure to create CSS for applying the given presentation scheme on a web page.	5.2	Style sheet properties: Font, text, box, color and background properties.	
	5c	Select the procedure to create internal, inline and external CSS for applying the given presentation scheme on a web page.	5.3	Creating and Using a simple external CSS file; Using the internal and inline CSS;background and color gradients in CSS Setting font and text in style sheet using table layout.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Use following HTML Tags for webpage design- <HTML>, <HEAD>, <TITLE>, <BODY> elements.	2#	CO1
I	2	Design Web page and apply some block level tags and some text level tags.	2#	CO1
I	3	Design Web page using font Color, font face, font size, background color.	2#	CO1
II	4	Design Web page including- i) Ordered lists ii) Unordered list iii) Nesting list	2#	CO2
II	5	Design Web page including links in a Web page. Local page in same folder • Page in different folder. • Page in web. • Specified location within document.	2#	CO2
III	6	Design a web page using Image tags with height and width and also Used for background image.	2#	CO3
III	7	Design a web page to link a different web page of same site and create webpage using Image tags with height and width and also Used for background image.	2#	CO3
IV	8	Design table in web page using basic tables tags- <table>, <tr>, <td>, <th>	2#	CO4
IV	9	Design a web page to create a web page using Table tags a)Using rowspan and columnspan b)Background Image in a table.	2#	CO4
IV	10	Create a web page using Table tags a)Create table of 3 rows and Columns b) Having border , border size, border color c) Image in a particular cell	2#	CO4
IV	11	Create a web page to implement frame tags.	2#	CO4
IV	12	Create a web page using Form tag. Example:-Admission Form.	2#	CO4
V	13	Develop HTML page to demonstrate Inline CSS.	2#	CO5
V	14	Develop HTML page to demonstrate Internal CSS.	2#	CO5
V	15	Develop HTML page to demonstrate External CSS.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to HTML	6	C	04	06	04	14
			O	00	00	00	0
2	Lists and Links	6	C	02	06	06	14
			O	00	00	00	0
3	Images, Colors and Background	6	C	04	04	06	14
			O	00	00	00	0
4	Table, Frames and Forms	6	C	02	06	06	14
			O	00	00	00	0
5	Cascading Style sheets	6	C	02	06	06	14
			O	00	00	00	0
Total		30	C	14	28	28	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	1R2	1U2	1U2	1U2	1A2	1A2	Q1 to Q35	
2	2R2	2U2	2U2	2U2	2A2	2A2	2A2		
3	3R2	3R2	3U2	3U2	3A2	3A2	3A2		
4	4R2	4U2	4U2	4U2	4A2	4A2	4A2		
5	5R2	5U2	5U2	5U2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of proper HTML Tags	5
2	Performance/Execution of program	10
3	Complete the practical in stipulated time	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	3	3	-	-	3	-	-
CO2	3	-	3	3	-	-	3	2	-
CO3	3	-	3	3	-	-	-	2	-
CO4	3	-	3	3	-	-	3	-	-
CO5	3	-	3	3	-	-	3	2	-
CO6	3	-	3	3	-	1	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Web Publishing with HTML and CSS.	Lemay Colburn,Pearson,	13: 978-0-672-33623-2
2	HTML and CSS Complete Reference	Thomos Powell,Tata McGraw Hil	13: 978-0-07-174170-5
3	Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Black Book	Kogent Learning Solutions Inc., Dreamtech Press, 2012	13: 978-9350045930

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1. https://www.geeksforgeeks.org/ accessed on 14th May 2024
2. https://www.w3schools.com/html/ , accessed on 14th May 2024
3. https://www.codecademy.com/learn/learn-html , accessed on 14th May 2024
4. https://www.learn-html.org/en/Links, accessed on 14th May 2024

XVI List of Major Equipment/Machineries with Specification:

1. Computer system with all necessary peripherals and internet connectivity.
2. Any Office Software
3. Any browser

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr.M.V.Sarode	HOD, Computer Engineering	Government Polytechnic, Nagpur
2	Mrs.D.S.Nalinde	Lecturer in Computer Engineering	Government Polytechnic, Nagpur
3	Mr.P.S.Thakre	Lecturer in Computer Engineering	Government Polytechnic, Nagpur
4	Dr.U.B.Aher	Lecturer in Computer Engineering	Government Polytechnic, Nagpur
5	Dr.Rakesh Kadu	Assistant Professor, I.T	Ramdeobaba College of Engg, and Management, Nagpur
6	Mr.Dipak Dhote	Operations Manager	IT-Network Infosystems Pvt LTD,Nagpur
7	Mrs.V.A.Raje	System Analyst	MSBTE ,RO,Nagpur

(Dr. M. V. Sarode)
HOD & Chairman PBOS, CM

(Dr. G. V. Gotmare)
Member Sectretary PBOS, CM

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/PK/AI/MT/AE/TX
Course Category	:	GE
Course Code	:	MK292H
Course Title	:	Computer Aided Design

I Rationale:

CAD (Computer Aided Design) technology is moving in the direction of greater integration of design activities & manufacturing activities. CAD is the use of computer system to assist in the creation modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, and improve communication through documentation. It also may be useful to generate assembly and manufacturing drawings.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use CAD software for design and drafting.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Use** CAD/CAM hardware and software.

CO2: **Develop** 2D geometric modeling features.

CO3: **Develop** 3D engineering model using solid modeling command.

CO4: **Use** advance features of 3D geometric modeling.

CO5: **Create** assembly of components and generate exploded view.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to CAD/CAM	1a	Use CAD/CAM software in industry.	1.1	Roles of computers in industrial Manufacturing, Introduction to: CAD/CAM, Product life cycle, Design process, Applications of CAD/CAM, CAD/CAM hardware.	CO1
	1b	Compare given softwares for use in CAD/CAM	1.2	Introduction to CAD/CAM software: CATIA, SolidWorks, Nx, CREO, M CAM, Del CAM	
cs of Geometric Modelling	2a	Differentiate between 2D and 3D parametric softwares.	2.1	Introduction to geometric modelling, 2D and 3D modelling, difference between 2D & 3D, parametric softwares.	CO2
	2b	Construct 2D geometric model.	2.2	Geometric construction methods: wireframe modeling, surface modeling, solid modeling, develop 2D Sketching of 3D model.	

UNIT II: Basi	2c	Use modification techniques and polting features.	2.3	Modeling facilities desired: drafting features, modelling features, editing features, annotations, dimensioning and constrains, Plotting features.	
UNIT III: Solid Modelling Basic	3a	Apply datum planes, axes, and points to construct 3D models.	3.1	Understanding/creating & Working with datum Planes, axis, points	CO3
	3b	Create 3D solid model by using Extrude, Revolve, Sweep command.	3.2	Creating Solid using Extrude,Revolve, Sweep command.	
	3c	Improve the developed 3D model by using Edit Round,chamfer commands.	3.3	Modifying & Regenerating by Edit Definition, Applying Round, chamfer, Rib, Auto round	
UNIT IV: Solid Modelling Advance	4a	Create 3D solid model using Holes, Spring & Threads.	4.1	Creating Holes, Spring & Threads using Helical sweep	CO4
	4b	Develop 3D solid model with the help of Swept blend, Helical sweep Warp, Applying Drift	4.2	Creat 3D solid model with the help of Swept blend, Helical sweep Warp, Applying Drift	
	4c	Reconstruct & modify the developed 3D solid model.	4.3	Copying features, Patterning, blending, View manager for Cross sections, customize screen, Environment	
UNIT V: Assembly Modelling	5a	Discriminate attributes of assembly.	5.1	Calling components, Constraining components, working with Layers & Visibility, Patterning	CO5
	5b	Produce assembly and animation to it	5.2	Creating Assembly features and animation	
	5c	Construct exploded views and orthographic views.	5.3	View manager, Exploded Views, projection views – Front, Top, side view and sectional views, BOM, drafting	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify different input and output devices used in CAD/CAM	2#	CO1
I	2	Install Creo software (open source software) on your personal computer.	2	CO1
II	3	Use basic draw commands to draw 2D drawing.	2#	CO2
II	4	Modify and Edit above drawing.	2#	CO2
II	5	Draw 2 dimensional figure using Solid Modeling sketcher commands.	2#	CO2
III	6	Develop a solid geometry by using Extrude.	2#	CO3
III	7	Develop a solid geometry by using Revolve.	2	CO3
III	8	Create 3 D solid modelling of any one engineering component	2#	CO3
IV	9	Create a hole in a solid body by using hole command.	2#	CO4
IV	10	Use helical sweep command to create springs and threads.	2#	CO4
IV	11	Use warp and drift command to rectangle box.	2#	CO4
IV	12	Apply swept blend command to form irregular shapes in a solid.	2	CO4
V	13	Call main assembly component and apply constrain on it.	2#	CO5
V	14	Complete the assembly and view it from all direction by using view manager.	2#	CO5
V	15	Apply the animation to moving part of assembly.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to CAD/CAM	2	C	02	04	00	6
			O	0	0	0	0
2	Basics of Geometric Modelling	3	C	02	06	00	8
			O	0	0	0	0
3	Solid Modelling Basic	8	C	02	06	08	16
			O	0	0	0	0
4	Solid Modelling Advance	10	C	06	10	08	24
			O	0	0	0	0
5	Assembly Modelling	7	C	04	06	06	16
			O	0	0	0	0
Total		30	C	16	32	22	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q1 to Q 35	1R2	1U2	1U2	2R2	2U2	2U2	2U2	35/35
	3R2	3U2	3U2	3U2	3A2	3A2	3A2	
	3A2	4R2	4R2	4R2	4U2	4U2	4U2	
	4U2	4U2	4A2	4A2	4A2	4A2	5R2	
	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Use of proper commands	5
2	Creating geometic modelling.	10
3	Experiment writing work.	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	2	-	2	-	-
CO5	3	-	-	3	2	-	2	-	-
CO6	3	-	-	3	2	-	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	CAD/CAM (Computer Aided Design/ Computer Aided Manufacturing)	Mikell P. Groover & Emory W. Zimmers, Prentice Hall of India Pvt. Ltd., New Delhi, 05th Edition, 1997	13: 978-81-7758-416-5
2	CAD/CAM Principles and Applications	P.N.Rao, Tata McGrawHill Education Pvt. Ltd.,New Delhi, Third Edition, 2010	13: 978-0-07-068193-4
3	Pro Engineer Wildfire 4 for Designers	Sham Tickoo, Dreamtech Press, New Delhi, 2010	13: 978-81-7722-904-2
4	CAD/CAM/CIM	P. Radhakrishnan, S. Subramhanyam, V. Raju, New Age international Publisher, New Delhi, Second Edition	10: 81-224-1248-3
5	CAD/CAM Concept and Applications	Chennakesava R. Alavala, PHI Learning Pvt. Ltd, Delhi, Sixth Edition, 2015	13: 978-81-203-3340-6
6	CAD/CAM (Computer Aided Design/ Computer Aided Manufacturing)	Suresh Dalela & P.K.Jain, S. Chand & Company Ltd., New Delhi, First Edition, 2000	10: 81-219-1784-0

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2. https://www.youtube.com/watch?v=yywxb9DLtng, 24th May, 2024
3. https://www.youtube.com/watch?v=8w_rllesjPE&list=PLsazGtdtYPVv0odDDT7qLQq9Q_NTnKslI, 24th May, 2024
4. https://www.youtube.com/watch?v=lvm3dqCI0q4, 24th May, 2024
5. https://www.youtube.com/watch?v=pwrxlSpk8Es&list=PLNHkWfMqgWnIPONSaMUfVbtvP6GbzDyba, 24th May, 2024
6. https://www.youtube.com/watch?v=bYKbYLfpk6k&list=PLRhPac0z_f_EiuNLBs_E_lOt-OqJPpHD_R, 24th May, 2024
7. https://www.youtube.com/watch?v=voIA0VyLW9E, 24th May, 2024
8. https://www.youtube.com/watch?v=h7dhDe-fZeg, 24th May, 2024

XVI List of Major Equipment/Machineries with Specification:

1. CPU with Intel (R) Core (TM) i5 processor or higher latest version
2. A color monitor with highest 32 bit/ 64 bit color display and with screen
3. A scroll mouse.
4. Laser printer
5. Windows7 operating system or higher version
6. Any one open source modeling software at AICTE website
7. Projector
8. Antivirus
9. LAN networking

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. G.K.Awari	HOD Mechatronics	Government Polytechnic, Nagpur
2	Ms. K.P.Thaware	Lecturer in Mechatronics	Government Polytechnic, Nagpur
3	Prof.Vikas M.Mankar	I/c HOD, Electronics & Tele.Engg.	Priyadarshini Polytechnic, Nagpur
4	Dr.Hemant B.Warkad	Jr. Works Manager	Ordnance Factory Ambajhari (OFA), Nagpur
5	Dr. S.M.Kale	Lecturer in Electronics	Government Polytechnic, Amravati

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/PK/MT/MK/AE/TX
Course Category	:	GE
Course Code	:	AI292H
Course Title	:	Basics of Artificial Intelligence

I Rationale:

This course provides a comprehensive introduction to the fundamental principles and methodologies of artificial intelligence (AI). Students will explore the concept of intelligence and the various methods for encoding knowledge in computer systems. The course covers essential AI elements, including problem formulation, problem space exploration, search algorithms, knowledge representation, inference, logic, and learning mechanisms. By the end of the course, students will have developed a solid understanding of these core AI components and their applications in real-world scenarios.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Comprehend the knowledge of the foundational concepts of AI

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** the need of AI and its applications in real life.

CO2: **Use** appropriate search techniques for solving a AI problem

CO3: **Identify** the methods used for knowledge representation in developing logic for game playing.

CO4: **Apply** knowledge representation and reasoning methods for solving real world problems using Artificial Intelligence.

CO5: **Apply** AI knowledge in developing Internet of Things applications

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Artificial Intelligence	1a	Classify artificial intelligence on the basis of given point.	1.1	Definitions – Artificial Intelligence, History of AI, Evolution of AI	CO1
	1b	Distingusih between various types of AI on the basis of given points	1.2	Applications of AI in NLP, Robotics, Automation, Human Emothion recognition, Types of AI	
	1c	Select the intelligent agent from the given data.	1.3	Types of Agents, Intelligent Agent	
	1d	Justify the difficulties encounted while conducting the Turing Test	1.4	Agent Environment,Turing Test in AI	
UNIT II: Search Techniques in AI	2a	Select and justify given search technique on basis of given point.	2.1	Search Techniques in AI ,Search based problems- Slide bar puzzle problem,Tower of Hanoi	CO2
	2b	Choose a suitable heuristic function for solving given problem.	2.2	Uninformed Search Breadth first Search Depth First Search, Heuristic Search/ Informed Search Techniques: Generate-and-Test, Hill Climbing, Best-first Search	

UNIT III: Game playing in AI	3a	Apply procedures on given function using given search.	3.1	Game Playing: The Minimax Search Procedure, Adding Alpha-beta Cutoffs, Iterative Deepening	CO3
	3b	Apply specific search methods on particular game	3.2	Case study : Search in Game Playing	
UNIT IV: Knowledge Representation	4a	Differentiate between the various types of knowledge based on the given criteria.	4.1	Introduction to Knowledge representation, types of knowledge	CO4
	4b	Compare the given techniques on the basis of given data.	4.2	Techniques of knowledge representation-Logical Representation, Semantic Network Representation Frame Representation, Production Rules	
	4c	Represent the given knowledge using propositional logic.	4.3	Propositional logic in Artificial intelligence	
	4d	Represent the given knowledge using First order logic.	4.4	First-Order Logic in Artificial intelligence	
UNIT V: Role of AI in Internet ofThings (IoT)	5a	Identify the contribution of AI in making IoT work	5.1	Role of AI in making IoT sucessful, Applications of AI in IoT	CO5
	5b	Suggest 2 imaginations of future based on collaboration of AI and IoT	5.2	Real world examples of AI in IoT,Future of AI based IoT	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
II	1	Implement Hill climbing to solve 8-Puzzle problem	2#	CO2
II	2	Develop a program to solve Tower of Hanoi problem using recursion.	2#	CO2
II	3	Develop a program to perform the generate and Test Search using Heuristic approach	2#	CO2
III	4	Implement Best First Search to solve a problem using Heuristic approach	2#	CO3
III	5	Develop a program to perform breadth- first search of a given problem graph.	2#	CO3
III	6	Develop a program to perform depth- first search of a given problem graph.	2#	CO3
IV	7	Develop a program to solve family tree problem using rules	2#	CO4
IV	8	Design an application to simulate number puzzle problem	2#	CO4
V	9	Implement water jug problem using artificial intelligence technique	2#	CO5
V	10	Implement the program based on Minimax Search for designing the Tic-Tac-Toe game	2#	CO5
V	11	Develop a program to solve the Travelling Sales person Problem using Heuristic approach	2#	CO5
V	12	Develop a program to solve the Slide bar puzzle problem using Heuristic approach	2#	CO5
V	13	Develop a mini project on Automated inventory tracking using IoT	2	CO5
V	14	Develop a mini project on IoT in Healthcare.	2	CO5
V	15	Develop a mini project on IoT in any other application.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Artificial Intelligence	6	C	02	04	10	16
			O	00	00	00	00
2	Search Techniques in AI	6	C	02	04	06	12
			O	00	00	00	00
3	Game playing in AI	6	C	02	04	06	12
			O	00	00	00	00
4	Knowledge Representation	6	C	02	02	10	14
			O	00	00	00	00
5	Role of AI in Internet ofThings (IoT)	6	C	02	06	08	16
			O	00	00	00	00
6			C	00	00	00	0
			O	00	00	00	00
Total		30	C	10	20	40	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q 1 to Q 35	1R2	1U2	1U2	1A2	1A2	1A2	1A2	35/35
	1A2	2R2	2U2	2U2	2A2	2A2	2A2	
	3R2	3U2	3U2	3A2	3A2	3A2	4R2	
	4U2	4A2	4A2	4A2	4A2	4A2	5R2	
	5U2	5U2	5U2	5A2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Writing Program (Execution)	5
2	Performance	10
3	Showing Execution Process and outcome	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	3	-	3	-	-
CO2	3	-	-	3	3	-	3	-	-
CO3	3	-	-	3	3	-	3	-	-
CO4	3	-	-	3	3	-	3	-	-
CO5	3	-	-	3	3	-	3	-	-
CO6	3	-	-	3	3	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Artificial Intelligence	E. Rich and K. Knight and ShivashankarB.Nair.,3rd Edition, Tata McGraw Hill, 2008	13: 978-0-07-067816-3, 10: 0-07-067816-2
2	Artificial Intelligence - A Modern Approach	S. Russell and P.Norvig, Pearson Education, 4th edition, 2020	13: 978-0-13-604259-4
3	Introduction to Artificial Intelligence & Expert Systems	Dan W Patterson, PHI Learning, 1st Edition, 2011	13: 9789332551947

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1. https://www.javatpoint.com/types-of-ai-agents, accessed on 29th May 2024
2. http://www.dkriesel.com/en/science/neural_networks, accessed on 29th May 2024
3. https://www.youtube.com/results?search_query=artificial+intelligence, accessed on 29th May 2024
4. https://www.youtube.com/watch?v=s-s9ilkMVj8, accessed on 29th May 2024
5. https://www.javatpoint.com/subsets-of-ai, accessed on 29th May 2024
6. https://www.youtube.com/watch?v=s-s9ilkMVj8, accessed on 29th May 2024

XVI List of Major Equipment/Machineries with Specification:

1. Computer system with latest configuration.
2. Software: opensource framework, AItools (Scikit Learn,TensorFlow,Auto ML,H2O,google ML kit)

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. A R Mahajan	HOD, Information Technology	Government Polytechnic, Nagpur
2	Dr.Paresh R. Kamble	Machine Learning specialist	OZ SportZ, Nagpur, HQ-Reykjavik, Iceland
3	Dr. Vijaya Balpande	Associate Professor	Priyadarshini College of Engg., Nagpur
4	Mrs. Shifa Azharuddin	Lecturer in Information Technology	Government Polytechnic, Nagpur
5	Dr. S. S. Gharde	Lecturer in Information Technology	Government Polytechnic, Nagpur

(Dr. A. R Mahajan)
HOD & Chairman PBOS,

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Member Secretary PBOS,

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/IT/CM/PK/MT/AE/AI/MK/TX
Course Category	:	GE
Course Code	:	TR292H
Course Title	:	Wildlife Tourist Guide / Naturalist

I Rationale:

Over a period of time, it has been observed that efficiency of polytechnic student can be increased at the workplace by imparting key skills right from entry to the polytechnic. It is an effort to develop student that enables him to be successful in finding a practical and quick solution to any problem he comes across. It covers more or less all aspects of life skills. The development of subject is progressively ascending parallel to development of study in polytechnic.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Facilitate guided wildlife and nature tours with strong communication, safety, and interpretive storytelling skills.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Classify** the concept of Tour Guiding and Naturalist.

CO2: **Identify** the key communication and behavior skills for Guide.

CO3: **Identify** types of products for tour guiding and types of tourists.

CO4: **Identify** and understand the tourist behavior and expectations.

CO5: **Identify** technical and storytelling skills required for effective tour guiding.

CO6: **Identify** various hygiene, safety and documentation process.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	25	10

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction	1a	Classify the duty of tour guiding.	1.1	Introduction of tourism industry. Background of tour guiding Duty and responsibilities.	CO1
	1b	Identify the role of wildlife tourism in India.	1.2	Wildlife tourism in India, Role of Naturalists.	
	1c	Identify the local experience and excursion.	1.3	Introduction of Local excursion and experiences.	
UNIT II: Communication Skills	2a	Identify skill set.	2.1	Learn basic communication skills required for the profession.	CO2
	2b	Relate skills with profession.	2.2	Etiquettes and behaviour.	
	2c	Recognize the types of skills.	2.3	Presentation skills and storytelling.	
	2d	Identify the hard skills.	2.4	Hard skills and domain knowledge.	
IT III: Tour ing Products	3a	Recognize the types of Products.	3.1	Types of tour.	CO3
	3b	Recognize product for tour guiding.	3.2	Types of products for tour guiding, costing, inclusion etc.	

UNI Guid	3c	Identify type of tourist.	3.3	Types of tour for different types of tourist.	
UNIT IV: Tourist Expectation	4a	Identify behavior of tourist.	4.1	Types of tourist, Types of destination, Types of tour, Behaviour of the tourist at the destinations.	CO4
	4b	Identify expectation of Tourist.	4.2	Understating the expectation and outcome of the tour.	
	4c	Identify communication and importance of feedback.	4.3	Communication during the tour, feedback and testimonials.	
UNIT V: Component of the Wildlife Destination	5a	Classify Wildlife Tourism products.	5.1	Different types of Destination, Inbound and Domestic Market, Eco system of the wildlife Industry.	CO5
	5b	Identify types of components of the wildlife tourism products.	5.2	Understanding flora and Fauna of the wildlife destination.	
	5c	Prepare pitch for storytelling.	5.3	Art of Story Telling. Short and long pitch, content creation for the story telling.	
UNIT VI: Hygiene, Safety & Documentation	6a	Identify use hygiene in tourism industry.	6.1	Understanding the importance of hygiene during tours, Tips to maintain hygiene during tour and making connections with tourists.	CO6
	6b	Use of safety guidelines for tourist.	6.2	Safely at the destination and while taking walking tours. Important checklist for the safety of tourists.	
	6c	Identify use of tour guiding documentation.	6.3	Tour Guiding documentation.	
	6d	Use of procedures pre during and post tours.	6.4	Pre service and Post service procedure, Maintaining documents.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Prepare the list of types of wildlife and historic destination in Vidarbha.	2#	CO1
I	2	Prepare and present the importance of wildlife tourism in India.	2#	CO1
II	3	Prepare and present a role play for tour guiding profession.	2#	CO2
II	4	Prepare a story for oral narration with respect to a wildlife destination.	2#	CO2
III	5	Present the Tourism Products.	2	CO3
III	6	Prepare a present a role plays of types of tourists.	2	CO3
III	7	Prepare report on the product of tour guiding.	2#	CO3
IV	8	Prepare Roleplay on Tourist behavior.	2#	CO4
IV	9	Prepare report on tourist expectation at different types of destination.	2#	CO4
IV	10	Prepare feedback form for tourist visiting wildlife destination.	2	CO4
V	11	Demonstarte wildlife Story telling.	2#	CO5
V	12	Submit the assignment of a destinations flora and fauna in the form of story telling.	2#	CO5
VI	13	Prepare the documentation chekist for an organization managing wildlife tourism activities.	2#	CO6
I to VI	14	Presents your self as a wildlife tourist guide.	2#	CO1 to CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Not Applicable.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction	5	C	02	04	00	6
			O	0	0	0	0
2	Communication Skills	5	C	02	08	00	10
			O	0	0	0	0
3	Tour Guiding Products	5	C	02	04	12	18
			O	0	0	0	0
4	Tourist Expectation	5	C	02	04	06	12
			O	0	0	0	0
5	Component of the Wildlife Destination	5	C	02	04	06	12
			O	0	0	0	0
6	Hygiene, Safety & Documentation	5	C	00	08	04	12
			O	0	0	0	0
Total		30	C	10	32	28	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q1 to Q 35	1R2	1U2	1U2	2R2	2U2	2U2	2U2	35/35	
	2U2	3R2	3U2	3U2	3A2	3A2	3A2		
	3A2	3A2	3A2	4R2	4U2	4U2	4A2		
	4A2	4A2	5R2	5U2	5U2	5A2	5A2		
	5A2	6U2	6U2	6U2	6U2	6A2	6A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Performance	10
2	Overall Presentation of given assignment	10
3	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	3	-	3	-	-
CO2	3	-	-	-	3	-	3	-	-
CO3	3	-	-	-	3	-	3	-	-
CO4	3	-	-	-	3	-	3	-	-
CO5	3	-	-	-	3	-	3	-	-
CO6	3	-	-	-	3	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Wildlife Tourism Resources	Chiranjeev Avinash, Jnanada Prakashan,	13: 9788171391738
2	Working in Wildlife Tourism: A handbook for guides, small business, students and NGOs	Ronda Green, Green Publications, 2023	
3	Tourism and Biodiversity	Romila Chawla, Sonali Publisher.	13: 978-8188836727

XV e-References:

1. https://www.wildlifetrip.in/accessed on 15 nonember 2024
2. https://www.naturesafariindia.com/wildlife-in-india/indian-wildlife/accessed on 15 nonember 2024
3. https://www.responsibletravel.com/holidays/india-wildlife/travel-guide/accessed on 15 nonember 2024
4. https://www.wildlife-safari-india.com/accessed on 15 nonember 2024
5. https://thewildlifetour.com/accessed on 15 nonember 2024
6. https://www.nathab.com/know-before-you-go/asia-the-pacific/india/wildlife-guid/accessed on 15 nonember 2024
7. https://www.insideindianjungles.com/accessed on 15 nonember 2024

XVI List of Major Equipment/Machineries with Specification:

1. Computer with internet connectivity.
2. Projector with screen.
3. World map, Map of India, Maps of Indian states and Union Territories.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr.P. P. Virkhare	HoD, Travel and Tourism Department.	Government Polytechnic, Nagpur.
2	Mr Rajesh P Pund	Lecturer in Travel and Tourism	Government Polytechnic, Nagpur.
3	Dr Aarti Meshram	I/c Principal	GIHMCT, Nagpur.
4	Miss Erika Kar	Director	Pegasus Institute, Nagpur.
5	Mr Adityashekhar Gupta	Director	Horizon Safaris, Nagpur.
6	Dr Arvind Upasani	Visiting Lecturer	RSTM Nagpur University.

(Dr. P. P. Virkhare)
HOD & Chairman PBOS, TR

(Dr. G. V. Gotmare)
Member Secretary PBOS, TR

Exit Course

II Year

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/AE/MT/PK/TX/MK/AI
Course Category	:	INP
Course Code	:	IN252H
Course Title	:	Internship (Vocational Skills)

I Rationale:

The Internship (Vocational Skill) course is a vital component for fulfilling the requirements of the diploma in vocation after the fourth semester as per NEP guidelines as an exit course. It provides students with hands-on experience in small, medium, or large-scale industries related to their field of study. This course bridges the gap between academic learning and practical application, enabling students to apply their theoretical knowledge in real-world industrial settings, enhancing their employability and vocational competencies.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Bridge theoretical knowledge with practical experience in a professional environment.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Evaluate** the organization's structure, processes, safety protocols, and industry standards to determine operational effectiveness.

CO2: **Apply** industry-specific tools, technologies, and skills to perform various operations.

CO3: **Contribute** to organizational goals by handling projects/ tasks under mentor guidance, applying learned skills.

CO4: **Analyze** technical challenges, addressing industry-specific issues effectively.

CO5: **Prepare** a internship report, ensuring accuracy and clarity.

CO6: **Deliver** presentation using visual aids and effective communication.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	-	8	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	-	-	-	-	50	20

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)	Topics and Sub-topics	Aligned Cos

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Learn the organization's structure, operational workflow, safety standards, industry practices, methodologies, technologies, and workplace processes to analyze operational efficiency and compliance requirements.	10#	CO1
II	2	Undergo training on industry-specific tools, technologies, and software, while gaining hands-on experience in performing basic operations, troubleshooting, and maintenance tasks, applying relevant skills to real-world industry scenarios and challenges.	20#	CO2

III	3	Participate in daily operations under mentor guidance, handling assigned projects or tasks aligned with industry needs, applying learned skills to contribute to organizational goals and gaining practical experience in real-world scenarios.	60#	CO3
IV	4	Identify and analyze technical challenges in industry, and address industry-specific issues (if any).	10#	CO4
V	5	Prepare a comprehensive internship report that effectively documents work experiences, technical tasks, and key achievements throughout theinternship. Ensure the accuracy of the content by cross-referencing with project details. Organize the report clearly, following industry standards.	10#	CO5
VI	6	Prepare a PowerPoint presentation on internship learnings, create and share a structured seminar outline, review technical documents, and present it.	10#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. During the summer vacations, after the 4th Semester, students are required to undergo internship with industry/ NGO"s/ Government organizations/ Micro/ Small/ Medium enterprises to make ready for the industry.

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of industry	5
2	Work done and Feasibility of work	25
3	Daily diary, supervisor remark and report writing	10
4	Presentation	10
	TOTAL	50

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	3	3	-	-
CO3	-	-	-	-	-	3	3	-	-
CO4	-	-	-	-	1	3	3	-	-
CO5	-	-	-	-	-	3	3	-	-
CO6	-	-	-	-	-	3	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Industrial Training and Education	Lokesh Choudhary, Mittal Publications, 2007	10: 8183242367 13: 9788183242363
2	Training Practice	Penny Hackett, McGraw-Hill Education, September 2003	10: 0852929803 13: 9780852929803
3	AICTE Internship Policy: Guidelines & Procedures	All India council of Technical Education New Delhi	-

XV e-References:

1. https://internship.aicte-india.org/ assessed on 23rd April 2024
2. https://www.coursera.org/articles/computer-science-internships assessed on 23rd April 2024

XVI List of Major Equipment/Machineries with Specification:

1. Desktop computers
2. Laser Printer
3. DLP

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. R. P. Mogre	Principal	Government Polytechnic, Nagpur
2	Dr. M. V. Sarode	HoD, Computer Engineering and I/C Trainining & Placement Officer	Government Polytechnic, Nagpur
3	Dr. G. V. Gotmare	I/C Curricullum Development Cell	Government Polytechnic, Nagpur

(Dr. M. V. Sarode)
HOD & Chairman PBOS, CM

(Dr. G. V. Gotmare)
Member Sectretary PBOS, CM

Semester

V

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK301H
Course Title	:	Packaging of Food & Beverages

I Rationale:

Food is a fundamental biological need for all living beings. Extending the preservation of food has always been a significant endeavor. Effective packaging plays an important role in prolonging the shelf life of food products and beverages.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge of characteristics of food preservation methods, shelf life studies and modern methods of packaging in developing packaging systems for food products and beverages.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** various food products and beverages; analyze and review the Indian food and beverage market.

CO2: **Identify** the causes of food deterioration; evaluate and recommend appropriate preservation methods.

CO3: **Conduct** sensory evaluation and analyze elemental shelf life studies for food products.

CO4: **Determine** the packaging requirements and analyze the systems used for different food products.

CO5: **Apply** knowledge of modified atmosphere packaging systems in the food industry to design appropriate packaging.

CO6: **Utilize** knowledge of modern packaging systems in the food industry to design innovative packaging solutions.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Classification of Foods & Beverages	1a	Justify the importance of food and its essential nutrients in relation to packaging.	1.1	Food: Importance for life, Essential nutrients, Functions of food, Indian food market; a scenario.	CO1
	1b	Classify various types of foods and relate them to suitable packaging needs.	1.2	Classification of foods, Terminologies - perishable, non-perishable foods and shelf stable, fresh food, fresh produce, canned foods, frozen foods, dried foods, grain products, snacks, jams & jellies.	
	1c	Differentiate main food categories and illustrate relevant packaging considerations.	1.3	Introduction to main food types: Raw red meat, Raw poultry, Cooked, cured and processed meat products, Fish and fish products, Fruits and vegetables, Dairy products, Fats & oils, Fresh Herbs & Spices, Nuts & Seeds.	
	1d	Illustrate beverage types and justify packaging requirements in the Indian market.	1.4	Beverages: Indian beverage market, types of beverages.	

UNIT II: Food Biodetrioration and Methods of Preservation	2a	Differentiate agents of biodeterioration and justify packaging strategies to prevent spoilage.	2.1	Biodetrioration - Introduction. Agents of food biodetrioration; Enzymes - Microorganisms (Bacteria, Fungi), Microbial growth - binary fission, Requirements for growth - physical, chemical and energy, effect of temperature on microbial growth. Non-enzymic-biodetrioration, Prevention of microbial growth in food.	CO2
	2b	Interpret the role of water activity and sorption isotherm in food preservation.	2.2	Role of water in foods, moisture content & water activity, sorption isotherm.	
	2c	Differentiate between biodeterioration and spoilage; justify packaging responses.	2.3	Food Spoilage; difference between bio-deterioration and food spoilage, food poisoning, Biological and Abiotic spoilage - causes and difference.	
	2d	Compare preservation methods and justify their suitability for specific foods.	2.4	Food preservation methods: High temperature - Blanching, Thermal processing/retorting, Continuous thermal processing (aseptic), Pasteurization. Low temperature; Freezing - effects of freezing, Chilling and cooling. Drying and water activity control. Chemical preservation - Curing, Pickling, Smoking. Fermentation, modifying the atmosphere.	
	2e	Justify advanced preservation technologies for enhancing food shelf life.	2.5	Other techniques and developments: High pressure processing, Ohmic heating, Irradiation, Membrane processing, Microwave processing.	
	3a	Illustrate factors affecting the shelf life of packaged foods.	3.1	Definition of Shelf Life, Factors affecting shelf life of packaged foods.	

UNIT III: Packaged Product Quality and Shelf Life	3b	Describe with justification how food composition affects shelf life and packaging.	3.2	Food factors affecting Shelf Life; Food deterioration Modes, Package dependent versus product dependent deteriorations, Quality indexes and critical limits, sensory quality, microbial count, losses in nutrients and pigments, production of undesirable components, physical changes and processes.	CO3
	3c	Evaluate environmental factors influencing shelf life and justify control measures.	3.3	Environmental factors affecting Shelf Life - Ambient environment, physical environment and human environment.	
	3d	Justify packaging material selection based on its role in shelf life.	3.4	Package factors affecting Shelf Life - Packaging parameters important to shelf life, permeation versus reaction controlled shelf life, Migration, Package interactions.	
	3e	Illustrate shelf life testing procedures and justify their application.	3.5	Shelf Life Studies - Testing under Normal conditions, testing under accelerated conditions, procedure for shelf life studies.	
Requirements	4a	Classify cereal and bakery products; justify packaging practices and trends.	4.1	Cereal and bakery Products - Cereal Grain and Flours, Ready to eat breakfast cereals and snacks, fresh and dried pasta products, fresh bakery products. Packaging requirements, practices & modern trends.	
	4b	Compare meat and fish product packaging needs and justify industry practices.	4.2	Meat and fish products - Fresh meat and poultry, processed meat products, fish products. Packaging requirements, practices & modern trends.	

UNIT IV: Food Products, Stability and Packaging	4c	Evaluate dairy product packaging options based on functional requirements.	4.3	Dairy products; Pasteurized and UHT sterilized milk and cream, Dried milk products, cheese, fermented milk. Packaging requirements, practices & modern trends.	CO4
	4d	Illustrate packaging of confectionery products and justify materials used.	4.4	Confectionary products - chocolate products, hard boiled sweets, toffees and other confectioneries. Packaging requirements, practices & modern trends.	
	4e	Justify packaging practices for fats, oils, beverages, and produce based on trends.	4.5	Fat and oils - Packaging requirements, practices & modern trends. Beverages/Drinks - Fruit juices, soft drinks, beer, wine. Packaging requirements, practices & modern trends, Tetrapack - concept, layers functions of each layer & its market. Fresh fruit and vegetables - Packaging requirements, practices & modern trends. Frozen foods - Packaging requirements, practices & modern trends.	
ed Atmosphere Packaging	5a	Identify gases used in MAP and justify their selection for different foods.	5.1	Modified atmosphere packaging (MAP) - Introduction, Gases used in MAP.	CO5
	5b	Analyze effects of MAP gases on microbial growth and justify packaging choices.	5.2	Effect of the gaseous environment on the activity of bacteria, yeasts and molds, Effect of oxygen, Effect of carbon dioxide, Effect of nitrogen.	
	5c	Assess changes in food properties under MAP and justify packaging designs.	5.3	Effect of the gaseous environment on the chemical, biochemical and physical properties of foods; Effect of oxygen, Effects of other MAP gases.	

UNIT V: Modifi	5d	Illustrate gas modification techniques and justify their effect on shelf life.	5.4	Modification of the pack atmosphere - Gas flushing, compensated vacuum gas flushing.	
	5e	Justify plastic and machinery selection in MAP for different food types.	5.5	Main plastics used in MAP - Names, Factors of selection of plastic packaging materials. Main food types packed in MAP. Modified atmosphere packaging machines- Chamber machines, Snorkel machines.	
IT VI: Modern Methods of Food Packaging	6a	Differentiate active packaging components and justify their role in product safety.	6.1	Active Packaging - Introduction, Oxygen scavengers, oxygen scavenging materials, Carbon dioxide scavengers/emitters, Ethylene scavengers, Ethanol emitters, Preservative releasers, Moisture absorbers, Flavor/odor absorbers, Temperature control packaging, Food safety, consumer acceptability and regulatory requirements.	CO6
	6b	Illustrate intelligent packaging features and justify their use in monitoring.	6.2	Intelligent Packaging - Introduction, framework.	
	6c	Compare smart packaging devices and justify their application in food packaging.	6.3	Smart Packaging - Introduction, Smart Packaging Devices - TTI, Leak, Gas Indicators, Freshness Indicator, Barcode, Electronic Identification Tags.	
	6d	Illustrate principles of microwaveable packaging and evaluate related challenges.	6.4	Microwaveable Packaging - Microwaves and Microwave oven, Microwave/food/packaging interaction, List of challenges in microwave heating of foods.	

UN	6e	Classify microwaveable packaging materials and justify their use and compliance.	6.5	Microwavable packaging materials - microwave transparent materials, microwave reflective materials, microwave absorbent material. Interactive microwave packages - surface heating packages, field modification packages, and steam cooking packages. High Barrier plastic packaging - Stepcan, Letpak. Labeling - Introduction, types, labeling Information, legislative labeling requirements.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify different types of Food Products and Beverages. Visit nearby market. List and classify the products. Prepare a report.	2#	CO1
I	2	Search the present market status of the Indian Food and Beverage market using tools like the internet and magazines, and prepare a report on it.	2#	CO1
II	3	Perform freezing of various food products and observe & analyze the effects of freezing on various food products. Prepare a report.	2#	CO2
II	4	Find out water content in food products like bread, papad, etc. Collect samples. Perform the test and prepare a report.	2#	CO2
II	5	Identify the agents of biodeterioration in Perished Foods. Collect sample Observe & identify the causes of spoilage. Prepare a report.	2#	CO2
II	6	Perform chemical preservation i.e. Pickling, Smoking or Curing for a suitable food product.	2	CO2
III	7	Perform Simulated Sensory Evaluation / Organoleptic Properties of any food product. Form groups of four-to-six students each. Identify/collect samples. Perform the evaluation. Note the readings. Prepare a report.	2#	CO3
III	8	Find out GTR of a Primary Package of any Food product. OR Find out WVTR of a Primary Package of any Food product.	2	CO3
III	9	Perform Shelf Life study - Testing Under Normal Conditions.	2#	CO3
IV	10	Identify packaging materials and packaging systems used - for Cereal and bakery Products, Meat and fish products, Dairy products and Confectionary. Collect samples, study its material and type of packaging and prepare a report on it.	2#	CO4
IV	11	Prepare a vist report on different types of Food Products and Beverages by visiting Food/ Beverage Industy.	2#	CO4

IV	12	Identify packaging materials and packaging techniques employed for the packaging of fat, oil and beverages. Visit nearby market. Observe packaged products. Note the related observations. Prepare a report.	2#	CO4
V	13	Carry out a case study on MAP for any food products. Use tools like Internet and magazines etc. Prepare a report on it.	2#	CO5
VI	14	Design a Label for a bottle of Mineral Water or Beverage on Desktop Computer System. Identify product. Prepare a layout on paper. Design on computer. Take printout.	2	CO6
VI	15	Perform Bar Code Reading. Collect samples, scan the barcode, note down the coded information and write the report on it.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Search the present market status of any one country except India for Food and Beverage market using tools like the internet and magazines, and prepare a report on it. (Draw charts, graphs to show market segment).

2. Collect the samples of all types of food packaging, identify the type of container, its material and prepare a report.
3. Perform comparitive analysis of Indian and any other country on present market status of food and beverage market and prepare a report on it. (Draw charts, graphs to show market segment).
4. Perform the child test on CR packaging; collect samples, visit a school, select the children of proper age group, perform the test, note down the readings and draw conculsion.
5. Perform the adult test on CR packaging; collect samples, visit a school, select the children of proper age group, perform the test, note down the readings and draw conculsion.
6. Prepare lemon/carrot/cucumber - pickle/ achar, and study its shelf life under normal conditions- write a report on ingridients, precautions, process, and shelf-life analysis.
7. Carry out a case study on Intelligent and smart packaging for any food products. Use tools like Internet and magazines etc. Prepare a report on it.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Classification of Foods & Beverages	8	C	2	4	6	12
			O	2	4	0	6
2	Food Biodetrioration and Methods of Preservation	6	C	2	4	6	12
			O	0	0	4	4
3	Packaged Product Quality and Shelf Life	8	C	2	4	6	12
			O	0	4	0	4
4	Food Products, Stability and Packaging Requirements	8	C	2	4	4	10
			O	0	4	6	10
5	Modified Atmosphere Packaging	7	C	2	4	6	12
			O	0	0	4	4
6	Modern Methods of Food Packaging	8	C	0	4	8	12
			O	2	4	6	12
Total		45	C	10	24	36	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	5R2	1R2	6R2	5	7
2	1U4	2U4	6U4	4U4	5A4			3	5
3	4U4	6A4	3U4	1U4	2A4			3	5
4	4A4	5U4	6A4	3U4	6U4			3	5
5	1A6	2A6	6A6					2	3
6	3A6	5A6	4A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	3	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	1	-	3	-	-	3	1	2
CO4	3	-	-	3	-	-	3	-	2
CO5	3	-	-	3	1	-	3	-	2
CO6	3	-	1	3	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Food packaging Materials	M Mahadeviah and R. V. Gowramma, Tata McGraw-Hill Publicating Company Limited-1996	10: 0-07-462238-2
2	Food Packaging Principles and Practice-2E	Gordon L. Robertson, Taylor & Francis, CRC Publications	10: 0-8493-3775-5
3	Handbook of Package Engineering	J. F. Hanlon, Technomic Pub., 2E, 1992.	10: 0-87762-924-2
4	Fundamentals of Packaging Technology	Walter Soroka, Institute of Packaging Professionals, Virginia	10: 1930268254
5	The Wiley Encyclopedia of Packaging Technology	Kit L. Yam, John Wiley & Sons, Inc., 2009	13: 9780470087046

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2. https://www.slideshare.net/slideshow/make-india-food-processing-feb-2016/58221310, assessed on 13 August 2024
3. https://en.wikipedia.org/wiki/Moisture_sorption_isotherm, assessed on 13 August 2024
4. https://www.slideshare.net/slideshow/food-freezing/51537667, assessed on 13 August 2024
5. https://wikieducator.org/Food_Packaging_Technology, assessed on 13 August 2024
6. https://www.modifiedatmospherepackaging.com/, assessed on 13 August 2024
7. https://www.slideshare.net/aulger/modified-atmosphere-and-intelligent-packaging-of-food-presentation, assessed on 13 August 2024

XVI List of Major Equipment/Machineries with Specification:

1. Humidity Chamber.
2. Refrigerator deep freezing facility.
3. Desktop Computer Systems.
4. Electronic weighing scale - least count 0.01g (minimum).
5. Gas Transmission Rate/Oxygen Transmission Rate Testing Machine.
6. Water Vapor Transmission Rate i.e. WVTR Testing Machine.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Head of Department, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Lecturer in Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
5	Mr. Prasad Balan Iyer	Director	SIES School of Packaging, Navi Mumbai – 400 705.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali Mohd Zeeshan MSM	Assistant Professor	Anjuman College of Engineering and Technology, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK302H
Course Title	:	Package Design Engineering

I Rationale:

The course equips students with the ability to scientifically design packaging by applying mechanical principles such as stress, strain, and impact behavior of materials, enabling optimization of strength, cost, and performance; it emphasizes cushioning systems, structural analysis, environmental considerations, and regulatory standards to ensure packaging reliability, safety, and sustainability in real-world applications.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Design optimum cushioning for a product being packed.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** concepts of strength of materials to perform tests on stress and strain.

CO2: **Apply** shear force and bending moment concepts to analyze beams and interpret diagrams.

CO3: **Analyze** handling, stacking, and impact forces to apply general packaging design considerations effectively.

CO4: **Design** optimum cushioning solutions for handling, stacking, and impact loads.

CO5: **Design and analyze** corrugated boxes, wooden crates, and containers to ensure they meet the required strength criteria.

CO6: **Investigate** the stresses induced in thin metal containers due to internal pressure and other loads.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	4	1	8	4

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70 @	100	40	25	10	25+	10	25	10

@ 4 Hours Duration

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
oment of Inertia and Simple Stress and Strain	1a	Calculate moment of Inertia of simple shapes.	1.1	Definition: M.I. of plane lamina, radius of gyration. Parallel and perpendicular axes theorems. M.I. of rectangular, circular semicircular and triangular section.	CO1
	1b	Compute moment of Inertia of Symmetric & asymmetric structural sections using parallel and perpendicular axes theorems.	1.2	M.I. of symmetrical and Unsymmetrical I-section, channel section, T-section, angle section, & Hollow sections and built up section about centroid axes. Polar Moment of Inertia of circular sections. (simple numericals)	
	1c	Compute the values of given terms.	1.3	Definition: Stress, strain, elasticity. Basics of rigid, elastic and plastic bodies. Deformation of elastic body under various forces.	
	1d	Calculate Material Properties Under Longitudinal & Lateral Loads.	1.4	Longitudinal and lateral strain, Poisson's ratio, volumetric strain, change in volume and Bulk modulus. (simple numericals)	

UNIT I: Mo	1e	Calculate design constants for various conditions. Calculate the change in dimensions and volume of the body subjected to uniaxial loads/stresses.	1.5	Types of stresses – normal tensile and compressive; Stress-strain curve for mild steel – key points and interpretation. Hooke's Law and the concept of elastic limit. Modulus of elasticity, yield stress, working stress, and factor of safety – definitions and significance. (simple numericals)	
UNIT II: Shear Force and Bending Moment	2a	Draw Shear Force & Bending Moment Diagram for Statically Determinate Beams.	2.1	Shear stress and strain, modulus of rigidity. Relation between modulus of elasticity, modulus of rigidity and bulk modulus. Differentiate between Sudden, Gradual & Impact Loads.	CO2
	2b	Compute values of given terms.	2.2	Types of beams, supports and loads. Concept and definition of shear force andbending moment.	
	2c	Draw Shear Force & Bending Moment Diagram for Statically Determinate Beams on given data.	2.3	Shear force and bending moment diagram for simply supported and one sided overhanging beams subjected to point loads and uniformly distributed loads only.	
	2d	Calculate the shear force and bending moment for determinate beams with load combinations of point load and uniformly distributed load based on given data.	2.4	Point of maximum sagging and hogging bending moment, point of contra-flexure, Relation between load, shear force and bending moment. Point of maximum sagging and hogging bending moment, point of contra-flexure, Relation between load, shear force and bending moment.	

UNIT III: General Design Considerations	3a	Describe with justification given terms related to package design.	3.1	Scope of packaging field. Role of shipping container. Possible types of damage to container content. Important factors that affect the design of a shipping container. Design considerations. Design conditions – handling loads, stacking loads and impact loads.	CO3
	3b	Determine displacement of cushioning material on given data.	3.2	Definition & units of Factor of safety, Elastic constant, Spring constant. Impact design criteria, horizontal impact, vertical cushioning displacement: Crushing type & Elastic type of cushioning material. Calculation of displacement of cushioning material.	
	3c	Calculate given terms on given data.	3.3	Fundamentals of cushioning. Cushioning materials-classification and properties. Cushioning devices & system. Calculation of impact velocity, time of fall, height of drop, deceleration during stopping after impact, force exerted by/on the packaged item, deformation of the cushioning material, total thickness of cushioning material required (for elastic type cushioning material) in case of a freely falling package.	
	3d	Determine given terms on given data.	3.4	Define and determine Load factor or G-value. Determination of acceleration or deceleration, distance/ displacement, time in case of horizontal impacts.	

	3e	Design the package using various performance curves.	3.5	Design cushioning theory- Draw & state the applications of force-deformation curves & Energy- load curves of cushioning materials. Use of cushioning materials curves in cushion designing. Determination of forces developed during handling, stacking and impact.	
UNIT IV: Optimum Cushioning	4a	Find out thickness optimum from the given curve.	4.1	Importance of optimum cushioning, Objective of good cushioning design. Methods of reducing damage due to shock. Analysis of package on impact. Significance of area under load- deflection curve, plot characteristics/ curves from data obtained experimentally: load- energy curve, Force/Energy-load curve.	CO5
	4b	Interprete given thickness optimum curves.	4.2	Method of obtaining shock force - static weight curve from above curves. Interpretation of thickness optimum. Effect of increasing energy absorption to increase efficiency of a cushion without any increase in its thickness.	
	4c	Select cushioning material based on given data.	4.3	Cushioning factors. Comparison of cushioning efficiencies of various cushioning materials & selection of appropriate cushioning material. Factors affecting cushioning reliability. Determination of effect of varying drop conditions using J factor. Economics of optimum cushioning.	

UNIT V: Corrugated & Wooden Packaging	5a	Describe with justification sketches the construction of different fibreboard containers.	5.1	Corrugated Fibre board Container, Influence of GSM of paper/paperboard/ corrugated fibreboard, type of fluting, number of walls, bursting strength, edge crush resistance, flat crush resistance, water resistance, puncture resistance, style of box on the performance/design of box. Methods of closing a fibreboard container. Strength requirements of fibreboard containers□	CO5
	5b	Estimate the cost of corrugated fibre board container by designing.	5.2	Blank design and blank layout - single piece and two piece blanks. Calculation of deckle size. Material requirement calculation for box of given specification. Cost estimation. Method of determination of wet bursting strength of corrugated fiberboard. Mathematical analysis for handling loads, stacking loads and impact loads.	
	5c	Analyze wooden crates and containers for given conditions.	5.3	Wooden Crates & Containers. Description of wooden crate – construction, Analysis for handling, stacking, and impact load considerations. Simple mathematical analysis like calculation of moment of inertia of composite section of such containers, stresses in struts, force exerted by a product on various members of a container, analysis of force on that member. Tools used in assembly.	

	5d	Describe with justification construction of given plywood Container.	5.4	Description of plywood containers and its construction. Material specifications for domestic shipment and overseas shipment. Holding fittings and additional supports for quick assembly and disassembly and reinforcement.	
	5e	Analyze plywood Containers for given conditions.	5.5	Typical plywood container analysis for handling loads, stacking loads, package drop against bottom, drop against side, package drop against end, package drop against top, load factor calculations. Description of construction of sheathed crates.	
UNIT VI: Thin Metal Containers	6a	Calculate given stresses on given data.	6.1	Stresses in walls of thin cylindrical shells due to internal pressure, circumferential and longitudinal stresses. Calculation of stresses.	CO4
	6b	Calculate internal pressure from given data.	6.2	Change in dimensions and volume of cylindrical shell due to internal pressure. Thin spherical shells, change in diameter and volume due to internal pressure (No derivation).□	
	6c	Describe with justification design requirement of Metal Containers.	6.3	Materials requirement for reusable shipping and storage metal containers, Design requirements – general requirements, functional characteristics, handling provisions. Environmental requirements.	
	6d	Justify given test procedure.	6.4	Test procedures – Drop edgewise test, drop cornerwise test, end impact test, roll over test, vibration test, stacking test, handling characteristics test, leak test.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Calculate the M.I. of symmetrical section (T & I) using standard formulae and centroidal axes.	2#	CO1
I	2	Calculate the M.I. of asymmetrical sections (C) using standard formulae and centroidal axes.	2#	CO1
I	3	Measure the elongation of steel by using Extensometer.	2#	CO1
I	4	Calculate compresive strength of concrete specimen.	2#	CO1
II	5	Perform Shear test on Wood specimen.	2#	CO2
II	6	Perform Shear test on Aluminium specimen.	2#	CO2
II	7	Construct shear force and bending moment diagrams for simply supported and cantilever beams. (Two problems on – Two A3 size sheets.)	2#	CO2
II	8	Locate maximum bending moment and point of contra-flexure on pre-defined beam problems. (Two problems on – Two A3 size sheets.)	2#	CO2
III	9	Determine the handling, staking and impact loads that will be imposed upon a package item of given weight subjected to given drop height and will be stacked. Part I	2#	CO3
III	10	Determine the handling, staking and impact loads that will be imposed upon a package item of given weight subjected to given drop height and will be stacked. Part II	2#	CO3
III	11	Determine the handling, staking and impact loads that will be imposed upon a package item of given weight subjected to given drop height and will be stacked. Part III	2#	CO3
III	12	Perform Load Deformation test & plot various characteristics of cushioning material.	2#	CO3
III	13	Design a package for deceleration using force consideration.	2#	CO3
III	14	Design a package for impact load (Vertical drop).	2#	CO3
IV	15	Design an optimum cushioning for package under impact load.	2#	CO4

IV	16	Design a cushioning system for a given product considering; fragility, size, weight, and the types of stresses it will experience during handling and shipping.	2#	CO6
IV	17	Design a cushioning system for a given product considering; selecting appropriate cushioning materials (like foam, bubble wrap, or air cushions, spring, cushioning pads),	2#	CO4
IV	18	Design a cushioning system for a given product considering proper fit and coverage. On above two practicals (Practical Number 16 & 17)	2#	CO4
IV	19	Calculate area under load- deflection curve	2#	CO4
IV	20	Plot characteristics/ curves from data obtained experimentally: load- energy curve.	2#	CO4
IV	21	Plot characteristics/ curves from data obtained experimentally:Force/Energy-load curve.	2#	CO4
IV	22	Analyze cushioning effciencies of different materials.	2#	CO4
IV	23	Design a cushioning for package under veritical drop considering thickness, contact area of cushioning material.	2#	CO4
IV	24	Design a cushioning system for various cushioning materials considering cost effectiveness.	2#	CO4
V	25	Determine Grammage of fibreboard.	2#	CO5
V	26	Determine Puncture resistance of fibreboard.	2#	CO5
V	27	Determine Wet bursting strength of fibreboard.	2#	CO5
V	28	Perform Box compression test to predict stacking height of a given corrugated box.	2#	CO5
VI	29	Carry out Rolling test on filled fibreboard container	2#	CO6
VI	30	Perform Drop test on a package	2#	CO6
VI	31	Perform Vibration test on a package.	2#	CO6
VI	32	Design a wooden crate for a product under given condition.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Design a simple structural component (e.g., a beam or column) using the concepts of M.I., stress, strain, and material properties. Justify the design choices based on calculations, safety factors, and material behavior under load.

2. Derive the M.I. for symmetrical and unsymmetrical sections (e.g., I-section, T-section, circular section) using parallel and perpendicular axes theorems. Apply these concepts to solve problems related to the radius of gyration and polar moment of inertia for circular sections.

3. Demonstrate the ability to calculate stress, strain, and deformation in elastic bodies under various forces. Perform calculations for longitudinal strain, lateral strain, Poisson's ratio, and volumetric strain, and interpret the stress-strain curve for mild steel under tension.

4. Draw on full size Sheet (Make chart) the Construct and interpret shear force and bending moment diagrams for simply supported, cantilever, and overhanging beams subjected to point loads and uniformly distributed loads. Also derive all the necessary formulas on separate sheets.

5. Analyze the stresses developed in thin cylindrical and spherical shells due to internal pressure and their impact on structural integrity: Introduction to Thin Shell Structures – Applications in engineering (pipelines, pressure vessels, tanks) Assumptions in thin shell analysis. Circumferential & Longitudinal Stresses in Cylindrical Shells .Also derivation & significance of hoop and axial stresses Do Real-world examples & case studies.

6. Analyze the stresses developed in thin cylindrical and spherical shells due to internal pressure and their impact on structural integrity: Dimensional Changes Due to Internal Pressure Volume expansion & deformation effects. Effects on material selection & safety considerations. Thin Spherical Shells & Practical Applications; Change in diameter & volume (without derivation).Comparison of spherical vs. cylindrical shell behavior.

7. Conduct and interpret various packaging test procedures and structural analysis techniques: Introduction to Structural Testing; Importance of structural integrity in packaging. Types of mechanical stresses during transportation Drop & Impact Tests; Edgewise, cornerwise, and end impact testing. Shock absorption & damage assessment Vibration, Stacking & Leak Tests; Simulating real-world shipping conditions. Evaluating load-bearing capacity & sealing effectiveness Structural Analysis & Failure Predictions; Finite element analysis (FEA) for container design. Improving durability using computational modeling.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Moment of Inertia and Simple Stress and Strain	8	C	2	8	6	16
			O	0	4	0	4
2	Shear Force, Bending Moment	6	C	0	4	6	10
			O	2	0	6	8
3	General Design Considerations	8	C	2	4	4	10
			O	0	4	4	8
4	Optimum Cushioning	7	C	2	4	4	10
			O	2	4	0	6
5	Corrugated & Wooden Packaging	8	C	2	4	6	12
			O	0	0	6	6
6	Thin metal containers	8	C	2	4	6	12
			O	0	4	4	8
Total		45	C	10	28	32	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	4R2	3R2	6R2	5R2	4R2	2R2	5	7
2	2U4	1U4	3U4	6A4	3A4			3	5
3	4U4	5U4	6U4	3U4	1U4			3	5
4	3A4	1U4	4A4	6U4	4U4			3	5
5	1A6	2A6	5A6					2	3
6	5A6	6A6	2A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	-	2	-	-	1	-
CO2	3	3	3	-	-	-	-	-	1
CO3	3	3	3	1	2	-	3	-	-
CO4	3	3	3	1	-	-	3	1	-
CO5	3	3	3	-	-	-	3	-	1
CO6	3	3	3	-	2	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Packaging - An Introduction	Stanley Saccharow; HBJ Publications, 1976.	10: 0150044860 13: 9780150044864
2	Introduction to Packaging	F.A. Paine., Chapman & Hall, Glasgow, 1992.	10: 0216932106
3	Engineering Design Handbook - Packaging and Pack Engineering	John Wiley & Sons	13: 9781615839988
4	Fundamentals of Packaging Technology	Walter Soroka, Institute of Packaging Professionals, Fourth E, 2009	10: 1930268289 13: 9781930268289
5	Package Design Engineering	Kenneth Brown, John Willey & Sons, Inc Publishers, NewYork,1959	-

XV e-References:

1. https://www.youtube.com/watch?v=uyU25DdONjo, assessed on 13th August 2024
2. http://www.containerhandbuch.de/chb_e/stra/index.html?/chb_e/stra/stra_03_01_0 0.html assessed on 13th August 2024
3. https://en.wikipedia.org/wiki/Crate#Wooden_crates assessed on 13th August 2024
4. http://www.woodencrates.org/standards/HDBK-252.pdf assessed on 13th August 2024
5. https://www.youtube.com/watch?v=f1pxiNDTyHc assessed on 13th August 2024
6. https://en.wikipedia.org/wiki/List_of_moments_of_inertia, assessed on 13th August 2024
7. https://en.wikipedia.org/wiki/Stress%E2%80%93strain_curve, assessed on 13th August 2024
8. https://www.mechlearning.com/2021/07/relation-between-young-modulus-modulus.html, assessed on 13th August 2024

XVI List of Major Equipment/Machineries with Specification:

1. Universal Testing machine of capacity 400kN,600 kN/1000kN, analog type/digital type with all attachments and accessories
2. Extensometer with least count 0.01mm, maximum extension 25 mm with single dial gauge/ digital display suitable for various gauge length
3. Compression testing machine of capacity 2000KN, analog /digital type having facility to measure deformation with all attachments and accessories.
4. Thickness caliper.
5. Grammage tester.
6. Puncture resistance tester.
7. Cobb tester.
8. Weigh balance.
9. Universal testing machine.
10. Bursting strength tester, Drop tester, Vibration tester.,Box compression tester

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology.	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4	Dr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
5	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSE
Course Code	:	PK303H
Course Title	:	Packaging of Engineering Goods

I Rationale:

The business of engineering goods, characterized by centralized production and wide distribution, demands meticulous attention to packaging due to high product costs and potential risks. Packaging is no longer an afterthought; it begins at the design stage, integrating marketing and safety considerations to remain competitive. For heavy engineering goods, the choice of packaging—or even the decision to forego it—requires careful evaluation. Hazardous goods, with their potential to harm life, property, and the environment, necessitate specialized packaging solutions to prevent catastrophic consequences. Thus, packaging in this sector is both an art and a critical responsibility.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Suggest proper packaging solutions for various engineering goods.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Evaluate** the packaging system of a Refrigerator.

CO2: **Evaluate** the packaging system of a Television.

CO3: **Evaluate** the packaging systems of the Electric Lamps.

CO4: **Evaluate** the packaging systems of the Electrical / Electronic Measuring Instruments and Monitoring Devices.

CO5: **Evaluate** the packaging systems of the Domestic appliances, Computers and Peripherals.

CO6: **Identify** the product characteristics, handling, transportation, packaging and export considerations for Heavy Engineering Goods.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Refrigerators	1a	Classify given types of refrigerator for given applications.	1.1	Function of refrigerator, operating principle, types, uses and applications, popular brands and standard models.	CO1
	1b	Describe the constructional features of refrigerator.	1.2	Constructional features, outline of manufacturing process, packaging in assembly line.	
	1c	Identify the product charateristics of refrigerator for given consideration.	1.3	Product characteristics, handling considerations and hazards, warehousing considerations and hazards, transportation and distribution considerations and hazards, other desirable packaging functions.	
	1d	Identify the given types of damages and suggest protection for it.	1.4	Most likely and common damages, Protection needs, suitable packaging systems / solutions, current packaging practices.	

	1e	Evaluate the given packaging system for refrigerator.	1.5	Evaluation of packaging system- Technical, technological, economic & commercial, relevant standards.	
UNIT II: Televisions	2a	Classify the given types of television.	2.1	Operating principle, types, uses and applications, popular brands and standard models.	CO2
	2b	Describe the construction and protective features of television.	2.2	Constructional features including built in protection features, outline of manufacturing process, packaging in assembly line.	
	2c	Identify the product charateristics of television for given consideration.	2.3	Product characteristics, handling considerations and hazards, warehousing considerations and hazards, transportation and distribution considerations and hazards, other desirable packaging functions.	
	2d	Identify the given types of damages and suggest protection for it.	2.4	Most likely and common damages, Protection needs suitable packaging systems / solutions, current packaging practices.	
	2e	Evaluate the given packaging sysytem of television.	2.5	Evaluation of packaging system- Technical, technological, economic & commercial, relevant standards.	
: Electric Lamps	3a	Classify the given types of electric lamps.	3.1	Types of Electric Lamps: Incandescent bulbs, fluorescent tubes, compact fluorescent lamps, miniature bulbs and automobile bulbs	CO3
	3b	Identify the product charateristics for given considerations of electric lamps.	3.2	Product characteristics, handling considerations and hazards, warehousing and retailing considerations and hazards, transportation and distribution considerations and hazards, other desirable packaging functions.	

UNIT III	3c	Identify the given damages and suggest protection for electric lamps.	3.3	Most likely and common damages, Protection needs suitable packaging systems / solutions / concepts, current packaging practices.	
	3d	Evaluate the given packaging system of electric lamps.	3.4	Evaluation of packaging system - Technical, technological, economic & commercial, relevant standards.	
UNIT IV: Electrical / Electronic Measuring Instruments and Monitoring Devices	4a	Classify the given measuring instruments with their characteristics.	4.1	Applications of measuring instruments in medical, engineering, industrial, space and aircraft and automobile areas, Broad classification of measuring instruments and monitoring devices- digital analogue and hybrid type, examples, common constructional features and components, General functional characteristics- accuracy, repeatability, precision, reliability, etc. and their importance for packaging design.	CO4
	4b	Identify the given damages and its causes and suggest the given considerations.	4.2	Most likely physical and functional damages, their causes and remedies in electronic packaging, General transit, handling, warehousing considerations and relevant hazards, desired packaging functions.	
	4c	Identify the packaging solutiions for given packages.	4.3	Packaging solutions / systems, components of package.	
	4d	Evaluate the given packaging sysytem of measuring instruments.	4.4	Evaluation of packaging system- Technical, technological, economic & commercial, relevant standards.	
	4e	Select the special packaging for given instruments at differennt denstinations.	4.5	Special packaging considerations for instruments for panel mounting, field & mobile use, Packaging for assembly line.	

UNIT V: Domestic appliances, Computers and Peripherals.	5a	Distinguish the current packaging practices for given domestic appliances.	5.1	Packaging considerations and current packaging practices for the domestic appliances like Ceiling fan, Table fan, Microwave oven, Food processor, Iron.	CO5
	5b	Distinguish the current packaging practices for given computing devices and peripherals.	5.2	Packaging considerations and current packaging practices for computing devices and peripherals like Computer Mouse, Hard disk, Compact disks and DVDs, Keyboards, Laptops.	
Engineering Goods	6a	Apply given charateristics of heavy engineering goods for packaging applications.	6.1	Heavy Machinery, vessels and structures: Characteristics- weight, volume / size, center of gravity, assembly of components, use of fasteners, overhanging members, protruding members, giant machines, irregularity of shape and size etc, Protection needs: Likely damages- physical, physiochemical, functional, avoiding damages, options of dismantling and multi-packing.	
	6b	Compare the given handling consideration for packaging application.	6.2	Handling Considerations: In plant handling, Handling at destination, Handling for transshipment, methods of handling, use of slings and pallets, Handling devices, relevant standards, laws and regulations.	

UNIT VI: Packaging of Heavy I	6c	Identify the given transport consideration for heavy engineering goods.	6.3	Transport considerations: Selection of mode and type of load for transportation, Importance of planning the route, local Laws and regulations en- route, permissions and permits of controlling authorities, transit hazards. Packaging considerations: deciding to pack or not, Basic packaging functions, economics of packaging.	CO6
	6d	Compare the given packaging considerations for given heavy engineering products.	6.4	Heavy Engineering products: Packaging considerations for metallic coils of wire and thin foils / sheets and bars.	
	6e	Identify the given export consideration with given national and international regulation.	6.5	Export considerations: Mode of transportation and the route decision, international regulations on handling, transport, marking and labeling, Restrictions on use of packaging materials, disinfection of packages, Use of containers.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Perform the analysis of various refrigerator models, identify their characteristics, and understand the potential hazards they encounter by visiting nearby vendor and write a observation report.	2#	CO1
I	2	Evaluate the current packaging systems used for refrigerators visually by visiting nearby vendor, Examine the packaging systems of the selected refrigerator model, Evaluate the packaging system visually, focusing on its ability to mitigate hazards identified earlier, Write a report on the evaluation, including observations and suggestions for improvement.	2#	CO1
II	3	Conduct a market study on televisions and observe the available models and specifications, select a specific television model and analyze its characteristics. Visit a nearby vendor dealing in televisions, Observe and document various models and brands along with their specifications (e.g., screen size, technology, features), Identify and document the model's characteristics, such as dimensions, weight, material, and unique features. Prepare a brief report highlighting the selected model's features and why it was chosen.	2#	CO2
II	4	Evaluate the packaging system of a television and identify potential hazards during its lifecycle. Identify hazards that the television may encounter during handling, storage, and transportation, Visually evaluate the current packaging system for its effectiveness in protecting against these hazards. Write a detailed report with observations and suggestions for improving the packaging system.	2#	CO2
III	5	Collect the information about the different bulb avaialable in the market and perform the analysis about its charateristics and possible hazards occurs on it.	2#	CO3
III	6	Identify the various hazards faced by slected electric bulb and evaluate its current packaging system.	2#	CO3
III	7	Carryout market survey related to trends and specifications of electric bulbs.	2	CO3
IV	8	Carryout market survey related to electric/electronic measuring/monitoring instruments and their specifications.	2	CO4

IV	9	Select a specific model of an electric/electronic measuring/monitoring instrument and analyze its characteristics.	2#	CO4
IV	10	Identify potential hazards and evaluate the packaging system for electric/electronic measuring/monitoring instruments.	2#	CO4
V	11	Evaluate current packaging system for Ceiling fan, Table fan, Microwave oven, Food processor, Iron (Any two).	2#	CO5
V	12	Evaluate current packaging system for Mouse, Hard disk, Compact disks and DVDs, Keyboards, Laptops (Any two).	2#	CO5
V	13	Identify the different hazards occurs on the domestic appliances and computer peripherals.	2	CO5
VI	14	Identify the product charateristics and handling consideration in plant of Heavy Engineering Goods.	2#	CO6
VI	15	Identify the transport considerations and export considerations for any heavy engineering product. (Select any product)	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare a detail report on packaging materials used by popular refrigerator brands, Analyze technical and economic aspects of these packaging systems, and Evaluate their performance under transport and warehousing conditions.
2. Prepare a report on packaging of electric lamps (e.g., incandescent bulbs, CFLs) and their protection during transit.
3. Prepare a comparative analysis report of packaging solutions for any selected two types of measuring instruments.
4. Prepare a report on comparative study on the packaging of selected domestic appliances (e.g., microwave oven, ceiling fan). Suggest alternatives for improved sustainability and cost-effectiveness.
5. Prepare a details report on complexities of export packaging for heavy machinery also Study international regulations and standards for export packaging.
6. Investigate eco-friendly packaging alternatives for computing devices, Study existing packaging for items like laptops and keyboards. Prepare a report on comparative study.
7. Prepare a examination report on packaging systems for metallic coils, foils, and bars, Study the specific needs (e.g., corrosion prevention, stability) and Propose a multi-packaging solution for long-distance transport.
8. Prepare a investigation report on causes of transit damage in measuring devices.
9. Prepare a evaluation report on packaging solutions for heavy engineering products under various conditions, Study existing practices for products like wire coils or thin sheets.
10. Suggest innovative packaging systems for a any selected domestic appliance. Develop a concept for an improved, consumer-friendly design.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Refrigerators	8	C	2	4	6	12
			O	0	4	4	8
2	Televisions	8	C	2	4	6	12
			O	0	8	0	8
3	Electric Lamps	7	C	2	4	4	10
			O	0	0	6	6
4	Electrical / Electronic Measuring Instruments and Monitoring Devices	7	C	0	4	6	10
			O	2	4	0	6
5	Domestic appliances, Computers and Peripherals.	7	C	4	4	4	12
			O	2	4	0	6
6	Packaging of Heavy Engineering Goods	8	C	4	4	6	14
			O	0	0	6	6
Total		45	C	14	24	32	70
			O	4	20	16	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	6R2	6R2	4R2	5R2	5	7
2	5R4	1U4	2U4	1U4	2U4			3	5
3	3U4	4U4	5U4	2U4	4U4			3	5
4	6U4	3A4	5A4	5U4	1A4			3	5
5	1A6	2A6	3A6					2	3
6	4A6	6A6	6A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	3	-	-
CO6	3	-	-	-	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Fundamentals of Packaging Technology	S. Natrajan, M. Govindrajan, B. Kumar, 2E, PHI LPL, Delhi, 2014	13: 978-81-203-5054-0
2	Handbook on Pulp & Paper Industries	SIRI Board of Consultants & Engineers, SIRI Pub. Div. Delhi.	10: 81-85480-24-9
3	The Wiley Encyclopedia of Packaging Technology	Marilyn Bakker, John Wiley & Sons Inc. Canada.	10: 0471-80940-3
4	The Packaging Designers Book of Patterns	Laszlo Roth, George L/ Wybenga, Wan Nostrand, Reinhold, New York, 1991	10: 0-442-00524-5
5	Paper, Paper Converting, Plastics & Other Pkg. Industries	R. K. Kush, SBP Pub. Co. Delhi, 1998	--------
6	Handbook of Pulp & Paper Technology	Kenneth W. Britt, 2E, CBS Publishers Delhi, 1984	--------

XV e-References:

1. http://boxmaster.com/products/box-basics/, assessed on 22nd September 2024.
2. http://www.madehow.com/Volume-1/Corrugated-Cardboard.html, assessed on 22nd September 2024.
3. http://lithotech.ca/types-of-corrugated/, assessed on 22nd September 2024.
4. https://www.tridentpbi.in/products/corrugated-box-cardboard-cartons/, assessed on 22nd September 2024.
5. http://www.cupmachinery.com/english/process.html, assessed on 22nd September 2024.
6. https://www.bharathmachines.in/disposable-cup-making-machine.html, assessed on 22nd September 2024.
7. http://www.packcon.org/index.php/en/articles/117-2021/303-packaging-of-light-bulbs, assessed on 22nd September 2024.
8. https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/3/__PG_M.B.A%20Logistics%20Management_English_Packing
9. https://www.scribd.com/presentation/232136140/Packaging-of-Heavy-Machinery, assessed on 22nd September 2024
10. https://xpertpack.in/services/project-packaging/heavy-machinery-packaging/, assessed on 22nd September 2024.

XVI List of Major Equipment/Machineries with Specification:

1. Analog Substance Indicator/GSM Tester.
2. Bursting Strength Tester.
3. Universal Testing Machine.
4. Compression Tester- ECT/FCT/RCT, etc.
5. Electronic Thickness Gauge.
6. Analog Puncture Strength Tester.
7. Box Compression Tester.
8. Vibration Tester.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Anup P. Pardey	Sr. Lecturer, Paper Technology	Government Polytechnic, Nagpur.
3	Mr. Subhash N. Madhugiri	Head of Department, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Lecturer in Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
5	Mr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
6	Mr. Prasad Balan Iyer	Director	SIES School of Packaging, Navi Mumbai
7	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.

(Mr. Syed Imran Ahmed K.)
HOD & Chairman PBOS, PK

(Dr. G. V. Gotmare)
Member Sectretary PBOS, PK

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSE
Course Code	:	PK304H
Course Title	:	Packaging of Chemicals, Garments & Handicrafts

I Rationale:

This course emphasizes the vital role of packaging in ensuring the safe storage, handling, and transportation of chemicals, including hazardous substances that pose risks to health, property, and the environment if not properly contained. It also addresses the specific packaging needs of bulk commodities like paints, fertilizers, cement, and textiles, which require tailored solutions based on their handling characteristics. For delicate items such as handicrafts, the course focuses on protective packaging to prevent damage during transit. Students will gain a comprehensive understanding of packaging materials, systems, and regulatory requirements. The course equips technicians with practical knowledge to implement safe, efficient, and compliant packaging strategies across diverse product categories.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Select and evaluate packaging solutions ensuring safety, compliance, cost, and suitability as per market needs.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Classify** chemicals and justify their packaging needs, materials, safety, legal, and regulatory requirements.

CO2: **Evaluate** packaging materials, methods, and compliance requirements for paints.

CO3: **Assess** cement packaging with respect to functional needs, economics, and market trends.

CO4: **Evaluate** fertilizer packaging considering product properties, economic factors, and export aspects.

CO5: **Analyze** garment packaging based on customer needs, protection, display, and current market practices.

CO6: **Evaluate** packaging of handicrafts and fragile items for protection, function, and cost in domestic and export contexts.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
I: Packaging of Chemicals and Dangerous Goods	1a	Classify given chemicals on given packaging purpose.	1.1	General classification of chemicals, classification for packaging purpose-according to physical state and form.	CO1
	1b	Identify basic packaging requirements for given chemical.	1.2	Basic packaging requirements of packaging of chemicals-safety, security, customer convenience, cleanliness, shelf life, cost, Appearance, reuse / alternative use value, availability.	
	1c	Identify the given national and international regulations for given chemicals.	1.3	Laws and regulations-national / international laws and regulations for coding, marking and labeling, transport and handling, regulating authorities	
	1d	Select given types of materials and containers for given applications.	1.4	Materials and containers for chemicals for industrial use (bulk), Closing methods, safety and security features, selection criteria.	

UNIT	1e	Evaluate the given chemical packaging for given applications.	1.5	Applications and economics of returnable container, Current packaging practices for domestic and agricultural chemicals (unit packages).	
UNIT II: Packaging of Paints	2a	Classify given paints with given applications.	2.1	Classification of paints based on physical state, composition, application, specialties etc, Methods of application of paints, basic constituents of paints, Major brands in Indian market and their product range, Local manufacturers and their brand names.	CO2
	2b	Distinguish the given manufacturer and consumers for paint marketing.	2.2	Major sectors of Paint market: industrial, commercial, urban, rural, consumer characteristics and market trends, Distribution channels and practices for branded and local manufacturers, sales outlets, marketing methods.	
	2c	Identify the given characteristics for given damages.	2.3	Product characteristics in general based on the physical state and composition of the paints, Likely damages, protection and preservation needs.	
	2d	Compare the given packages with their closing methods for paint packaging.	2.4	Functional considerations, Unitization: basis and ranges for various types, Containment: Basic rigid and flexible containers suitable for paints, closures, methods of closing, materials and comparison, Communication: communication needs, advertising needs, components of communication, Dispensing and dispersing: relevant packaging features, need and suitability to various applications, PP & TE: Importance, various features to ensure PP & TE, comparison of metallic and plastic containers.	

	2e	Evaluate the given paint packaging system.	2.5	Evaluation of packages, relevant standards, laws and regulations, current packaging trends.	
UNIT III: Packaging of Cement	3a	Classify given cements with their given composition.	3.1	Standard types, typical composition, Schematic manufacturing process and application, Major brands in Indian market and their product range.	CO3
	3b	Identify the distribution and marketing practices for given cement.	3.2	Major sectors of cement market: industrial, civil and structural engineering, individual, consumer characteristics and market trends, Distribution channels and practices, sales outlets, marketing methods.	
	3c	Identify the given product characteristics for given cement packages.	3.3	Product characteristics: physical and physiochemical, Likely damages and loss of product, protection and preservation needs.	
	3d	Distinguish the given consideration for given cement packages.	3.4	Functional considerations: considerations for unitization, containment, protection, communication, PP & TE, Dispensing and package filling. Transport handling and storage systems: Need for standard systems, current practices.	
	3e	Evaluate the given cement packages.	3.5	Economic considerations: cost of package and loss of product, cost of loss prevention, value of loss of product. Global packaging trends, evaluation of packages, relevant standards.	
	4a	Classify given fertilizers with their given composition.	4.1	Standard types, typical composition, Schematic manufacturing process, application, Major brands in Indian market and their product range.	

UNIT IV: Packaging of Fertilizers	4b	Identify given charateristics of fertilizers and their distribution practices.	4.2	Consumer characteristics and market trends, Distribution channels and practices, sales outlets, marketing methods. Product characteristics: physical and physiochemical, Likely damages and loss of product, protection and preservation needs.	CO4
	4c	Distinguish the given considerations for fertilizers packaging.	4.3	Functional considerations: considerations for unitization, containment, protection, communication, PP & TE, Dispensing and package filling.	
	4d	Identify the given transport, handling and storage practices for given fertilizers.	4.4	Transport handling and storage systems: Need for standard systems, current practices.	
	4e	Evaluate the given fertilizer packages.	4.5	Economic considerations: cost of package and loss of product, cost of loss prevention, value of loss of product. Global packaging trends, evaluation of packages, relevant standards, export considerations.	
Garments and Accessories	5a	Classify given garments on given points.	5.1	Range of products and detailed classification, Classification of customers of garments and their characteristics, general characteristics of garments as products: based on purpose or intended use, choice, colour, pattern, fashion, life, trend, occasion, age group, location, ethnic values etc.	CO5
	5b	Classify given major brands and their distribution practices.	5.2	Major brands in garments trade, the range of products and the overview of their market share, local brands / unbranded products and their share in the market, Distribution practices, Characteristics of retail outlets and departmental stores.	

UNIT V: Packaging of	5c	Distinguish given window shoping, impulse buying, display value and sales appeal.	5.3	Concept of window shopping, impulse buying, Display value and sales appeal as applied to garments, unique sales prepositions.	
	5d	Identify given consideration on given points.	5.4	General product characteristics, likely damages and protection needs. Functional considerations like unitization, containment, protection and preservation, communication, Tamper evidence etc.	
	5e	Evaluate the given garment packaging on given points.	5.5	Various packaging practices, containers and closures, materials used currently.	
VI: Packaging of Handicrafts and Fragile Articles	6a	Classify given handcrafrs on given points.	6.1	Handicrafts, Popular categories of handicrafts, handicraft trade, famous areas for making handicrafts in India, valuation of handicrafts, Market of handicrafts in India, Customer characteristics, modern marketing methods for handicrafts like catalogue marketing.	CO6
	6b	Identify the given characteristics of handcrafts on given points.	6.2	Characteristics of handicrafts: uniqueness, multiples, replicas, originals, materials, skills, ethnicity and culture etc, Materials of manufacture, general packaging characteristics of handicrafts as products, likely damages and protection needs.	
	6c	Identify the given considerations on given points.	6.3	Functional considerations for packaging of handicrafts, Packaging of handicrafts for domestic and exports market, packaging materials, Economic considerations of packaging against the product value.	

UNIT V	6d	Identiffy the given cushioning materials for avoiding given damages.	6.4	Fragile Articles, Definition and concept of fragility, examples of fragile articles, Methods of avoiding shock damages to fragile goods, Methods and Materials used for cushioning.	
	6e	Identify the given considerations for fragile articles.	6.5	Functions of fitments in packaging of fragile goods, Transport, handling and storage considerations.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Evaluate the cost-effectiveness and environmental impact of returnable chemical containers.	2#	CO1
I	2	Evaluate the performance of current packaging used for chemicals in terms of usability, safety and customer satisfaction.	2#	CO1
I	3	Identify legal requirements (International regulations) for hazardous and non-hazardous chemical packaging, codeing , labeling, marking, referencing standards like BIS, UN and EU.	2	CO1
II	4	Evaluate the product characteristics of paints and identify likely damages.	2	CO2
II	5	Evaluate materials like metal cans, plastic pails, and flexible pouches based on cost, durability, and suitability.	2#	CO2
II	6	Perform the examination of closure systems for paint containers and test their effectiveness and Identify the tamper-evident (TE) and pilfer-proof (PP) features in paint packaging.	2#	CO2
III	7	Evaluate the physical and physiochemical properties of cement and identify likely damages.	2#	CO3
III	8	Evaluate the packaging strategies addopted for protecting and preserving cement.	2#	CO3
IV	9	Investigate the physical and physiochemical properties of fertilizers and identify potential damages.	2#	CO4
IV	10	Identify the packaging trend for fertilizer for like solid, liquid and analyze emerging trends like eco-friendly packaging.	2#	CO4
V	11	Identify different customer segments (e.g., luxury, casual, functional wear) for garments and their packaging preferences.	2#	CO5
V	12	Identify the role of packaging in window shopping and impulse buying.	2#	CO5
V	13	Identify the materials used in garment packaging and evaluate the current pakaging system adopted for packaging of various types of garments.	2	CO5
VI	14	Evaluate the methods for avoiding shock damage to fragile goods.	2#	CO6
VI	15	Evaluate materials and methods used for cushioning fragile articles.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Perform case study by comparing materials like plastic, glass, and metal for industrial chemical packaging. Prepare a report comparing material suitability for various chemicals.
2. Investigate the importance of tamper-evident (TE) features in paint packaging. Prepare a report consisting conceptual design or a detailed analysis of TE features in existing products.
3. Explore the applications and economics of returnable containers for cement. Prepare a report on the feasibility and challenges of implementing returnable packaging.
4. Perform case study for cushioning and designing protective packaging for fragile items. Prepare a report on evaluation of a fragile packaging system.
5. Investigate how packaging influences consumer buying decisions in the garment industry. Prepare a report on it.
6. Evaluate current packaging practices for domestic and agricultural chemicals. prepare a report on report highlighting gaps and suggesting improvements.
7. Identify the modern packaging trends for exporting Indian handicrafts. Prepare a report on case study of a specific handicraft and its packaging for export.
8. Prepare a report on safety features integrated into paint packaging to prevent accidents.
9. Analyze functional requirements for cement packaging, including protection, communication, and dispensing. Prepare a report on detailed analysis of packaging features and improvements.
10. Explore global trends and sustainability in the packaging of fragile items. Prepare a report on sustainable practices and their adoption in fragile goods packaging.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Packaging of Chemicals and Dangerous Goods	8	C	2	4	6	12
			O	0	4	4	8
2	Packaging of Paints	8	C	2	4	6	12
			O	0	8	0	8
3	Packaging of Cement	7	C	2	4	4	10
			O	0	0	6	6
4	Packaging of Fertilizers	7	C	0	4	6	10
			O	2	4	0	6
5	Packaging of Garments and Accessories	7	C	4	4	4	12
			O	2	4	0	6
6	Packaging of Handicrafts and Fragile Articles	8	C	4	4	6	14
			O	0	0	6	6
Total		45	C	14	24	32	70
			O	4	20	16	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	6R2	6R2	4R2	5R2	5	7
2	5R4	1U4	2U4	1U4	2U4			3	5
3	3U4	4U4	5U4	2U4	4U4			3	5
4	6U4	3A4	5A4	5U4	1A4			3	5
5	1A6	2A6	3A6					2	3
6	4A6	6A6	6A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	3	-	3	-	3	3	3
CO2	3	-	3	-	3	-	3	3	3
CO3	3	-	3	-	3	-	3	3	3
CO4	3	-	3	-	3	-	3	3	3
CO5	3	-	3	-	3	-	3	3	3
CO6	3	-	3	-	3	-	3	3	3

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Handbook of Package Engineering	Joseph F. Hanlon, Robert j. Kelsey, Hallie e. Forcinio, CRC Press, Third Edition, 1998	10: 1566763061 13: 9781566763066
2	Fundamentals of Packaging Technology	Natarajan S. Govindarajan M. Kumar B., PHI Learning Pvt. Ltd, Second Edition, 2011	13: 9788120350540 10: 8120350545
3	Packaging of Chemicals and Other Industrial Liquids and Solids	Newnes-Butterworths, 1981	10: 0-408-00106-2
4	Chemical Packaging Guidelines	Institute of Packaging Professionals (IoPP)	13: 978-1-931877-33-3
5	The Wiley Encyclopedia of Packaging Technology	Kit L. Yam, John Wiley & Sons, Inc., 2009	13: 9780470087046

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2. http://www.epch.in/seminars/semi082.pdf, assessed on 09/09/2024
3. http://www.textilescommittee.nic.in/writereaddata/files/packaging.pdf, assessed on 12/09/2024
4. http://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/waste/guide_ref/files/chemw_e.pdf, assessed on 14/09/2024
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7. http://s1.q4cdn.com/259923520/files/doc_downloads/suppliers-terms/packing-standards/Packing-Guide-Cement-bags.pdf, assessed on 22/09/2024
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9. https://www.packagingconnections.com/blog-entry/4-types-fertilizer-packaging-bag.htm, assessed on 13/09/2024
10. https://www.allpackchina.com/fertilizer-packaging/, assessed on 13/09/2024

XVI List of Major Equipment/Machineries with Specification:

1. Analog Substance Indicator/GSM Tester
2. Bursting Strength Tester
3. Universal Testing Machine
4. Compression Tester- ECT/FCT/RCT etc
5. Electronic Thickness Gauge
6. Analog Puncture Strength Tester
7. Impact strength tester
8. Weighing machine
9. Drop tester
10. Vibration Jig Machine.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Anup P. Pardey	Sr. Lecturer, Paper technology	Government Polytechnic, Nagpur.
3	Mr. Subhash N. Madhugiri	Head of Department, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Lecturer in Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
5	Mr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
6	Mr. Prasad Balan Iyer	Director	SIES School of Packaging, Navi Mumbai – 400 705.
7	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.

(Mr. Syed Imran Ahmed K.)
HOD & Chairman PBOS, PK

(Dr. G. V. Gotmare)
Member Sectretary PBOS, PK

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	SEC
Course Code	:	PK351H
Course Title	:	Packaging Development

I Rationale:

Packaging is a large-scale operation, the economic aspects, including packaging economics and cost analysis, are essential components. Modifications in packaging design and the adoption of alternative packaging materials are key strategies for achieving cost efficiency and enhancing the value proposition within the packaging industry. This course is structured to provide an in-depth understanding of the economic considerations integral to the packaging process.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Design and develop economic packages for different products.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Analyze** the importance of economics in the packaging industry.

CO2: **Evaluate** the necessity of value engineering within the packaging sector.

CO3: **Evaluate** packaging cost factors including materials, efficiency, alternatives, and recycling importance.

CO4: **Design** and organize a material layout, and develop a plan for material requirements.

CO5: **Construct** a packaging model and predict the practical challenges that may arise during its manufacturing.

CO6: **Conduct** various tests to assess the performance and quality of the packaging.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	4	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	50	20	50+	20	-	-

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	**Phase 1: Product & Requirement Understanding;** Identify Packaging Requirements for a Product: Select a product and list packaging needs related to safety, logistics, marketing, and shelf life.	2#	CO1
I	2	Benchmark Existing Primary Packages: Collect and observe two existing primary packages for a similar product; note structure, materials, and usability.	2	CO1
I	3	Compare Two Primary Packages on Material Properties: Test parameters like GSM, thickness, bursting strength, and Cobb value using shared equipment; analyze results.	2#	CO1
I	4	Study Legal and Regulatory Labeling Requirements: Identify mandatory information (e.g., MRP, expiry, license numbers) for a selected product category and summarize.	2#	CO1
I	5	Design a Basic Label Using Packaging Software: Create a simple front label layout using CorelDRAW or similar, including brand, text, and legal declarations.	2#	CO1
II	6	**Phase 2: Material Study & Selection;** Evaluate Common Packaging Substrates: Study the properties and uses of paperboard, plastic films, aluminum foil, and laminates using sample swatches.	2#	CO2

II	7	Prepare Paper and Plastic Bags (Two Types Each): Fabricate two types of paper and two types of plastic bags; sketch their blank layouts and sealing method.	2#	CO2
II	8	Compare Flexible vs Rigid Packaging: Select a product and analyze pros and cons of using flexible vs rigid packaging in terms of cost, weight, and handling.	2#	CO2
II	9	Explore Cost-Effective Material Alternatives: Analyze an existing pack and suggest a cheaper or eco-friendlier alternative; justify with basic costing.	2#	CO2
II	10	Evaluate Environmental Impact of Packaging Materials: Rate materials used in a product's packaging based on recyclability, biodegradability, and sustainability.	2	CO2
III	11	**Phase 3: Costing & Value Engineering;** Calculate Basic Packaging Cost Per Unit for a selected package (e.g., bottle or carton), estimate cost based on material area, weight, and unit price.	2#	CO3
III	12	Break Down Packaging Cost Components: Create a pie chart showing cost share of materials, conversion, printing, wastage, and transportation.	2	CO3
III	13	Conduct Value Engineering Brainstorming: Apply value engineering by analyzing cost drivers in an existing package and proposing at least 3 improvements.	2#	CO3
III	14	Compare Folding Carton Layouts for Cost Efficiency: Draw and compare two blank layouts for the same-sized folding cartons; assess paper usage and waste.	2#	CO3
III	15	Compare Corrugated Box Styles by Cost and Strength: Evaluate two box styles (e.g., RSC vs HSC) for same volume; compare board usage, weight, and stacking suitability.	2#	CO3
IV	16	**Phase 4: Structural Design & Prototyping;** Draw and Assemble an RSC Corrugated Box: Create a full-size blank layout for an RSC box, then assemble a basic paperboard prototype.	2#	CO4
IV	17	Design a Specialty Carton for a Selected Product: Take measurements of a real product and design a custom carton with locking or display features.	2#	CO4
IV	18	Create a Dieline for Folding Carton or Label: Using drawing tools or software, design a dieline with clear cut, fold, and bleed lines.	2#	CO4

IV	19	Redesign Secondary Packaging for Space Optimization: Propose a revised outer pack or shipping container layout that reduces volume or increases pallet fit.	2	CO4
IV	20	Design a Tamper-Evident Pack Concept: Sketch a tamper-evident design and explain its mechanism and application for sensitive products.	2#	CO4
V	21	**Phase 5: Manufacturing Process & Quality:** Document Packaging Manufacturing Operations: For a selected pack, list production steps from raw material to finished pack (e.g., die-cutting, folding, sealing).	2#	CO5
V	22	Simulate a Packaging Line Layout for a Product: Create a simple flowchart showing filling, labeling, sealing, and cartoning stations.	2#	CO5
V	23	Perform Cobb and Bursting Strength Tests: In groups, conduct Cobb and bursting strength tests on paperboard samples; interpret data and application.	2#	CO5
V	24	Prepare a Packaging Specification Sheet: Fill a standard packaging spec format including dimensions, materials, tolerances, and finishing details.	2	CO5
VI	25	Conduct a Drop Test on a Sample Pack: Drop test a filled sample from a standard height; observe damage and suggest design improvements.	2#	CO6
VI	26	Design a Child-Resistant or Senior-Friendly Pack: Study two closures or formats and suggest an ergonomic, safe design for pharma or chemical packaging.	2#	CO6
VI	27	Create a Print Approval Checklist: Draft a checklist of quality checkpoints and artwork approval steps for a folding carton or label.	2#	CO6
VI	28	Compare Monolayer vs Multilayer Films: Observe and compare two film samples for barrier and mechanical properties; suggest use cases.	2#	CO6
VI	29	Develop a Mock POS (Point-of-Sale) Display: Assemble designed packs on a shelf/display and analyze visibility, appeal, and consumer interaction.	2	CO6
VI	30	Study Global vs Local Packaging Standards: Select an international and local package for same product; compare specs like labeling, tamper-proofing, and recyclability.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	10
2	Regular Lab Performance	10
3	Record/Journal Submission (Quality of work / Neatness)	10
4	Viva Voce (During Sessions)	10
5	Internal Practical Test (Mock)	10
	TOTAL	50

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	1	-	-	-	-	-	1	-
CO2	3	-	-	-	-	1	-	-	-
CO3	3	-	-	-	-	1	1	-	1
CO4	-	-	1	-	-	-	-	-	-
CO5	3	1	-	-	-	-	-	-	-
CO6	3	-	-	1	-	-	-	1	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Creating Value Through Packaging: Unlocking a New Business and Management	By Jim Peters, Brian Higgins, Michael Richmond, 2012	13: 978-1605950877
2	Value Engineering: Analysis and Methodology (Cost Engineering) Hardcover	Del Younker, CRC Press; 1 edition, 2003	13: 978-0824706968
3	Introduction to Packaging	F.A. Paine.	--
4	YCMOU, University Learning Material	MBA Curriculum, M.S. 5 Block	--
5	Learning Materials	IIP packaging volumes	--

XV e-References:

1. https://books.google.co.in/books?id=XmKTwbgpFI4C&printsec=frontcover&dq=books+value+engineering+packaging+economics&hl=en&sa=X&ved=0ahUKEwiOw4O096TPAhUG2mMKHZEcCRoQ6AEIQTAG#v=onepage&q&f=false Assessed on 13 Aug 2024.
2. https://books.google.co.in/books?id=Mtq_qunJIBMC&printsec=frontcover&dq=books+value+engineering+packaging+economics&hl=en&sa=X&ved=0ahUKEwiOw4O096TPAhUG2mMKHZEcCRoQ6AEIGzAA#v=onepage&q&f=false Assessed on 13 Aug 2024.
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4. https://www.bizongo.com/blog/packaging-design-development. Assessed on 13 Aug 2024.
5. https://www.ashokcharan.com/Marketing-Analytics/~pk-packaging-development.php#gsc.tab=0. Assessed on 13 Aug 2024.

XVI List of Major Equipment/Machineries with Specification:

1. GSM Tester
2. Bursting Strength Tester
3. Cobb Tester
4. Bursting Strength Tester
5. Box compression Testing Machine
6. Thickness Gauge.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
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4	Mr. Rajesh S. Raool	Lecturer in Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
5	Mr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali Mohd Zeeshan MSM	Asst. Professor	Anjuman College of Engineering, Nagpur

(Mr. Syed Imran Ahmed K)
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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	DIPLOMA IN AE/ME/PK/EC/MC/CM/IT/AI/MT/TX/EE
Course Category	:	INP
Course Code	:	IN301H
Course Title	:	Industrial Management

I Rationale:

Diploma level students works at middle management level in the industries.Therefore he has to be proficient in planning, organizing & coordinating various activities of industries s/ organizations or when he is required to work in different types of projects. They are also expected to deal with workforce and management problems. In the present era of competition, optimum utilization of the resources with achieving higher productivity is essential for any industry to survive. This course aims to deal effectively at superwisory level.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge of management.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Analyze** management concepts, organizational structures, functions, principles, and levels for effective decision-making.

CO2: **Analyze** financial sources, capital types, break-even point, and EOQ effectively.

CO3: **Apply** Human Resource Management functions, safety practices, supervision techniques, and industrial acts effectively.

CO4: **Determine** product costs, selling price, depreciation, and financial statements effectively.

CO5: **Apply** quality control techniques, TQM, and ISO standards to ensure quality management and improvement.

CO6: **Apply** the principle of project management, Project Planning and Scheduling.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	--	--	--	2	1

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	--	--	--	--	--	--

**Online Objective Types

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Management	1a	Campare the concept and principles of management.administration & form of ownership.	1.1	Definitions: Management, Organization, Administration and Entrepreneurship. Forms of ownership: Proprietorship, Partnership, Joint stock company.	CO1
	1b	Select suitable forms of ownership & its limitation	1.2	Co-operative sector, Public sector, Government Undertaking, Advantages, Limitations & Application of each type, comparison between different forms.	
	1c	Compare given types of organizations.	1.3	Types of Organization: Line, Functional, line & staff organization, Advantages, limitations & Applications of each type, comparison between different types.	
	1d	Apply the principles of management and functions of management.	1.4	Functions of Management: Forecasting, Planning, Organizing, Directing, Motivating, Controlling, Coordinating, Decision making.	

	1e	Apply the level of management.	1.5	Principles of management, Levels of management and its Function.	
UNIT II: Financial Management	2a	Select suitable finance mode for a given venture.	2.1	Need of Finance and Sources of finance for enterprises - Short term,Medium term and long term sources.	CO2
	2b	Compare the share and debentures on given factors.	2.2	Shares, debentures, types of shares and Comparison between shares & debentures.	
	2c	Calculate Economic Order Quantity (E.O.Q.) based on given data.	2.3	Break Even Analysis, Importance of Break even point, E.O.Q.(Numerical on EOQ).	
	2d	Identify the types of capital use for organisation.	2.4	Types of capital: fixed and working capital, fix deposites.	
UNIT III: Human Resource Management	3a	Apply the Human Resourses Management for organisation.	3.1	Concept, aim, & objectives of Human Resource Management.	CO3
	3b	Apply HRM functions to solve workplace human resource management problems.	3.2	Functions of HRM: planning, organizing, staffing, recruitment, education & training- its need, methods of training, Motivation, controlling,compensation, Labour welfare, Industrial relations.	
	3c	Apply the safety need, causes and its prevention in organisation.	3.3	Safety Engineering: need, organization, committee, programme, instructions & training. Accidents:causes & prevention.	
	3d	Justify the given charecterstic and function of management.	3.4	Characteristics of supervisors, functions of supervisors and styles of supervision & its advantages and limitations.	
	3e	Apply the purpose of the act .	3.5	Industrial act: Need, Factory act 1948, ESI act, Workmen compensation act only	

UNIT IV: Marketing and Inventory Management	4a	Select the Market and apply the Functions,Consumer behavior.	4.1	Definition of Market, Functions of Marketing Department, Marketing strategies, Marketing environment, Consumer behavior.	CO4
	4b	Apply marketing concepts for effective sales forecasting and promotional strategies.	4.2	Market research, Market survey,marketing mix.Sales forecasting, Sales promotion, advertising, media selection.	
	4c	Apply the inventory & inventory control in industries.	4.3	Definition of inventory & inventory control.Types of inventory items in industries, ABC and VED analysis only.	
	4d	Select the Material Cost, Labour Cost and Expenses in Factory	4.4	Product cost determination, Direct Cost and Indirect Cost, Material Cost And Labour Cost, Expenses-Factory and Overheads.Determination of Selling Price of product- Profit and Loss Statement,Balance sheet description.	
	4e	Estimate depreciation.	4.5	Depreciation &, Obsolescence-Concept and Comparison. Methods of Calculating depreciation straightline, reducing balance, annuity, sinking fund & sum of the digit methods. (Simple Numerical)	
UNIT V: Total Quality Management	5a	Apply the concept of quality control and Quality Assurance	5.1	Concept and definition of Quality, Quality Control, Quality Conformance and Quality Assurance	CO5
	5b	Apply the Total quality Management.	5.2	TQM- Concept, Objectives and Process.	
	5c	Suggest the Quality control techniques.	5.3	Quality control techniques: Lean Manufacturing -JIT, 5S”, Six sigma, Kaizen.	
	5d	Compare the Quality Circle and ISO on given points..	5.4	Quality Circle and ISO 9000, ISO14000, ISO 9001: 2015, ISO 14001:2015,	
	5e	Compare ISO and TQM on given points.	5.5	Difference between ISO9000 and TQM.	

UNIT VI: Introduction to Project Management	6a	Justify the Project Management.	6.1	Concept and Definition of Project Management.	CO6
	6b	Suggest the clear project objectives and its scope.	6.2	Project Objectives and its Scope.	
	6c	Apply the project objectives and scope align with project team and stakeholders.	6.3	Defining clear project objectives and scope to align the project team and stakeholders. Managing scope creep and ensuring the project delivers as per the defined scope.	
	6d	Identify the Project Planning.	6.4	Project Planning and ensuring the project delivers as per the defined scope.	
	6e	Select the Scheduling Techniques.	6.5	Introduction to scheduling tools like Gantt charts, Critical Path Method (CPM), and Program Evaluation and Review Technique (PERT). Methods to allocate resources efficiently and track project timelines.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)	Hours	Aligned COs

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Management	5	C	2	4	6	12
			O	0	0	0	0
2	Financial Management	6	C	2	4	8	14
			O	0	0	0	0
3	Human Resource Management	5	C	2	4	6	12
			O	0	0	0	0
4	Marketing and inventory management	6	C	2	4	6	12
			O	0	0	0	0
5	Total Quality Management	4	C	2	4	4	10
			O	0	0	0	0
6	Introduction to Project Management	4	C	2	4	4	10
			O	0	0	0	0
Total		30	C	12	24	34	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q 1 to Q 35	1R2	1U2	1U2	1A2	1A2	1A2	2R2	35/35	
	2U2	2U2	2A2	2A2	2A2	2A2	3R2		
	3U2	3U2	3A2	3A2	3A2	4R2	4U2		
	4U2	4A2	4A2	4A2	5R2	5U2	5U2		
	5A2	5A2	6R2	6U2	6U2	6A2	6A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

NIL

XII Scheme of Self-Learning Summative Assessment (SA):

NIL

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	--	--	--	--	--	3	--	--	--
CO2	--	--	--	--	--	3	---	--	--
CO3	--	--	--	--	--	3	--	--	--
CO4	--	--	--	--	--	3	--	--	--
CO5	--	--	--	--	1	3	--	--	--
CO6	--	--	--	--	--	3	--	--	--

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Industrial Engineering & Management	T.R.Banga & S.C.Sharma, Khanna Publishers,Edition-25,20142	10:81-7409-078-9 13:978-81-7409-078-9
2	Industrial Management	Dr.I.K.Chopde & A.M.Sheikh, S.Chand & Co. Ltd, Delhi, 2nd Edition, 1999	10:81-219-1480-9
3	Industrial Engineering And Management	O.P.Khanna, Dhanpat Rai, New Delhi,1980	10:81-885-9777-5
4	Industrial Engineering: Organization and Management.	Tara Chand, Nem Chand, 5th,1982	10:8185240302
5	Entrepreneurial Development.	S.S. Khanna, S. Chand & Co.Ltd,Delhi,1st,1999, reprint 2006.	10: 81-219-1801-4
6	Industrial Organization and Management	Lawrence L Bethel& James L Riggs, New York, McGraw-Hill,6th,1979	10: 09-322-3849-1

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2. https://www.youtube.com/watch?v=3VReVbsmjKI&ab_channel=NPTEL-
3. https://www.youtube.com/watch?v=2Ie9uH9ySpo&ab_channel=Management
4. youtube.com/watch?v=9QM-3LMeBQA accessed on 18th December 2024

XVI List of Major Equipment/Machineries with Specification:

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Shri.Anil R. Umale	HOD, Mechanical Engineering Shift I	Government Polytechnic, Nagpur
2	shri.A.A.Jagdale	HOD, Mechanical Engineering Shift II	Government Polytechnic, Nagpur
3	Shri.N.J.Burbure	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
4	Dr.Narendra Pawar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
5	Shri.G.H.Dahole	I/C HOD, Mechanical Engineering	Government Polytechnic, Gondia
6	Shri.G.F.Potbhare	Principal	NIT Polytechnic Nagpur
7	Shri.A.R.Shaikh	Director	A.R.Automation. Jafer Nager Nagpur

(Shri. Anil Umale)
HOD & Chairman PBOS, ME

(Dr. G. V. Gotmare)
Member Secretary PBOS, ME

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Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/AE/MT/ PK/TX/TR/AI/MK
Course Category	:	VEC
Course Code	:	VE351H
Course Title	:	Indian Constitution

I Rationale:

This course aims to equip students with practical skills and knowledge necessary for promoting constitutional morality in engineering practices and in society as a whole. The focus will be on hands-on activities, real-Indian applications, and practical projects that address key areas of Indian Constitution.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use constitutional provisions in society.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Narret** the history of Indian Constitution.

CO2: **Illustrate** the Phylosophy of Indian Constitution.

CO3: **Represent** the significance of fundamental rights and duties in day to day life.

CO4: **Demonstrate** the importance of directive principles of state policy in governance.

CO5: **Illustrate** the functioning of constitutional institutions like legislatice, executive, judiciary and media.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	2	-	2	1

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	25	10	25	10	-	-

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Prepare a report on history of making of Indian constitution including montague chelmsford reform, Govt. of India Act 1919, The Southborough Committee, The Simon Commission and Neharu Constitutional committee.	2#	CO1
I	2	Prepare a report on Round Table Conferences, 1935 Act, Cripps Mission 1942, Simla Conference 1945, Cabinet mission 1946, Interim Government 1946, The Indian Independence Act of 1947.	2	CO1
I	3	Prepare a report on parts, Total Articles, Total schedules of Indian Constitution and Total ammendments till date.	2#	CO1
I	4	Summerize Dr. B. R. Ambedkar's Speech in Constitution Assembly on 25th November 1949.	2#	CO1
II	5	Recite the preamble of the Indian Constitution at the time of starting of every assembly in laboratory / class room.	2#	CO2
II	6	Prepare a report on Phylosophy of preamble of Indian Constitution.	2#	CO2
II	7	Prepare a report by reading the definition, vision and importance of Indian Constitution.	2	CO2

II	8	Summerize the Article 1 of Indian Constitution.	2#	CO2
III	9	Prepare a report by reading the Fundamental rights mentioned in Indian Constitution.	2#	CO3
III	10	Prepare a report by reading the Fundamental duties mentioned in Indian Constitution.	2#	CO3
III	11	Prepare a report by reading Legal and Constitutional rights mentioned in Indian Constitution.	2	CO3
IV	12	Illustrate the meaning, importance and significance of Directive Principles of State Policy in Indian Constitution.	2#	CO4
IV	13	Summerize various institutions of Indian Constitution.	2#	CO4
IV	14	Prepare a report on Union and state legislature; Judiciary; Election Commission of India; Human Right Commissions.	2#	CO4
V	15	Prepare a report on the pillers of Indian Constitution and Constitutional morality.	2#	CO5
V	16	Prepare a report on the procedure of ammendment in Indian Constitution.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Prepare report / case study	5
2	Performance / Observation	10
3	Results and Discussions (if any)	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	-	-	3	3	-	-
CO2	-	-	-	-	3	3	3	-	-
CO3	-	-	-	-	3	3	3	-	-
CO4	-	-	-	-	3	3	3	-	-
CO5	-	-	-	-	3	3	3	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	The Constitution of India 2024 (English Version)	Legislative Department	
2	The Constitution of India (paperback)	Delhi Book Market	
3	Bhartache Samvidhan (Marathi)	Pradeep Gaikwad	
4	The Constitution of India	Dr. B. R. Ambedkar	13: 978-8119660384
5	The Constitution of India (Coat Pocket Edition)	Gopal Sankaranarayanan Eastern Book Company	13: 9788119868438

XV e-References:

1. https://legislative.gov.in/constitution-of-india/ assessed on 04th Nov. 2024
2. https://www.parliament.uk/about/living-heritage/evolutionofparliament/legislativescrutiny/parliament-and-empire/collections1/collections2/1947-indian-independence-act/ assessed on 04th Nov. 2024
3. https://www.studyiq.com/articles/interim-government/?srsltid=AfmBOoqqZCzRG7mpTcaj-IDxrBQY58Hdqgyb3dcD6UTbMtumyc_L1npm assessed on 04th Nov. 2024.
4. https://www.insightsonindia.com/modern-indian-history/freedom-to-partition-1939-1947/wavell-plan-and-simla-conference-1945/ assessed on 04th Nov.
5. https://www.drishtiias.com/mains-practice-question/question-314/pnt. assessed on 04th Nov. 2024
6. https://www.britannica.com/topic/Simon-Commission assessed on 04th Nov. 2024
7. https://en.wikipedia.org/wiki/Southborough_Franchise_Committee assessed on 04th Nov. 2024
8. https://www.drishtiias.com/to-the-points/paper1/government-of-india-act-1919 assessed on 04th Nov. 2024

XVI List of Major Equipment/Machineries with Specification:

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. D. K. Parbat	Head, Civil Engineering	Government Polytechnic, Nagpur
2	Dr. G. V. Gotmare	Head, Electrical Engineering	Government Polytechnic, Nagpur
3	Dr. B. R. Ambade	Lecturer, Civil Engineering	Government Polytechnic, Nagpur
4	Er. G. B. Takey	EE, Vigilance & Quality Control	PWD, Nagpur
5	Dr. Abhay Shende	Principal	J. L. Priyadarshini College of Engg, Nagpur.
6	Dr. V. G. Kondekar	Head, Civil Engineering	Government Polytechnic, Sakoli

(Dr. D. K. Parbat)
HOD & Chairman PBOS, CE

(Dr. G. V. Gotmare)
Member Sectretary PBOS, CE

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/AE/MT/PK/TX/MK/AI
Course Category	:	INP
Course Code	:	IN351H
Course Title	:	Internship (Seminar)

I Rationale:

The internship course is a critical component of the diploma program, providing students with hands-on experience in a real-world industry setting. The internship takes place after the fourth semester during summer vacation and involves working in a small, medium, or large-scale industry related to the student's field of study. The course is designed to bridge the gap between academic learning and industrial application, allowing students to apply theoretical knowledge in a practical environment. For ease, assessment this course is devided into two semester, semimar assessment in fifth semester and report writing in sixth semester.

The seminar presentation component of the internship course enables students to develop and refine their communication skills by presenting their internship experience to peers and faculty. This part of the course focuses on the student's ability to articulate the work they performed, the skills they acquired, and the knowledge they gained during their internship. It also emphasizes the importance of clear and effective communication, which is essential in the professional world.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Bridge theoretical knowledge with practical experience in a professional environment.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Evaluate** the organization's structure, processes, safety protocols, and industry standards to determine operational effectiveness.

CO2: **Apply** industry-specific tools, technologies, and skills to perform various operations.

CO3: **Contribute** to organizational goals by handling projects/ tasks under mentor guidance, applying learned skills.

CO4: **Analyze** technical challenges, addressing industry-specific issues effectively.

CO5: **Create** a structured presentation, ensuring accuracy and clarity.

CO6: **Deliver** presentation using visual aids and effective communication.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	2	10	12	6

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	-	-	25	10	50	20

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)	Topics and Sub-topics	Aligned Cos

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Learn the organization's structure, operational workflow, safety standards, industry practices, methodologies, technologies, and workplace processes to analyze operational efficiency and compliance requirements.	30#	CO1
II	2	Undergo training on industry-specific tools, technologies, and software, while gaining hands-on experience in performing basic operations, troubleshooting, and maintenance tasks, applying relevant skills to real-world industry scenarios and challenges.	60#	CO2
III	3	Participate in daily operations under mentor guidance, handling assigned projects or tasks aligned with industry needs, applying learned skills to contribute to organizational goals and gaining practical experience in real-world scenarios.	150#	CO3

IV	4	Identify and analyze technical challenges in industry, and address industry-specific issues (if any).	60#	CO4
V	5	Prepare a PowerPoint presentation on internship learnings, create and share a structured seminar outline, review technical documents, and practice presentations with peers to ensure accuracy, relevance, and logical flow.	20#	CO5
VI	6	Design slides with visual aids, practice body language, record and refine voice modulation, participate in mock Question & Answer sessions, and deliver the final presentation incorporating feedback for clarity and engagement.	10#	CO6

Note: # Compulsory. Unit No. I to IV during summer vacation in industry and Unit No. V and VI during Fifth Sem.

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. During the summer vacations, after the 4th Semester, students are required to undergo internship with industry/ NGO"s/ Government organizations/ Micro/ Small/ Medium enterprises to make ready for the industry.

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Preperation of Presentation	10
2	Presentation Skills	10
3	Question and Answers	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of industry	5
2	Work done and Feasibility of work	25
3	Daily diary and supervisor remark	10
4	Problem identification	10
	TOTAL	50

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	3	3	-	-
CO3	-	-	-	-	-	3	3	-	-
CO4	-	-	-	-	3	3	3	-	-
CO5	-	-	-	-	-	3	3	-	-
CO6	-	-	-	-	-	3	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Industrial Training and Education	Lokesh Choudhary, Mittal Publications, 2007	10: 8183242367 13: 9788183242363
2	Training Practice	Penny Hackett, McGraw-Hill Education, September 2003	10: 0852929803 13: 9780852929803
3	AICTE Internship Policy: Guidelines & Procedures	All India council of Technical Education New Delhi	-

XV e-References:

1. https://internship.aicte-india.org/ assessed on 23rd April 2024
2. https://www.coursera.org/articles/computer-science-internships assessed on 23rd April 2024

XVI List of Major Equipment/Machineries with Specification:

1. Desktop computers
2. Laser Printer
3. DLP

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. R. P. Mogre	Principal	Government Polytechnic, Nagpur
2	Dr. M. V. Sarode	HoD, Computer Engineering and I/C. Trainining & Placement Officer	Government Polytechnic, Nagpur
3	Dr. G. V. Gotmare	I/C. Curricullum Development Cell	Government Polytechnic, Nagpur

(Dr. M. V. Sarode)
HOD & Chairman PBOS, CM

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GE Courses

Sem: V

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COURSE CURRICULUM

Program	:	Diploma in ME/EE/EC/IT/MT/TX/AE/PK/CM/MK/AI
Course Category	:	GE
Course Code	:	CE391H
Course Title	:	Building Services

I Rationale:

This Course is designed for other programmes Students under NEP guidelines because it is necessary for the students to understand the basic principles of building services.Building services like water supply, sanitary services, rain water harvesting, elevators and fire protection systems form an essential part of every residential and commercial building. No building can be put into effective use without these services. Also now days the eco friendly design of these systems are on demand. It is necessary for the students to understand the basic principles of building services.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Manage effectively Various building services.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** various types of building services required

CO2: **Design** the various building services like water supply, Building drainage, rain water harvesting.

CO3: **Identify** types of tools and accessories required to design plumbing and sanitary services**.**

CO4: **Identify** various installation services like fire fighting extinguisher, elevators.

CO5: **Evaluate** green building criteria for sustainable building practices

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

** Online Objetive type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Building Services	1a	Identify given types of building services.	1.1	Definitions of building services, Objective and usesof services, Applications of services for different types building.	CO1
	1b	Select given building services for specific need.	1.2	Classification of building services, Types of services and selection of building services.	
	1c	Compare natural and mechanical ventilation on given points .	1.3	Distinguish natural and mechanical ventilation, Necessity of Ventilation, Types – Natural and Mechanical Factors to be considered in the design.	
	2a	Classify given types of systems.	2.1	Sanitary appurtenances - Classification of fixtures (ablution fixtures and Soil fixtures), bathroom accessories & fitting	

UNIT II: water & waste water	2b	Identify given type of fitting.	2.2	Building Drainage- General principles governing building drainage, Nature of drainage phenomenon, Various plumbing systems (one pipe,two pipe, single stack single tack partially ventilated and hybrid), Capacity and sizing of pipes (primary & secondary braches), Siphonic action & vent piping, Traps for appliances-Bottle trap, Nahani trap, Gulley trap, Air admittance valve, installation of pipes	CO2
	2c	Compare the various water recycling method.	2.3	Recycling of water- need & its usesses & types-storm water, Residential, Industrial & commecial, Grey water.	
	2d	Suggest the use of recycled water.	2.4	Environmental Benefits of recycled water, future of water	
	2e	Justify the concept of Zero Liquid Discharge (ZLD) in industrial plants.	2.5	Recycling of waste water need & uses ZLD – Concept of Zero Liquid Discharge for industrial plant.	
and Communication Services	3a	Identify the design considerations for pipe systems.	3.1	Introduction, Collection of runoff, pipe system, design consideration, Road surface runoff (open drain and close)	
	3b	Identify the given methods of rainwater disposal.	3.2	Disposal of rain water (surface and under ground rainharvesting) - Overview of rainwater management Importance of effective rainwater disposal Design principles for surface rainwater harvesting systemsComponents: collection surfaces, gutters, downspouts, and storage, Maintenance and cleaning of surface systems.	CO3

UNIT III: Rainwater	3c	Identify safety mechanisms commonly used in lifts.	3.3	Construction aspects of Lift, types of lifts, Overview of lift systems and theri importance in building design Basic principles of lift operation.	
	3d	Identify the essential features of a lift.	3.4	Essential features of a Lift (machine room equipment, lift well,lift pit, lift landing door,lift car), Electrical requirements, Preventive maintenance & legal formalities of elevators.	
UNIT IV: Fire Services	4a	Identify the various types of fire fighting system.	4.1	Systems of fire fighting –External (pillar and flush hydrants), Internal (residential and industrial), training topersonnel for service & maintenance and safety measures.	CO4
	4b	Identify the key provisions and updates of the latest.	4.2	Maharashtra fire Prevention and Life Safety Measures Act.	
	4c	Identify the compliance requirements for effective fire safety management.	4.3	Fire Audit -Purpose and importance of fire auditsTypes of fire audits (internal vs. external) , Fire Safety Regulations and Standards - Relevant local and national codes (e.g., NFPA, IS codes) Compliance requirements.	
ination & Ventilation	5a	Interpret the strategies to minimize noise through special treatments.	5.1	Recommendations to minimise noise, special treatments ceiling, wall, floor, sound insulation.	
	5b	Interprete the factors affecting illumination for effective lighting planning.	5.2	Recommended value of illumination, factors affecting illumination- sources of day lighting, siting of buildings, design & planning.	

UNIT V: Acoustics, Illum	5c	Evaluate the concept of green building.	5.3	Green Building- Concept, advantages & comparison of green building with normal building. Green Building Standards and Certifications LEED (Leadership in Energy and Environmental Design). Overview and certification. Acoustics and Noise, lightinging and levels, Key criteria and credits.	CO5

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the various Building Services required for the given Building.	2	CO1
II	2	Perform tests to check for leaks, water pressure.	2#	CO2
II	3	Design a basic plumbing system of water supply and distribution.	2#	CO2
II	4	Design a simple water supply system for a given building.	2#	CO2
II	5	Conduct Market Survey on varous pipes,pipe fitting & trap & write a report on that.	2#	CO2
III	6	Identify proper location for Lift/Escalator/elevator in commercial Complex.	2#	CO3
III	7	Analyze the Collected samples of storm water, residential grey water samples for various parameterssuch as pH, turbidity.	2#	CO3
III	8	Identify and examine the key components of lift systems, such as the lift car, hoistway, control panel,and drive mechanisms.	2#	CO3
III	9	Prepare Lift Standars as per norms.	2#	CO3
IV	10	Perform routine checks on fire extinguishers.	2#	CO4
IV	11	Perform safety measures associated with fire fighting systems.	2#	CO4
IV	12	Identify the LEED (Leadership in Energy and Environmental Design) certification process and criteria & write a report on it .	2#	CO4
V	13	Identify various methods of minimizing noise through sound insulation treatments for ceilings, walls, and floors & write a report on it .	2	CO5
V	14	Prepare a report of various sound insulation materials available in market.	2#	CO5
V	15	Suggest Noise Control Methods for Commercials.	2#	CO5

Note # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Building Services	2	C	02	02	02	6
			O	0	0	0	0
2	water & waste water	8	C	02	06	08	16
			O	0	0	0	0
3	Rainwater and Communication Services	8	C	02	06	10	18
			O	0	0	0	0
4	Fire Services	6	C	02	04	10	16
			O	0	0	0	0
5	Acoustics, Illumination & Ventilation	6	C	02	04	08	14
			O	0	0	0	0
Total		30	C	10	22	38	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q.1 To Q.35	1R2	1U2	1A2	2R2	2U2	2U2	2U2	35/35
	2A2	2A2	2A2	2A2	3R2	3U2	3U2	
	3U2	3A2	3A2	3A2	3A2	3A2	4R2	
	4U2	4U2	4A2	4A2	4A2	4A2	4A2	
	5R2	5U2	5U2	5A2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Prepare a report	5
2	Performance	10
3	Diagrams	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	1	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-
CO4	3	-	-	-	1	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Plumbing :Design & Practice	S.G. Deolalikar, Tata McGraW Hill Education Pvt. Ltd., 2004	10: 007462069X 13: 9780074620694
2	A Text Book on Building Services	R udaykumar, Eswar Press , 2007	
3	Building Construction: Design Aspects of Leakage and Seepage Free	Krishna Kant, Tata McGraw Hill Education Pvt. Ltd, 2001	10: 1259006069 13:9781259006067
4	National Building Code 2024	Bureau of Indian Standards	
5	Building Repair & maintainance Management	S.M.Patil, Standard Publisher,2009	13:9788175259805

XV e-References:

1. https://youtu.be/8jxRn-T_LCs?si=QuJGC60qQ5taDHbM, assessed on 30/12/2024
2. https://youtu.be/ktrv34zW7-A?si=2qpTHjevhxyAPPvq, assessed on 30/12/2024
3. https://youtu.be/27TUmzyL9DI?si=oRhRpiFfbjkHfou0, assessed on 30/12/2024

XVI List of Major Equipment/Machineries with Specification:

1. Model of a civil engineering structure depicting various components.
2. Chart showing detailing of lift, escalator and ramp.
3. Model of a civil engineering structure depicting various components of Solar
4. Model of a civil engineering structure depicting various components of Rain

XVII List of Industry Experts and Faculties who contributed for this curriculum:

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1	Dr.D.K.Parbat	HOD in Civil Engineering	Government Polytechnic, Nagpur
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GOVERNMENT POLYTECHNIC, NAGPUR
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Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/EE/EC/IT/MT/PK/CM/AE/TX/AI/MK
Course Category	:	GE
Course Code	:	ME391H
Course Title	:	Heat Engine Technology

I Rationale:

This course introduces the fundamentals of heat engines, including IC and SI engines, essential across various engineering fields. Students learn to analyze engine performance, aiding in operation, selection, and maintenance of power devices. Applicable in industries like automotive, energy, and manufacturing, this multidisciplinary knowledge supports collaboration among engineers from electrical, civil, and other domains, promoting efficient, sustainable, and practical engineering solutions in real-world applications.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Work with Internal combuction and spark ignition engines.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** I.C. engines and its auxiliaries.

CO2: **Identify** faults of SI Engine and its components and service the engine.

CO3: **Interpret** different system in CI Engine and its faults.

CO4: **Maintain** cooling and lubrication system of I C Engine.

CO5: **Test** the performance of I C Engine.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

** Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to IC engine	1a	Classify given type of engine depending on various parameters.	1.1	Classification of I.C. engines, Different parts of I.C. engines and their functions.	CO1
	1b	Illustrate applications of given IC engines.	1.2	Applications of I. C. engine, Basic engine terminology: (Bore, stroke, TDC, BDC, Clearance volume, Swept volume, Compression ratio, Piston speed and Cut off ratio).	
	1c	Analyse given thermodynamic power cycle.	1.3	Thermodynamic Power Cycles: Working of 4 stroke engines (Otto cycle, Diesel cycle), PV and TS diagram.	
	1d	Compare applications of 2- stroke SI and CI engine.	1.4	Working of 2-stroke engine, Advantages and Application of 2-stroke SI and CI engine.	
ngine	2a	Analyze the theoretical and actual valve timing diagrams for four-stroke S.I. engines.	2.1	Working and application of Two and Four stroke S.I. engine. Theoretical and Actual Valve timing diagram for four stroke SI engines.	

UNIT II: Spark Ignition Er	2b	Illustrate the concept of Octane Number including Research Octane Number (RON) and Motor Octane Number (MON).	2.2	Combustion in SI engines, Octane Number, Research Octane Number (RON) and Motor Octane Number (MON) Concepts of pre-ignition and detonation.	CO2
	2c	Justify the requirement of different A:F mixture requirement in different condition of running of SI engine.	2.3	Carburetion: Fuel supply system, Function of carburetor, Air-Fuel mixture and fuel requirements of S. I. engines., Concept of Simple carburetor and its drawback.	
UNIT III: Compression Ignition Engine	3a	Draw actual valve timing diagram for low speed 4-stroke diesel engine.	3.1	Working and application of Four stroke C.I. engine. Theoreticall and Actual Valve timing diagram for four stroke CI engines.	CO3
	3b	Identify given fuel injection system in CI engine.	3.2	Fuel injection: Function of fuel injection system, Types of fuel injection systems, CRDI concept, Combustion in CI engines, Importance of Cetane Number.	
	3c	Justify the need of electronic injection system.	3.3	Working of Fuel injector, Fuel pump -Bosch type only, Need of electronic injection system.	
	3d	Differentiate given engines on the basis of given points.	3.4	Comparison between S.I. and C.I. engine. Comparison between two stroke and four stroke engine.	
System	4a	Illustrate the need for cooling in an I.C.engine, including effects of heat on performance.	4.1	Cooling: - Pupose of Cooling of an I. C. engine, Effects of Cooling of IC engine, Types of cooling system and their selection as per the type of engine.	

UNIT IV: Cooling and Lubrication	4b	Compare Cooling systems on various factors.	4.2	Types of Water / liquid cooling (Thermo-syphon and Forced circulation of water), Application and advantages of forced water cooling system. Comparison between water and air cooling. Different types of coolants.	CO4
	4c	Evaluate the applications of splash, pressure, and charge lubrication systems in various engine configurations in automotive engines.	4.3	Need of lubrication in an I.C. engine. Functions of lubrication system. Types of lubrication system and its application, Splash, Pressure and Charge lubrication system, Lubricant additives and their function.	
UNIT V: Testing and Emission control	5a	Calculate IP for given 4-stroke petrol engine data.	5.1	I.C. Engine testing: Need of testing, I.P, B.P, BSFC, ISFC, mean effective pressure, compression ratio. Thermal and mechanical efficiency. Morse test.	CO5
	5b	Analyze the trade-offs between engine performance and emissions control when adjusting air-fuel ratio.	5.2	Types of pollutants in exhaust emissions of petrol and diesel engines, Effects of exhaust pollutants on environment, Effect of air – fuel ratio on exhaust emission.	
	5c	Illustrate the need for continuous improvement in auto industry.	5.3	Need of pollution norms for vehicles, Bharat stage V and VI norms, Table of pollutants emitted from petrol and diesel engines, including carbon monoxide (CO), nitrogen oxides (NOx), hydrocarbons (HC), and particulate matter (PM) for LMV and HMV.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Inspect 2- stroke engine and identify its different parts.	2#	CO1
I	2	Inspect 2-stroke S.I. engine, note down its complete specification.	2#	CO1
I	3	Inspect 4- stroke S.I. engine locate its various parts.	2#	CO1
I	4	Inspect 4- stroke C.I. engine, identify its various parts.	2#	CO1
II	5	Perform basic maintenance tasks on a S.I. engine, such as checking and changing spark plugs, air filter, oil filter and oil.	2#	CO2
II	6	Perform troubleshooting of a carburetor.	2#	CO2
II	7	Service and inspect the given carburetor.	2	CO2
II	8	Test and diagnose ignition system components, such as spark plugs and ignition coils.	2#	CO2
III	9	Troubleshoot common issues related to the operation of a four-stroke CI / SI engine and apply appropriate solutions.	2#	CO3
III	10	Identify and label different types of fuel injection systems installed on CI engines.	2	CO3
IV	11	Inspect components of different types of cooling systems to understand their construction and function.	2#	CO4
IV	12	Identify function and interconnections and also observe the distribution of lubricant to different engine components on working model.	2#	CO4
V	13	Conduct engine tests in a laboratory environment and Identify the importance of engine testing in evaluating and optimizing engine performance and efficiency.	2#	CO5
V	14	Identify types of pollutants emitted from petrol and diesel engines, including carbon monoxide (CO), nitrogen oxides (NOx), hydrocarbons (HC), and particulate matter (PM).	2	CO5
V	15	Examine the evolution of emission standards, such as Bharat Stage V and VI norms, and their role in addressing environmental challenges.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to IC engine	5	C	04	04	04	12
			O	00	00	00	0
2	Spark Ignition Engine	7	C	04	06	06	16
			O	00	00	00	0
3	Compression Ignition Engine	7	C	04	06	06	16
			O	00	00	00	0
4	Cooling and Lubrication System	5	C	02	04	06	12
			O	00	00	00	0
5	Testing and Emission control	6	C	02	04	08	14
			O	00	00	00	0
Total		30	C	16	24	30	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q 1 to Q 35	1R2	1R2	1U2	1U2	1A2	1A2	2R2	35/35	
	2R2	2U2	2U2	2U2	2A2	2A2	2A2		
	3R2	3R2	3U2	3U2	3U2	3A2	3A2		
	3A2	4R2	4U2	4U2	4A2	4A2	4A2		
	5R2	5U2	5U2	5A2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Prepare experimental set up/Draw Line diagram for experiment	5
2	Performance and measuring different parameters/Collection of Data	10
3	Calculation, Result, Drawing Graphs (if any)/Drawing different sketches	5
4	Viva Voce/Answer to simple questions and submitting report in time	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	2	-	2	-	-
CO5	3	-	-	3	2	-	2	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Internal Combustion Engine	R. P. Sharma, Dhanpat Rai Publication, 2010	13: 9788189928469
2	A Course in Internal Combustion Engine (SI Units)	V.M. Domkundwar, Dhanpat Rai & Co. Ltd. Publication, Fourth edition, 2014	13: 978-81-7700-116-7
3	Internal Combustion Engine	V. Ganeshan, Mcgraw Hill Education, 4th Edition, 2012	13: 9781259006197 10: 1259006190
4	Internal Combustion Engine	H. B. Keswani, Standard Book, 4th Edition, 2003	10: 81900893511
5	IC Engines Combustion and Emissions	Pundir B. P.Narosa Publishing House, New Delhi, 2010	13: 978-8184870879
6	A Textbook of Internal Combustion Engines	Rajput R.K. Laxmi Publications; Third edition, New Delhi, 2016	13: 978-8131800669

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1. https://www.youtube.com/watch?v=pqa4zCo4erY , assessed on 23rd August, 2016
2. https://www.youtube.com/watch?v=s2WGFELXPNg assessed on 23rd August, 2016
3. automobiletechinfo.blogspot.com/.../dtsi-digital-twin-spark-ignition-system.html assessed on 23rd August, 2016
4. https://www.youtube.com/watch?v=H2J0lSTYVhQ assessed on 23rd August, 2016
5. https://www.youtube.com/watch?v=H2J0lSTYVhQ assessed on 23rd August, 2016
6. www.cpcb.nic.in/Vehicular_Exhaust.php assessed on 23rd August, 2016
7. https://jalopnik.com/how-variable-valve-timing-works-500056093
8. https://www.araiindia.com/pdf/Indian_Emission_Regulation__Booklet.pdf

XVI List of Major Equipment/Machineries with Specification:

1. Test rig of four stroke petrol/ diesel engine.
2. Test rig on two stage reciprocating air compressor. Pressure and temperature gauges at suitable locations with manometer. Minimum ½ HP compressor
3. Working Model of fuel pump, injector & carburetor.
4. Working Model of S.I. / C.I. engine, Lubrication system and cooling system.
5. Demonstration Model & chart of cooling, lubrication & fuel supply system of I. C. engine
6. Exhaust gas analyzer 3/5 gas analyzer.
7. Single cylinder IC engine suitable for assembly/ dismantling with necessary tool set. (Engine complying latest Euro Norms)
8. Multi cylinder IC engine suitable for assembly/ dismantling with necessary tool set. (Engine complying latest Euro Norms)
9. Test rig on multi cylinder IC engine. 3/5/7 HP petrol engine with required accessories.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Prof. A. R. Umale	HOD Mechanical Engineering (Section A)	Government Polytechnic, Nagpur
2	Prof. A. A. Jagdale	HOD Mechanical Engineering (Section B)	Government Polytechnic, Nagpur
3	Prof. N. J. Burbure	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
4	Prof. G. H. Dahole	I/C HOD Mechanical Engineering	Government Polytechnic, Gondia
5	Prof. G. F. Potbhare	Principal	NIT Polytechnic, Nagpur
6	Prof. A. R. Sheikh	Director	A. R. Automation, Jafar Nagar, Nagpur
7	Prof. S. R. Kaduskar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
8	Prof. S.H.S. Patel	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EC/PK/AI/CM/IT/PK/MT/TX/AE
Course Category	:	GE
Course Code	:	EE391H
Course Title	:	Electrical Wiring and Estimation

I Rationale:

This course equips learners with essential skills in wiring and estimation of electrical installation projects. Students will understand basic concept of wiring, Layout, installation plans and calculation of material required also they are aware about current market rates. This course emphasizing hands-on experience and safety standards. It prepares future electrical technicians and supervisors for field demands, ensuring they are well-equipped to execute new installation projects effectively.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Prepare electrical estimates of electrical installations.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** various wiring tools, components and safety devices while undertaking any electrical work.

CO2: **Build** Various Wiring layouts.

CO3: **Prepare** documents of Quotations, Tenders and Contract

CO4: **Estimate** the cost and material required for residential and commercial electrical installation.

CO5: **Estimate** the cost and material required for industrial electrical installation.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
: Wiring tools, components and safety devices	1a	Identify the function of given electrical wiring tools.	1.1	Tools used in Electrical Wiring and its functions:Pliers and its types, Cutter, Screw driver, Tester, Test lamp, Crimping tool, Continuity tester, Electrician knife, Wire Gauge, Insulation remover.	CO1
	1b	Identify the function of given components used in electrical wiring system with their specification.	1.2	Different Components used in wiring systems and its function along with specifications: Various types of switches, Plugs, Sockets, DBs, MCBs, MCCBs, RCCBs, RCBs, Holders, Wires, Cables.	
	1c	Select the given safety accessories used in electrical wiring.	1.3	Significance of Electrical Safety, Electrical Safety Accessories such as Hand gloves, Helmet, Safety Shoes, Goggles, Rubber mats. Various types of fire extinguishing techniques.	

UNIT I	1d	Select the given type of earthing for given installation.	1.4	Earthing: Need of Earthing, Types of earthing such as Rod, Pipe and Plate. Earth resistance values for various installations as per IEEE standards. Measurement of earth resistance by Earth tester.	
UNIT II: Electrical Wiring Circuit system	2a	Identify wires based on colour codes.	2.1	Differentiation between wires and cables based on structure, Flexibility, Durability, Strength, Application and cost. Various sizes of wire and cable according to current carrying capacity. Colour coding of wire and cable in AC & DC system as per IS 732.	CO2
	2b	Identify given types of wiring system.	2.2	Different types of electrical Wiring systems - Surface conduit, concealed conduit, PVC casing capping with their application.	
	2c	Identify the given symbols used in electrical drawing.	2.3	Terminoloigy of electrical wiring drawing: Wiring Layout, Wiring Diagram, Single line diagram and Installation Plan. Different Symbols used in electrical wiring drawing.	
	2d	Implement the different wiring Layout as per the given functional requirements.	2.4	Different wiring Layout: 1. One lamp control from one place. 2. One lamp, one fan & one tube light control from switch on board. 3. Staircase Wiring Layout. 4. Go-down wiring Layout. 5. Bell Circuit. List various components and accessories used in above wiring system.	

UNIT III: Estimate, Contract, Tender and Quatation	3a	Justify the need of given type of estimates.	3.1	Need of estimation, Qualities of good estimator, Essential elements of Estimation. Meaning and purpose of- Rough Estimate, Detailed Estimate, Supplementary Estimate, Annual maintenance Estimate and Revised Estimate. Factors to be considered while preparing estimate.	CO3
	3b	Identify the role and qualities of good contractor.	3.2	Concepts of contract and their types, Contractor and their role, Qualities of good Contractor.	
	3c	Prepare the tender documents for given requirement.	3.3	Concept of Contract and their types, Tender Notice, Preparation of Tender document and method of opening of tender. Concept of Quotation and its different formats. Comparison between Tender and quotation. Comparative statement, format of comparative statement. Order format, Placing of purchasing order. Principles of execution of works, Planning, Organizing and completion of Work. Billing of Work.	
	4a	Interpret given civil engineering building drawing.	4.1	Residential Installation: Necessity and reading of Civil Engineering Building Drawing. General requirements and Inspection of Electrical installation according to IS: 732. Guidelines on design and construction of wiring installations as per part I section 9 of NEC- 2011.	

Γ IV: Residential and Commercial Installation	4b	Compare industrial and non-industrial Installation on the basis of given criteria.	4.2	Compare industrial and non-industrial Installation on the basis of purpose, load capacity, design complexity, voltage level, Safety, wiring system, Equipment & Components, Cost.	
	4c	Estimate material required for given Residential installation on the basis of given data.	4.3	Rules related to lighting load followed in electrical installation: 1. Positioning of equipment-Importance of plan and layouts. 2. Principles of circuit design in Lighting and power circuits- a) Light and fan circuit b) Power circuit. 3. Load calculation and selection of size of conductor- a) Load assessment b) Selection of size of conductor. 4. Selection of rating of main switch and protective switchgear. 5. Calculation of length of wire and other materials. 6. Calculation of labour cost. Sequence to be followed for preparing estimate.	CO4

UNIT	4d	Estimate material required for given Commercial installation.	4.4	1. Design consideration of electrical installation in commercial buildings. 2. Calculate number of luminaries according to recommended values of illumination. 3. Calculate total load, deciding number of sub-circuits, Deciding size and rating of switch board and distribution boards, deciding size of cables. Deciding size of conduits, Bus bar and bus bar chamber. 4. The Mounting arrangement of switch board & distribution board. 5. Calculation of length of wire and other materials. 6. Preparation of material schedule - Calculation of labour cost, Estimation and costing of unit.	
UNIT V: Industrial Installation	5a	Interpret the given electrical Drawing of industrial installation.	5.1	Design consideration of industrial installations. Types of Industrial Installation. General characteristics of industrial building. Selection of wiring system. Drawing of wiring diagram and single line diagram for single phase and three phase motors.	
	5b	Determine the different quantities for given industrial load.	5.2	Calculation of total load, Selection and rating of wire & cable size, main switch, fuses, distribution board, bus-bar, cable route, motor starter, earthing wire & earthing. Calculation of length of wire and other Materials. Preparation of material Schedule, Calculation of labour cost, Estimation and costing of unit.	CO5

5c	Identify the different application of IOT (Internet of things) in Building Installation	5.3	Concept of IOT in electrical installation. The application of IOT in Building Installation: 1. Smart Lighting System 2. Smart heatung , ventilation & air conditioner system. 3. Energy Management System. 4. Smart Security & Surveillance. 5. Smart Parking System.

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Use different types of wiring tools such as Combination Pliers, Nose Pliers, Cutter, Screwdriver, Continuity tester, Test Lamp, Crimping tools, Electrician tester and knife.	2#	CO1
I	2	Use different types of wiring equipment such as Switches, Sockets, Plugs, DB, MCBs, RCBs, ELCBs, Holders, Wires, and Cables.	2#	CO1
I	3	Identify the use of different electrical accessories such as Hand gloves, Helmet, Boots, Goggles, Rubber mats.	2#	CO1
II	4	Build a circuit to control one lamp from one place and test the wiring for phase control on wiring board.	2#	CO2
II	5	Build a circuit to control two lamps from two places independently on wiring board using conduit wiring.	2#	CO2
II	6	Build a circuit to control one lamp from two place using two way switches on wiring board using casing capping wiring.	2#	CO2
II	7	Build a circuit to control Bell circuit used in residential installation.	2#	CO2
II	8	Prepare a installation plan and layout diagram of one room consist of Light, ceiling fan, socket. (Assume suitable parameters)	2#	CO2
III	9	Prepare a quotation of electrical material required for wiring 1 BHK house.	2#	CO3
III	10	Prepare a contract document for the supply and installation of electrical installation of 1 BHK house.	2#	CO3
IV	11	Estimate the cost of material for a one room residential electrical installation.	2#	CO4
IV	12	Prepare the Bill of material for a small commercial installation (e.g. Book depot / Grossary shop) from installation plan. (Part - I)	2#	CO4
IV	13	Prepare the Bill of material for a small commercial installation (e.g. Book depot / Grossary shop) from installation plan. (Part - II)	2#	CO4
V	14	Prepare the estimate cost of material for a floor mill. (Part - I)	2#	CO5
V	15	Prepare the estimate cost of material for a floor mill. (Part - II)	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Wiring tools, components and safety devices	4	C	04	04	02	10
			O	00	00	00	00
2	Electrical Wiring Circuit system	5	C	04	04	04	12
			O	00	00	00	00
3	Estimate, Contract, Tender and Quatation	5	C	02	06	08	16
			O	00	00	00	00
4	Residential and Commercial Installation	8	C	02	06	08	16
			O	00	00	00	00
5	Industrial Installation	8	C	02	06	08	16
			O	00	00	00	00
Total		30	C	14	26	30	70
			O	00	00	00	00

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q.1 to Q.35	1R2	1R2	1U2	1U2	1A2	2R2	2R2	35/35
	2U2	2U2	2A2	2A2	3R2	3U2	3U2	
	3U2	3A2	3A2	3A2	3A2	4R2	4U2	
	4U2	4U2	4A2	4A2	4A2	4A2	5R2	
	5U2	5U2	5U2	5A2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Draw a circuit diagram, Equipment Selection	5
2	Performance	10
3	Calculation and Result	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	1	-	-	1	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	2	-	-	2	-	-	-	-
CO5	3	2	-	-	2	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Text Book on laboratory courses in Electrical Engineering	S.G.Tarnekar and P.K.Kharbanda, S.Chand & Company Ltd., Third, 1990.	13: 978-8121901048
2	Electrical Wiring Estimating & Costing	N.Allagappan, S.Ekambarram, Tata Mc-Graw Hill Publishing Co.Ltd, First Edition, 2010	13: 978-0074624784
3	Engineering Workshop Practice on Electrical & Electronics Engineering	Ms. J. Glory Priyadharshini, Dr.K. Sheela Sobana Rani, Ms. M.Prabha Maheswari & Ms. S.Gomathy, Notion Press, 1st Edition, 2021	13: 978-1639203819
4	Electrical Design Estimating and Costing	K.B. Raina, Dr.S. K.Bhattacharya, New Age International Publisher, First, Reprint 2010	13: 978-8122403633
5	A Course in Electrical Installation Estimating and Costing	J. B. Gupta, S.K. Kataria & Sons Publisher, January 2013	13: 978-9350142790

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1. https://en.wikipedia.org/wiki/Electrical_wiring, assessed on 10th Aug 2024
2. https://www.thespruce.com/electrical-wiring-1152909, assessed on 12th Aug 2024
3. https://www.vedantu.com/physics/types-of-wiring, assessed on 12th Aug 2024
4. https://www.turito.com/blog/physics/types-of-wiring, assessed on 12th Aug 2024
5. https://www.youtube.com/watch?v=syaGf_XUMxA, assessed on 18th Aug 2024
6. https://electricalinstallationservices.co.uk/what-is-an-electrical-installation, assessed on 24th Aug 2024
7. https://www.electrical-installation.org/enwiki/Main_Page, assessed on 31st Aug 2024
8. https://electricalindustry.ca/latest-articles/2694-iot-and-its-application-in-electrical-power-systems-part-1/

XVI List of Major Equipment/Machineries with Specification:

1. Crimping Tools: Handheld, suitable for terminal lugs, 0.5mm² to 6mm²
2. Wires and Cables: 1.5mm² to 6mm² copper conductor, PVC-insulated, 90°C-rated.
3. Digital Multimeter AC: 200mV to 750V, DC: 200mV to 1000V, Resistance Measurement: 200Ω to 20MΩ
4. Standard Wire guage Range: SWG 1 to 36
5. Pump: 1.5HP single-phase.
6. Motors: 10HP and 5HP three-phase, starter panels, and cables.
7. Megger 500V, 1000V, 0.01MΩ to 2000MΩ.
8. Earthing: GI earth rod, 1.5m.
9. Wiring Board: Plywood, predrilled for mounting components.
10. Earth Tester- Analog or digital, 0.01Ω to 2000Ω, 20V or 50V

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. M. C. Musale	I/c HOD, Electrical Engg.	Government Polytechnic, Nagpur
2	Dr. P. M. Daigavane	HOD, Electrical Engg.	G. H. Raisoni College of Engg. Nagpur
3	Mrs. Divya Piparode	Sr. Engineer	Powergrid Corporation of India Ltd. Nagpur
4	Mr. M. N. Gawande	Lecturer, Electrical Engg.	Government Polytechnic, Gondia
5	Mr. B. D. Wadhai	Lecturer, Electrical Engg.	Government Polytechnic, Nagpur

(Mr. M. C. Musale)
HOD & Chairman PBOS, EE

(Dr. G. V. Gotmare)
Member Secretary PBOS, EE

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/CM/IT/PK/AI/MT/MC/AE/TX
Course Category	:	GE
Course Code	:	EC391H
Course Title	:	Microcontroller and Applications

I Rationale:

Microcontrollers are essential for embedding intelligence into various devices, offering the ultimate flexibility for controlling and automating tasks. They are used in applications ranging from consumer electronics to industrial systems, enabling precise control, real-time processing, and efficient resource management. This makes them ideal for diverse uses such as home automation, medical devices, and automotive systems.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Develop microcontrollers program for various applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Interpret** features of various versions of 8051 microcontrollers.

CO2: **Interpret** features of advance microcontrollers.

CO3: **Design** sketch in Arduino IDE.

CO4: **Design** Arduino based applications.

CO5: **Develop** IoT based System.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Microcontrollers	1a	Identify given elements of Microcomputer.	1.1	Evolution of Microcontrollers, Block diagram of Microcomputer, elements of Microcomputer, types of buses	CO1
	1b	Identify given Architecture on given points.	1.2	Comparison of Microprocessor and Microcontrollers	
	1c	Select versions of Microcontroller for specified application.	1.3	Need of Microcontroller, Family of 8051 Microcontrollers and their specifications, Versions of Microcontroller 89C51, 89C1051, 89C2051, 89C4051	
ed System Basics and Microcontrollers	2a	Identify given Components of Embedded System.	2.1	Introduction to embedded systems, Block diagram of the components of embedded system hardware, Advantages and applications of embedded systems, Difference between Embedded Systems and General computing systems.	CO2

UNIT II: Embedd Advance M	2b	Identify Features of given Advance Microcontrollers.	2.2	Features of 89C51, PIC, AVR, ARM Microcontrollers with their applications. Comparison between 89C51, PIC, AVR and ARM	
	2c	Identify Function of given pins of ATMega328.	2.3	Features of ATMega328 Pin Diagram of ATMega328	
UNIT III: Open Source Development Board (Arduino)	3a	Identify given Components of Arduino UNO R3	3.1	Arduino : Introduction to Open Source Prototype Platform Types of Arduino Boards Features of Arduino UNO R3 Components of Arduino UNO R3 Functions of each Pin of Arduino UNO R3	CO3
	3b	Choose Arduino Variables and Structure.	3.2	Embedded C Programming: Introduction to Arduino Functions(I/O only), Variables(Constants, Data Types only) and Structure	
	3c	Suggest Arduino Sketch of Blinking Inbuild LED	3.3	Installation of Arduino IDE Sketch of Blinking Inbuild LED in Arduino IDE	
UNIT IV: Interfacing of Input and Output Devices with Arduino	4a	Choose Arduino based system with LED, Relay, Switch.	4.1	Interfacing with LED, Interfacing with Relay, Interfacing with Switch.	CO4
	4b	Choose Arduino based system with Seven Segment Display, LCD.	4.2	Interfacing with Seven Segment Display, Interfacing with LCD.	
	4c	Choose Arduino based system with 4x4 Keyboard.	4.3	Interfacing with 4x4 Keyboard.	
	4d	Choose Arduino based system with Stepper Motor.	4.4	Interfacing with Stepper Motor.	
	4e	Choose Arduino based system with IR Sensors, Buzzer.	4.5	Interfacing with IR Sensors, Interfacing with Buzzer.	

UNIT V: Introduction to Internet of Things (IoT)	5a	Interpret Features of IoT.	5.1	Introduction to IoT (Internet of Things): Features of IoT, Advantages and Disadvantages of (IoT), Embedded Devices (System) in (IoT), IoT Architecture Applications of IoT	CO5
	5b	Identify given IoT Devices.	5.2	Introduction of IoT Devices: Major IoT Boards in Market(Raspberry Pi, Arduino, ESP8266, Sense HAT 8x8 RGB LED matrix, Bluetooth Module HC-05	
	5c	Suggest IoT System for Controlling home light using WiFi Node MCU(ESP8266) and Relay module.	5.3	IoT Platforms: ThingWorx, Thingspeak, blynk, Controlling home light using WiFi Node MCU(ESP8266) and Relay module	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Interpret Blocks of 89C51 microcontroller using Datasheet.	2	CO1
II	2	Interpret Blocks of ATMega328 microcontroller using Datasheet.	2#	CO2
III	3	Interpret Blocks of Arduino UNO R3 using Datasheet.	2#	CO3
III	4	Install Arduino IDE in Windows OS.	2#	CO3
III	5	Design Arduino Sketch for Blinking Inbuild LED connected to pin 13.	2#	CO3
IV	6	Develop and execute Arduino sketch to read the status of key from port pin and turn ON/OFF a LED connected to another port of Arduino UNO R3.	2#	CO4
IV	7	Design Arduino based system to interface Seven Segment Display with Arduino UNO R3 and display the numeric value 0 to 9.	2#	CO4
IV	8	Design Arduino based system to interface LCD with Arduino UNO R3 and display the string "G. P. Nagpur".	2#	CO4
IV	9	Design Arduino based system to interface 4x4 keyboard with Arduino UNO R3 and display the key pressed.	2	CO4
IV	10	Design Arduino based system to interface stepper motor with Arduino UNO R3 and rotate it in clockwise and anti-clockwise direction.	2#	CO4
IV	11	Design Arduino based system to interface buzzer with Arduino UNO R3.	2#	CO4
IV	12	Design Arduino based system to interface IR sensor module with Arduino UNO R3 and blink led/buzzer on object detection.	2#	CO4
V	13	Interpret Blocks of Raspberry Pi 4 Model using Datasheet.	2	CO5
V	14	Interpret Blocks of Node MCU(ESP8266) using Datasheet.	2#	CO5
V	15	Develop Embedded C Program for IoT System for Controlling home light using WiFi Node MCU(ESP8266) and Relay module.	4#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Microcontrollers	2	C	02	04	00	6
			O	0	0	0	0
2	Embedded System Basics and Advance Microcontrollers	2	C	02	06	00	8
			O	0	0	0	0
3	Open Source Development Board (Arduino)	8	C	02	06	08	16
			O	0	0	0	0
4	Interfacing of Input and Output Devices with Arduino	12	C	06	10	08	24
			O	0	0	0	0
5	Introduction to Internet of Things (IoT)	6	C	04	06	06	16
			O	0	0	0	0
Total		30	C	16	32	22	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q 1 to Q 35	1R2	1U2	1U2	2R2	2U2	2U2	2U2	35/35
	3R2	3U2	3U2	3U2	3A2	3A2	3A2	
	3A2	4R2	4R2	4R2	4U2	4U2	4U2	
	4U2	4U2	4A2	4A2	4A2	4A2	5R2	
	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Devlopment of Program	5
2	Performance	10
3	Execution Process and outcome	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	1	-	-	-	-
CO2	3	-	-	-	1	-	-	-	-
CO3	3	-	3	3	-	3	3	-	-
CO4	3	-	3	3	-	3	3	-	-
CO5	3	-	3	3	-	3	3	-	-
CO6	-	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	The 8051 Microcontroller and Embedded Systems Using Assembly And C	Muhammad Ali Mazidi, Pearson Education, Asia 2007, second edition	10: 8131710262, 13: 9788131710265
2	Architecture, Programming and Design	Raj Kamal, Tata McGraw-Hill Education, 2nd Edition2011	13: 978-0-070-66764-8
3	Exploring Arduino: Tools and Techniques for Engineering Wizardry	Jeremy Blum, Wiley, 2013	13: 978-1-118-54936-0
4	Beginning Arduino	Michael McRobetrs, Apress, 2nd Edition 2013	13: 978-1430250166
5	Beginning Arduino Programming	Brian Evans, Apress, 1st Edition 2011	13: 978-1430237778
6	Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects)	Kindle Edition	13: 978-1449393571

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1. https://docs.arduino.cc/language-reference/#functions, accessed on 06th September2024
2. https://docs.arduino.cc/language-reference/#variables, accessed on 06th September2024
3. https://docs.arduino.cc/language-reference/#structure, accessed on 06th September2024
4. https://www.javatpoint.com/iot-internet-of-things, accessed on 06th September2024
5. https://thingspeak.com, accessed on 06th September2024
6. https://blynk.io, accessed on 06th September2024

XVI List of Major Equipment/Machineries with Specification:

1. Pentium III Desktop Computer.
2. Arduino UNO R3 Development Board.
3. Node MCU(ESP8266)
4. General Peripherals Breaddboard, LED, Key, Buzzer,LCD, 4x4 keyboard, IR sensor module, Stepper motor

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. R. V. Yenkar	HOD, Electronics & Telecomm. Engg.	Government Polytechnic, Nagpur
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3	Mr. S. D. Ambade	Lecturer, Electronics & Telecomm., Engg	Government Polytechnic, Nagpur
4	Ms. P. P. Rodge	Lecturer, Electronics & Telecomm., Engg	Government Polytechnic, Nagpur
5	Mr. Sandeep V. Darwhekar	Director	Beta Computronics Pvt. Ltd. Nagpur
6	Dr. V. J. Dongre	HOD, Electronics & Telecomm., Engg.	Government Polytechnic, Arvi
7	Prof. Mrs. Gazala Ali	HOD, Electronics & Telecomm., Engg.	Anjuman Polytechnic, Nagpur

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Member Secretary PBOS, EC

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Government of Maharashtra
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/PK/MT/AE/TX/MK
Course Category	:	GE
Course Code	:	IT391H
Course Title	:	Cyber Security and Privacy

I Rationale:

The rise in internet usage has led to an increase in cybercrimes and illegal activities online. It's crucial to understand various cybercrimes and the importance of cybersecurity to protect personal, governmental, and organizational data and systems. Additionally, understanding cyber laws is essential to address crimes in cyberspace, ensuring legal protection against online fraud, hacking, and other malicious activities. Strong cybersecurity measures and legal frameworks are key to safeguarding the digital world.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use the techniques of cyber security.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** different types of cyber organized crime

CO2: **Analyze** the planning, risk events and concept of cyber attacks

CO3: **Identify** types of Cybercrimes related with mobile and wireless Devices

CO4: **Analyze** the conceptual foundation of cyber security awareness

CO5: **Identify** importance of Cyber Laws

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Cybercrime	1a	Justify given term of cyber crime.	1.1	Cyber Crime: Definitions, An origin of the Word, cybercrime and information security	CO1
	1b	Identify criminals, with given cyber crimes.	1.2	Criminals in cybercrime, Classification of cyber-crimes; cyber defamation, internet time theft	
	1c	Identify a type of cybercrime done in given statements.	1.3	Hacking, online fraud, software piracy, password sniffing, Identity theft	
UNIT II: Planning of Cyber Attacks	2a	Justify given term.	2.1	CIA traid, Data protection, Security terminologies	CO2
	2b	Identify type of cyber-attacks in given scenario.	2.2	Attacks: passive and active attacks, Five phases of hacking:Reconnaissance, scanning, gaining - access, maintaining-access, clearing tracks	
	2c	Select from given statements, that showing cyber stalking.	2.3	cyber stalking: types of stalkers, stalking of cyber stalking, Real life incidents of cyber stalking	

UNIT III: Cybercrime: Mobile/Wireless devices	3a	Identify type/technique used for given cyber crime scenarios.	3.1	Credit card/debit card fraud in mobile and wireless computing era- types and technique of credit card fraud.	CO3
	3b	Justfy given android security.	3.2	Android security: Media player control security, networking API security for mobile devices, hardware and software security.	
	3c	Identify causes for given Cyber attack related with application and software security.	3.3	Applications and software security:Mobile viruses, Securities from mobile computing applications, hacking Bluetooth mobile devices.	
UNIT IV: Cybercrimes and need for Cyber - Security	4a	Analyze givenonline cybercrime.	4.1	Online Scams: Charity scam, lottery Scam, Fake offer/fake job scam	CO4
	4b	Analyse given type of Cyber threats.	4.2	Cyber threats: Types of Cyber threats,The legal Scenario and perspectives - Introduction, cybercrime and the legal base for cybercrime around world, Importance and need cyber laws.	
	4c	Identify given Recovery methodology.	4.3	Data privacy, Back-up and Recovery methodologies	
UNIT V: Cyber Laws and Way forward	5a	Identify importance of given feature of IT Act 2000.	5.1	Cyber laws in INDIA:IT ACT-2000, Positive aspects of IT ACT 2000, Weak areas in IT ACT 2000	CO5
	5b	Analyse Amendmends in IT ACT.	5.2	Amendments In cyber laws:changes made in IT ACT, State Government's power Impacted by amendment in IT ACT	
	5c	Identify required punishment for given Cybercrime.	5.3	Punishment: cybercrime and punishment, Information technology and students (Technology and students: An Indian scenario)	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Check the network speed of your internet connection in computer LAB.	2#	CO1
I	2	Enable and disable network also check the data acceptance in network.	2#	CO1
II	3	Tackle and handle externally delivered web-link considering cyber-attack. (http & https)	2#	CO2
II	4	Take back-up and restore data using online platform. (Google drive, etc.)	2#	CO2
II	5	Check and configure IP settings on your PC. (Manual and Automatic).	2#	CO2
III	6	Clear and delete browsing history & unnecessary cache memory on your system.	2#	CO3
III	7	Identify and Configure network settings on your mobile devices.	2	CO3
III	8	Create a standard regulated high security password for social media or any other important transactions platform.	2#	CO3
III	9	Make hardware settings to share data on another device. (e.g:-Whenever connecting a cell phone to PC)	2#	CO3
IV	10	Configure settings related with permissions for downloading foreign applications on your mobile devices.	2#	CO4
IV	11	Perform a secure file sharing between two devices.	2	CO4
IV	12	Identify and configure web application settings for safe browsing.	2#	CO4
IV	13	Identify pattern and configure File sharing using various social media platform on your mobile device	2#	CO4
IV	14	Analyse and install antivirus on your computer system	2	CO4
V	15	Identify suitable cyber law performing stealing of data using file sharing	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Cybercrime	6	C	02	04	00	6
			O	0	0	0	0
2	Planning of Cyber Attacks	6	C	02	06	00	8
			O	0	0	0	0
3	Cybercrime: Mobile/Wireless devices	6	C	02	06	08	16
			O	0	0	0	0
4	Cybercrimes and need for Cyber - Security	6	C	06	10	08	24
			O	0	0	0	0
5	Cyber Laws and Way forward	6	C	04	06	06	16
			O	0	0	0	0
Total		30	C	16	32	22	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q. 1 to Q. 35	1R2	1U2	1U2	2R2	2U2	2U2	2U2	35/35
	3R2	3U2	3U2	3U2	3A2	3A2	3A2	
	3A2	4R2	4R2	4R2	4U2	4U2	4U2	
	4U2	4U2	4A2	4A2	4A2	4A2	5R2	
	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing diagram/flowchart,	5
2	Performance	10
3	Use of techniques ,design, guidelines, principles, Process in execution	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	-	-	3	-	3	-	-
CO2	3	3	-	-	3	-	3	-	-
CO3	3	3	-	-	3	-	3	-	-
CO4	3	3	-	-	3	-	3	-	-
CO5	3	-	-	-	3	-	3	-	-
CO6	3	-	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	"Cyber Security" - Understanding Cybercrime, Computer forensic and legal perspective	Nina Godbole, Sunil Belapure, Wiley India Pvt. Ltd Reprint,2018	13:9788126521791
2	"Cyber security Managing systems-Conducting, Testing and Investigating Intrusion"	Thomas J. Mowbray, Wiley India Pvt. Ltd Reprint,2018	10:8121924405
3	Network Security Essentials: Applications and Standards	A William Stallings, Pearson Educaiton	13:9788131716649
4	Network Security and Management	Brijendra Sing, PHI, 2nd edition	13:9788120339101

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2. https://onlinecourses.swayam2.ac.in/cec20_cs09/preview assesed on 20 aug 2024
3. https://www.youtube.com/watch?v=chtp9UaVBMk&ab_channel=MYSWAYAM assesed on 20 aug 2024

XVI List of Major Equipment/Machineries with Specification:

1. Computer System
2. C Editor
3. linux operating system
4. Networking devices router, switch

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
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Member Secretary PBOS, IT

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma CE/ME/EE/EC/PK/IT/CM/MK/AI/AE/TR/TX
Course Category	:	GE
Course Code	:	MT391H
Course Title	:	Heat Treatment

I Rationale:

Heat treatment is crucial in metallurgical engineering for enhancing material properties such as strength, hardness, and toughness. It allows precise control over microstructures, tailoring materials to specific industrial needs. Understanding heat treatment equips students with essential problem-solving skills, ensuring quality control and effective failure analysis. This knowledge is vital for various industries, including automotive, aerospace, and construction, opening diverse career opportunities. Integrating heat treatment into the diploma curriculum ensures students are well-prepared for the challenges and demands of the metallurgical engineering field.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Carry out different heat treatment processes on steel to obtain desired properties.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Interpret** Fe-Fe3C diagram.

CO2: **Use** TTT Diagrams for different heat treatments.

CO3: **Find** Hardenability of steel using different methods.

CO4: **Recommend** proper heat treatment process to steels for given applications.

CO5: **Select** proper case hardening method for given applications.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Iron- Carbon Equilibrium Diagram	1a	Identify reactions in Fe-Fe3C Diagram.	1.1	Allotropic transformation of iron, Reactions in Iron- Carbon diagram, various phases in Fe-Fe3C diagram.	CO1
	1b	Choose critical temperatures from Fe-F3C diagram.	1.2	Critical temperatures in Iron-carbon diagram.	
	1c	Classify steel and cast iron based on iron carbon diagram.	1.3	Classifications of plain carbon steel and cast irons with reference to iron carbon diagram.	
	1d	Identify microstructures of different steels and cast irons.	1.4	Microstructure and properties of plain carbon steels and cast iron with reference to iron carbon diagram.	
II: Principles of Heat Treatment	2a	Analyse heat treatment parameters.	2.1	Role and importance of heat treatment in the industry, safety preacutions in heat treatment shop. heat treatment parameters. Heat treatment cycles.	CO2
	2b	Compare different transformation mechanism based on different points.	2.2	Austenitization: mechanism of formation of Austenite, Pearlitic and Martensitic Transformation.	

UNIT I	2c	Use TTT Diagram for heat treatment.	2.3	T.T.T. diagram, construction of T.T.T. diagram from transformation curves, applications of TT Diagram	
UNIT III: Hardenability of steel	3a	Compare hardness with Hardenability based on given points	3.1	Hardenability - Concept of hardenabilty, factors affecting Hardenability. Hardness vs Hardenability.	CO3
	3b	Compare various Hardenability methods based on given points.	3.2	Determination of Hardenability of steel by Grossman method, Jominy end quench test.	
	3c	Select proper quenchants for given heat treatment.	3.3	Quenchant- Severity of quenchant, types and characteristics quenching mediums.	
UNIT IV: Heat treatment Processes	4a	Find heating temperature for various heat treatment processes.	4.1	Heating of steel- Heating time and temperature.	CO4
	4b	Compare different annealing processes on given points.	4.2	Annealing treatments : Purpose of Annealing, full annealing, partial annealing, diffusion annealing, isothermal annealing.Spheroidizing of steel.	
	4c	Identify normalised structure.	4.3	Normalizing – purposes, microstructural changes and its applications.	
	4d	Find hardening temperature for given steel.	4.4	Hardening: - Purpose of hardening selection of hardening temp. - Methods of quenching,Tempering - purpose of tempering - stages in tempering.	
V: Surface Hardening	5a	Compare different case hardeninmg methods.	5.1	Case hardening of steel - carburizing. Nitriding.	CO5
	5b	Select proper case hardening method.	5.2	Surface hardening of steel: Induction hardening - principle, equipments and steels used,Flame hardening- principle, equipments and steels used.	

UNIT	5c	Suggest remedies for different heat treatment defects.	5.3	General Heat Treatment defects, causes and remedies.

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Perform assignments based on Fe- Fe3c diagram.	2#	CO1
I	2	Carry microstructure analysis of steels and cast irons using Fe-Fe3C diagram.	2#	CO1
I	3	Carry microstructure analysis of steels and cast irons using Fe-Fe3C diagram. (Part II)	2	CO1
III	4	Determine hardenability of steel by Jominy End Quenched test.(Part II)	2#	CO3
III	5	Determine hardenability of steel by Jominy End Quenched test.(Part II)	2#	CO3
IV	6	Perform Annealing on steel. (Part I)	2#	CO4
IV	7	Perform Annealing on steel. (Part II)	2#	CO4
IV	8	Perform Normalizing on steel. (Part I)	2#	CO4
IV	9	Perform Normalizing on steel. (Part II)	2#	CO4
IV	10	Perform Hardening on steel with varying hardening temperatures to analyze effect of temperatures on hardness. (Part I)	2#	CO4
IV	11	Perform Hardening on steel with varying hardening temperatures to analyze effect of temperatures on hardness. (Part II)	2#	CO4
IV	12	Perform tempering on hardened steel at different temperatures. (Part I)	2#	CO4
IV	13	Perform tempering on hardened steel at different temperatures. (Part II)	2	CO4
V	14	Perform any one surface treatment process (carburizing, flame hardening) of steel. (Part I)	2#	CO5
V	15	Perform any one surface treatment process (carburizing, flame hardening) of steel. (Part II)	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Iron- Carbon Equilibrium Diagram	2	C	02	04	04	10
			O	0	0	0	0
2	Principles of Heat Treatment	2	C	02	04	06	12
			O	0	0	0	0
3	Hardenability of steel	8	C	02	04	08	14
			O	0	0	0	0
4	Heat treatment Processes	12	C	06	08	08	22
			O	0	0	0	0
5	Surface Hardening	6	C	02	04	06	12
			O	0	0	0	0
6			C				
			O				
Total		30	C	14	24	32	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
1	1R2	1U2	1U2	2R2	2U2	2U2	2U2	35/35
2	3R2	3U2	3U2	3U2	3A2	3A2	3A2	
3	3A2	4R2	4R2	4R2	4U2	4U2	4U2	
4	4U2	4U2	4A2	4A2	4A2	4A2	5R2	
5	5R2	5U2	5U2	5U2	5A2	5A2	5A2	
6								

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Performance /report writing/submission	15
2	Vivo vice	10
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	3	-	-
CO2	3	-	-	-	3	-	3	-	-
CO3	3	2	2	2	3	-	3	-	-
CO4	3	-	-	-	3	-	3	-	-
CO5	3	2	2	2	3	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Introduction to Physical Metallurgy	Sidney H. Avner, McGraw-Hill International Edition, 2nd Edition, 1964	13:81-20300716-X
2	Material science & Metallurgy for engineers	V.D.Kodgire, S.V.Kodgire, Everest Publishing House, first Edition ,2011	10:8186314008 13:9788186314005
3	Physical Metallurgy for Engineers	Donald S. Clark , W.R. Varney, Van Nostrand Reinhold Company; 2nd Revised Edition, December 1962	10: 0442015704 13: 978-0442015701
4	Engineering Physical Metallurgy	Y. Lakhtin , CBS Publisher, 1st Edition, 2005	13:9788123906027 10:8123906021
5	Heat Treatment: Principles and Techniques	T.V.Rajan, C.P.Sharma, Ashok Kumar Sharma, Prentice Hall Of India. 2nd Edition 1994	13:978-81-203-4095-4

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2. https://www.youtube.com/watch?v=3_BH6HqpPtk , assessed on 16th March 2024
3. https://www.youtube.com/watch?v=eHFI-xuZIiQ, assessed 16 March 2024
4. http://www.engmatl.com/index.php?start=6, assessed on 16 March 2024
5. http://downloadingisnotsin.net/material-science-and-metallurgy-by-kodgire-pdf-free-download/, assessed on 22 March 2024

XVI List of Major Equipment/Machineries with Specification:

1. Standard Fe-Fe3C equilibrium diagram
2. Muffle furnace- max temperature 10000c
3. Grinder- double ended
4. Polishing machine
5. Image analyzer
6. Microscope- magnification 100X
7. Emery papers
8. Flame hardening set up
9. Safety equipments and accessories
10. Hardness tester- Rockwell c scale

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Shri.K.L. Meshram	HOD, Metallurgical Engineering	Government Polytechnic, Nagpur
2	Miss.V.C. Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
3	Shri. Y.Y. Mahajan	Assist. Professor , Metallurgy & Material	VNIT , Nagpur

(Mr. K. L. Meshram)
HOD & Chairman PBOS, MT

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(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/IT/MT/PK/CM/AE/AI/MK
Course Category	:	GE
Course Code	:	TX391H
Course Title	:	Garment and Fashion Technology

I Rationale:

This courseis designed for the students of other than Textile Deprtment. The Garment and Fashion Technology course equips students with the skills to design, produce and innovate garments using cutting edge technologies. Students master pattern making garment construction, textile science and fashion entrepreneurship. This fusion of creativity, technical expertise, and industry awareness prepares students for careers in fashion design, product development, and apparel manufacturing, driving innovation, sustainability, and excellence in the global fashion industry.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Manage fashion trends and apply on garments.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Suggest** the theories of fashion.

CO2: **Identify** the factors for clothing selection.

CO3: **Draft** a pattern for a garment.

CO4: **Use** cutting machine to cut the fabric.

CO5: **Use** sewing machine to stitch garment.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Fashion	1a	Select the given fashion terminologies.	1.1	Objective of Fashion. Basic fashion terminologies- Types of Fashion-Classic: Fad, Couture, Haute Couture, Label, Ensemble, Silhouette, Off-the-Rack	CO1
	1b	Identify the factors for given clothing selection	1.2	Fashion StyLe -Casual, Office Wear, Sports Wear, Classic, Exotic, Street, Vintage. Factors affecting textiles and clothing selection. Fashion cycle-Stages of fashion	
UNIT II: Fashion Design- Elements and Principles	2a	Apply elements of fashion design to make given garment.	2.1	Elements of Fashion Design - Line, Form, Shape, Texture and Colour.	CO2
	2b	Select the given principless of fashion.	2.2	Principles of fashion design- Balance, Proportion, Emphasis or Centre of Attraction, Rhythm, Harmony or Unity	

UNIT III: Garment - Marker planning and Pattern drafting	3a	Identify process flow chart for given Garment manufacturing	3.1	Importance of Garment industry. Process flow chart of Garment manufacturing. Principle of Garment Pattern drafting. Rules of Garment Pattern grading	CO3
	3b	Identify the pattern for given garment construction.	3.2	Draw Eight head theory, Planning, drawing and reproducing the marker. Marker planning, Methods of marker planning and Efficiency of marker plan.	
UNIT IV: Spreading and Cutting	4a	Classify the given fabric spreading methods.	4.1	Nature of fabric packages. Objective of spreading, Requirements of Fabric spreading process and methods of spreading	CO4
	4b	Use the given cutting devices.	4.2	Objectives of cutting process. Methods of cutting Manual and computerized. Types of cutting devices Straight knife, Round knie and Band knif.	
UNIT V: Sewing Machines	5a	Identify the given type of seam.	5.1	Objectives of sewing.Types of seams-Class 1: superimposed seam, Class 2: lapped seam, Class 3: bound seam, Class 4: flat seam.	CO5
	5b	Compare the given stitches on the given parameters.	5.2	Stitch types-Class 100 chainstitches, Class 200 hand stitches, Class 300 lockstitches and Class 400 multi-thread chain stitches	
	5c	Use sewing machine to stitch given garment.	5.3	Functions of sewing machine, Types of sewing machine, Parts of sewing machine and feed mechanism of sewing machine.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Draw and describe the different terminolgies of fashion.	02#	CO1
I	2	Draw and describe the different terminologies of fashion.	02#	CO1
I	3	Sketch any two styles of fashion.	02#	CO1
II	4	Sketch the different elements of fashion.	02#	CO2
II	5	Sketch the different principles of fashion design.	02#	CO2
III	6	Draw the flow chart of garment Industry.	02#	CO3
III	7	Draw pattern grading of any garment.	2	CO3
III	8	Use proper marker planning to improve efficiency of marker	2	CO3
IV	9	Use manual spreading technique to spread the fabric roll.	02#	CO4
IV	10	Use straight knife to cut the marked parts of garments.	02#	CO4
IV	11	Use round knife to cut the marked parts of garments.	2	CO4
V	12	Draw different types of seams and also practice on fabric.	02#	CO5
V	13	Draw different types of stitches and also practice on fabric.	02#	CO5
V	14	Use sewing machine to make to stitch the garment.	02#	CO5
V	15	Prepare any microproject based on garment and fashion designing.(Part I)	02#	CO5
V	16	Prepare any microproject based on garment and fashion designing.(Part II)	02#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Fashion	4	C	2	4	4	10
			O	0	0	0	0
2	Fashion Design- Elements and Principles	8	C	4	6	8	18
			O	0	0	0	0
3	Garment- Marker planning and pattern drafting	4	C	2	4	4	10
			O	0	0	0	0
4	Spreading and Cutting	6	C	2	6	6	14
			O	0	0	0	0
5	Sewing Machines	8	C	4	6	8	18
			O	0	0	0	0
Total		30	C	14	26	30	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q.1 TO Q.35	1R2	1U2	1U2	1A2	1A2	2R2	2R2	35/35	
	2U2	2U2	2U2	2A2	2A2	2A2	2A2		
	3R2	3U2	3U2	3A2	3A2	4R2	4U2		
	4U2	4U2	4A2	4A2	4A2	5R2	5R2		
	5U2	5U2	5U2	5A2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Draw neat sketches and working procedure.	10
2	Identify the functions of important parts.	5
3	Calculation	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	3	-	-
CO4	3	-	-	2	-	-	3	-	-
CO5	3	-	-	2	-	-	3	-	-
CO6	3	-	-	2	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Handbook of Garment Manufacturing Technology	Eiri Board, Engineers India Research Instt, 2003	10: 8189765027
2	Garment Manufacturing: Processes, Practices and Technology	Prasanta Sarkar, Online Clothing Study, 2015	13: 9789383701759
3	Garment Manufacturing Technology	D Nayak and R Padhye, Woodhead Publishing, 2015	13: 978-1-78242-232-7
4	The Technology of Clothing Manufacture	Carr and Latham, Blackwell Science Ltd. Second Edition, 1994	10: 6-632-03748-2
5	Apparel Manufacturing Technology	T Karthik, T.Ganeshanan, CRC press -2017	13: 978-1-4987-6375-2
6	The Complete Book of Fashion History	Jana Sedlackova,Walter foster Jr	13: 9781633221833
7	Fashion Design: The Complete Guide	John Hopkins,Ava Pub Sa; 2nd edition	13: 978-1350116573

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2. www.onlineclothingstudy.com/2013/05/what-is-marker-marker-making-marker.html assessed on 25th may 2024.
3. https://garmentsmerchandising.com/key-purposes-of-fabric-spreading/assessed on 25th may 2024.
4. http://www.fibre2fashion.com/industry-article/free-apparel-industry-article/4assessed on 25th may 2024.
5. textileflowchart.com/2014/12/flow-chart-of-garment-manufacturing-technology.html 4assessed on 25th may 2024.

XVI List of Major Equipment/Machineries with Specification:

1. Spreading table
2. Scissor
3. Staright knife
4. Sewing machine
5. Corel Draw and Adobe Photoshop Software

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr C.P.Kapse	I/C HOD Textile Manufacture	Government Polytechnic, Nagpur
2	Dr S.G.Gaikwad	Selection Grade Lecturer, Textile Manufacture	Government Polytechnic, Nagpur
3	Prof L.S.Chakraborty	Lecturer, Textile Manufacture	Government Polytechnic, Nagpur
4	Mr Laxminarayan Kaushik	Director	LLP Professionals, Nagpur
5	Prof. Harshal Ramteke	HOD Textile Technology	SASMIRA, Mumbai
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7	Prof.S.S.Lawand	Selection Grade Lecturer Textile Manufacture	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in AE
Course Category	:	GE
Course Code	:	AE391H
Course Title	:	Four Wheeler Technology

I Rationale:

This course is designed for the students who are studying diploma other than Automobile Engineering. This course equips students with a solid foundation in understanding the transformative impact of technology on the automotive sector. This course provides an overview of the four wheeler technology. By exploring recent trends, technological innovations, and emission regulations, students gain a holistic perspective essential for pursuing careers in automotive engineering and related fields. Key technologies covered include Automobile body technology, advancement in IC engines, Electric Vehicles (EVs), HVAC systems, Electronic Stability Control (ESC), Advanced safety and comfort systems along with On Board Diagnosis (OBD).

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the Knowledge of advanced technology in four wheelers.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** the Vehicle bodies and select relevant body materials for better performance.

CO2: **Select** suitable advanced engine technology as per the requirements.

CO3: **Select** suitable HVAC systems keeping in mind the environmental and ethical aspects.

CO4: **Identify** the advanced accessories regarding passenger safety and comfort in the given vehicles.

CO5: **Diagnose** problems related with automotive systems and subsystems with the help of OBD.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

** Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Automobile Body Engineering	1a	Identify the body type of given vehicles.	1.1	Introduction to automobile bodies. Definition of body, terminology of a body, specifications of various vehicle body and comparison. Types of bodies and body construction.	CO1
	1b	Suggest the suitable materials for given parts of vehicular body.	1.2	Automobile body materials, fabrication and accidental repairs. Body Accessories and its functions.	
	1c	Justify, the effect of given parameters on performance of vehicle.	1.3	Streamlining shape of a vehicle body and its effects. Resistance faced by the vehicle Air resistance, rolling resistance, gradient resistance and Tractive resistance. Traction and Tractive efforts. Pitching, Bouncing, Rolling, Sway and Yaw.	
	1d	Justify the Protective and anticorrosive treatments of given vehicle with suitable reasons.	1.4	Protective and anticorrosive treatments, painting and repainting procedure.	

UNIT II: Advances in Automobile Engines and Electric Vehicles	2a	Compare MPFI engines with conventional engines on the basis of given parameters.	2.1	MPFI Engines: Drawbacks of Carbureted (SI) engines. Throttle body injection (TBI) and Port fuel injection (PFI) systems. Sensors and Actuators of MPFI engine.	CO2
	2b	Identify the components of given fuel injection system and write their functions.	2.2	CRDI Engines: Features of CRDI Engines, Major Components. Block diagram of CRDI. CRDI System operation and advantages.	
	2c	Justify the effect of given technology on the milage and performance of the engines.	2.3	Variable Geometric Turbocharger (VGT). Variable Valve timing mechanism (VVT). Gasoline Direct Injection (GDI) and Stratified - charge injection.	
	2d	Compare given emission control technology on the basis of given criteria.	2.4	Emission control: Exhaust - Gas recirculation (EGR)- EGR valve and control system. Positive crankcase ventilation (PCV) system. Evaporation emission control system.	
	2e	Compare given types of batteries used in EVs based on given points.	2.5	Electric Vehicles (EVs): Introduction to electric vehicles system, propulsion systems and charging infrastructure. Layout of Electric vehicles. Battery: Types of battery (Lithium ion battery, Battery Characteristics, Battery Management System (BSM)- operation Electric Motor: Types, components, functions and applications.	
Air Conditioning	3a	Justify the environmental and safety aspects of using HVAC system.	3.1	Environmental and safety aspects in car HVAC system. Fundamentals of Refrigeration and air conditioning. Description of vapour compression cycle.	

UNIT III: Car Heating, Ventilation and A (HVAC)	3b	Identify the components of given HVAC systems.	3.2	Components of Car Air Conditioning system. Layout and operation of HVAC. Heating and Ventilation system.	CO3
	3c	Compare the given properties for a given refrigerants.	3.3	Human comfort conditions. Type of refrigerants used in car air conditioning and their properties.	
	3d	Describe thecontrol of temperature and humidity inside the vehicles with justification.	3.4	Refrigerant Charging process for car AC system. Temperature control system, humidity control systems.	
UNIT IV: Advanced Automotive Accessories and Safety Devices	4a	Justify the purpose of given advanced automotive asseccories.	4.1	Purpose and Operation of advanced accessories: Keyless entry system, Common anti-theft system, Automatic door lock system. Park assists system.	CO4
	4b	Distinguish between given navigation systems.	4.2	Automatic headlight dimming. Automatic on/off headlight with time delay. Navigation systems: GPS, GPRS.	
	4c	Compare between different antidazzle devices on the basis of given points.	4.3	Construction and working of Sealed beam headlight. Control of headlight beam, headlight dazzle, Antidazzle devices.	
	4d	Compare between different safety devices on the basis of given points.	4.4	Safety devices – Air Bags, Seat Belt, Central locking, Collapsible steering, ABS and Electronic stability control systems.	
nponents and Systems	5a	Interpret the results of given type of sensor tests.	5.1	Construction, working and Testing of following sensors: Oxygen sensor, Engine coolant sensor, Intake air temperature sensor, Throttle position sensor, Manifold absolute pressure sensor. Vehicle Speed sensor, Mass airflow sensor, Knock sensor, crank shaft position sensor.	

UNIT V: Diagnosis of Automobile Cor	5b	Interpret the results of given type of actuator tests.	5.2	Types of Actuators and functions of actuators. Construction, working and Testing of following actuators: Electronic fuel Injector testing (Sound test, Ohmmeter test only).	CO5
	5c	Interpret 5-digit Diagnostic Trouble Codes (DTCs) as per SAE J2012 standards.	5.3	Onboard diagnosis (OBD): Purpose of onboard diagnostic second generation, Flash codes of Malfunction indicator light, OBD II Concept, SAE J2012 standards Diagnostic Trouble Code (DTC):-5 digits only.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the types of body and Materials used in body for a given vehicles.	2#	CO1
I	2	Identify the various suspension irregularities in the given vehicles. Suggest suitable remedies for them.	2#	CO1
II	3	Identify the components of MPFI engines and write their applications.	2#	CO2
II	4	Identify the components of CRDI engines and write their applications.	2	CO2
II	5	Identify the aggregates of EV, Draw layout of EV chassis, Record benefits of EV chassis as compared to chassis with I.C. engine.	2#	CO2
II	6	Perform multimter test on EV Components and interpret the results.	2#	CO2
III	7	Identify the components of HVAC systems. Draw the layout of HVAC system through observations.	2#	CO3
III	8	Measure the various temperatures of Car HVAC system and interpret the results.	2#	CO3
IV	9	Identify the various advanced accessories in the given vehicles and demonstrate their working.	2#	CO4
IV	10	Perform the operation of headlights and other accessories system for a given vehicle.	2#	CO4
IV	11	Identify the various safety devices used in given vehicles. Observe their working and correlate their applications.	2#	CO4
V	12	Identify the given sensors and actuators and write their applications.	2	CO5
V	13	Perform the multimeter test on given sensors and interpret the results.	2#	CO5
V	14	Perform the multimeter test on given actuators and interpret the results.	2#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Automobile Body Engineering	6	C	04	06	04	14
			O	00	00	00	00
2	Advances in Automobile Engines and Electric Vehicles	6	C	02	08	04	14
			O	00	00	00	00
3	Car Heating, Ventilation and Air Conditioning (HVAC)	6	C	02	04	08	14
			O	00	00	00	00
4	Advanced Automotive Accessories and Safety Devices	6	C	04	04	06	14
			O	00	00	00	00
5	Diagnosis of Automobile Components and Systems	6	C	02	06	06	14
			O	00	00	00	00
Total		30	C	14	28	28	70
			O	00	00	00	00

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C/O
Q1 to Q35	1R2	1R2	1U2	1U2	1U2	1A2	1A2	35/35
	2R2	2U2	2U2	2U2	2U2	2A2	2A2	
	3R2	3U2	3U2	3A2	3A2	3A2	3A2	
	4R2	4R2	4U2	4U2	4A2	4A2	4A2	
	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of tools and equipment's.	5
2	Stepwise Procedure and Performance.	10
3	Conclusion and Result.	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	3	-	-
CO2	3	-	-	3	2	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	-	-	3	2	-	3	-	-
CO5	3	-	-	3	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Automotive Technology: A System Approach	Jack Erjavec, Robert Scharff, Delmar Publisher Inc., Second Edition	13: 9780827367241
2	Motor Automotive Technology	Anthony Schwaller, Delmar Publisher Inc., Second Edition, 1993	13: 978-0827351004
3	Automobile Mechanics	Donald L Anglin, William H Crouse, Tata McGraw – Hill, Tenth Edition, 2006	13: 9780028009438
4	Automotive Electricity, Electronics and Computer Controls	Barry Hollenbeck, Delmar Publishers, First Edition, 1998	13: 978-0827365667
5	Automotive Electrical Equipment	P. L. Kohli, Tata McGraw-Hill, 2006	10: 0074602160
6	Automobile Engineering Vol.II	R K Mohanty, Standard Book House, 2006	10: 81-900893-5-9
7	Automobile Engineering Vol.II	Dr. Kirpal Singh, Standard Publication,	13: 9788180141775

XV e-References:

1. https://www.youtube.com/watch?v=9q_XFRtrpTI&pp=ygUXaHlkcm9tZXRlciBiYXR0ZXJ5IHRlc3Q%3D
2. https://www.youtube.com/watch?v=vi7QioL0WzE&pp=ygUZc3RhcnRlciBjdXJyZW50IGRyYXcgdGVzdA%3D%3D
3. https://www.youtube.com/watch?v=NH8h8qO9JlQ&t=49s&pp=ygUXYXJtYXR1cmUgZ3Jvd2xlciB0ZXN0ZXI%3D
4. https://www.youtube.com/watch?v=LGB6ZEjGm7Q&pp=ygURYWx0ZXJuYXRvciB0ZXN0ZXI%3D
5. https://youtu.be/J24Z2Pn94cY
6. https://youtu.be/nBUmU-zRK8k
7. https://youtu.be/FpGGpgSEU94
8. https://youtu.be/dr6G-aQH7g4
9. https://youtu.be/OMLSNwQiiKg
10. https://youtu.be/W94iksaQwUo

XVI List of Major Equipment/Machineries with Specification:

1. Two / Three types of Automobile Bodies.
2. MPFI Engines and CRDI engines.
3. Electric Vehicles components.
4. Electric Vehicle chassis or operational cut section of EV. Any make and model.
5. Working model of automotive car air conditioning system (HVAC).
6. Working model of Ignition system and Ignition coil tester.
7. Battery hydrometer, Battery load tester.
8. Digital Multimeters and Clamp type ammetesr.
9. Scan tool and accessories
10. Multiport fuel Injection Engine with sensors, actuators, ECM and all advanced accessories.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. G. K. Awari	HoD, Autombile Engineering	Government Polytechnic, Nagpur
2	Dr. S. D. Thakre	Sr. Lecturer, Automobile Engineering	Government Polytechnic, Nagpur
3	Prof. D. K. Bawane	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur
4	Prof. J M Syed	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur
5	Mr. Promod Nichat	Rtd. Asst. General Manager	Ashok Layland, Chennai
6	Dr. Suhas Kongre	Sr. Lecturer in Mechanical Engineering	ASTS Polytechnic, Wardha
7	Dr. Manoj Baseshankar	HOD, Mechanical Engineering	Suryodaya College of Engineering, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/IT/MT/TX/AE/CM/MK/AI
Course Category	:	GE
Course Code	:	PK391H
Course Title	:	Injection Moulding & Blow Moulding

I Rationale:

This course introduces the fundamentals of injection and extrusion blow moulding with emphasis on packaging applications. It aims to provide cross-disciplinary knowledge to students from various engineering backgrounds. The course covers basic machine operations, mould design, materials, and product applications. Learners will understand the relevance of these processes in packaging and general manufacturing. It enhances technical awareness and supports skill development in polymer-based production methods.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply injection and extrusion blow moulding processes for manufacturing packaging components using appropriate materials, machinery, and quality control practices.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** and handle the feeding, motor, and drive systems of an injection moulding machine.

CO2: **Demonstrate** the barrel heating zones, clamping mechanism, and simulate the injection cycle.

CO3: **Observe** the cooling and ejection system and inspect injection moulded parts for defects.

CO4: **Identify** components of an extrusion blow moulding machine and simulate parison formation.

CO5: **Examine** blow mould cavities and demonstrate cooling and trimming procedures using samples. Evaluate blow moulded products for defects and differentiate design features based on application.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

** Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Fundamentals of Injection Moulding	1a	Justify the importance of injection molding in packaging.	1.1	Introduction and outline of the injection molding process.	CO1
	1b	Illustrate the principle of injection molding for packaging use.	1.2	Principle of injection molding and packaging-specific applications.	
	1c	Differentiate types of injection molding machines by design and application.	1.3	Types and constructional features of injection molding machines.	
	1d	Describe with justification the roles of main machine parts.	1.4	Main parts of the injection molding machine and their roles.	
	1e	Compare screw and plunger feed systems.	1.5	Barrel construction and material feed mechanisms (screw, plunger types).	

UNIT II: Mould Design and Injection Moulding Operation	2a	Illustrate core and cavity construction in mold design.	2.1	Mould design basics, core and cavity construction.	CO2
	2b	Differentiate runner systems and gate types with justification.	2.2	Runner system, mold venting, and gate types.	
	2c	Justify factors affecting shrinkage in molded parts.	2.3	Shrinkages in molded parts and factors affecting it	
	2d	Compare mold heating and cooling systems for performance.	2.4	Mould heating and cooling systems – types and functions.	
	2e	Illustrate ejection systems and their impact on cycle time.	2.5	Part ejection systems and cycle time optimization.	
UNIT III: Process Control, Applications & Defects in Injection Moulding	3a	Illustrate the full injection molding cycle with control points.	3.1	Complete process cycle and operation control.	CO3
	3b	Justify common packaging uses of injection molding.	3.2	Applications in packaging – caps, closures, containers, etc.	
	3c	Compare molding materials based on properties and use.	3.3	Types of materials used for packaging injection molding.	
	3d	Identify and justify causes of common molding defects.	3.4	Common injection molding defects (e.g., sink marks, short shot, flash)	
	3e	Justify corrective actions for injection molding issues.	3.5	Troubleshooting and corrective measures in molding.	
UNIT IV: Basics of Extrusion Blow Moulding	4a	Justify the role of blow molding in packaging.	4.1	Introduction to blow molding and packaging relevance.	CO4
	4b	Differentiate blow molding types by principle and use.	4.2	Principle and classification (extrusion blow, injection blow, stretch blow)	
	4c	Illustrate extrusion blow molding machine construction.	4.3	Construction and working of extrusion blow molding machine.	
	4d	Justify parison formation and extrusion head design.	4.4	Parison formation and extrusion head design.	
	4e	Compare materials used in blow molded packaging.	4.5	Material selection for extrusion blow molded packaging.	

UNIT V: Blow Moulding Operations	5a	Illustrate key features of blow mold design.	5.1	Blow mold design: cavity, neck finish, and parting lines, Clamping unit, inflation system, and cooling cycle.	CO5
	5b	Justify blow molding steps and wall thickness control.	5.2	Deflashing and trimming methods, Wall thickness control methods (parison programming), Process cycle – step-by-step working of extrusion blow molding.	
	5c	Illustrate applications and trends in blow molded packaging.	5.3	Packaging applications – bottles, jars, containers. Types of blow molded products and market trends.	
	5d	Identify and justify causes of blow molding defects.	5.4	Common defects – uneven wall thickness, flash, air entrapment.	
	5e	Justify quality control and innovations in blow molding.	5.5	Quality control in blow molded packaging. Innovations – multilayer blow molding, in-mold labeling, sustainability aspects.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Operate and Examine the Material Feeding System of an Injection Moulding Machine: Operate hopper and feeding zones. Identify granule flow, feeding mechanisms, and control settings.	2#	CO1
I	2	Identify and Analyze the Motor and Drive System Functionality: Trace electric/hydraulic drives. Observe screw rotation and injection control in operation.	2#	CO1
I	3	Observe and Record the Temperature Control Across Barrel Heating Zones: Inspect barrel sections. Measure set vs. actual temperatures and note heater arrangements.	2#	CO1
II	4	Demonstrate the Mould Clamping and Die Movement Process: Activate the clamping system. Observe toggle/hydraulic locking and safety interlocks.	2#	CO2
II	5	Perform Observation of Injection and Product Formation Cycle: Track plasticization, injection, mold filling, and part formation. Record parameters.	2	CO2
III	6	Monitor Cooling System Performance During the Moulding Cycle: Identify cooling channel layout. Measure cycle cooling time and coolant temperature.	2	CO3
III	7	Observe and Interpret the Ejection Mechanism Used for Part Removal: Inspect ejector pins, sleeves, or air systems. Monitor timing, part release, and safety.	2#	CO3
IV	8	Identify and Sketch Key Units of an Extrusion Blow Moulding Machine: Inspect and draw layout including extruder, die head, mold clamp and blowing station.	2#	CO4
IV	9	Monitor and Describe Parison Formation and Thickness Profile: Observe parison drop. Measure variation and note influence of temperature or flow.	2#	CO4
IV	10	Disassemble and Examine a Blow Mould for Neck and Cavity Design: Handle mould halves. Measure cavity shape and neck finish dimensions.	2#	CO4

IV	11	Operate and Study the Air Blowing and Cooling Cycle: Run or simulate blowing. Record pressure, cycle timing, and cooling phase.	2#	CO4
V	12	Observe and Record Trimming and Deflashing Operations: Handle post-processed parts. Identify flash areas, trimming tools, and defects.	2#	CO5
V	13	Inspect and Categorize Defects in Blow Moulded Products: Study defect samples. Classify based on appearance and identify probable causes.	2#	CO5
V	14	Collect and Compare Blow Moulded Packaging Applications: Gather different products. Identify materials used and packaging functions.	2#	CO5
V	15	Examine and Compare Mono-layer and Multi-layer Blow Bottles: Dissect and analyze sample bottles. Identify barrier layers and their functions.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Fundamentals of Injection Moulding	6	C	02	06	04	12
			O	00	00	00	00
2	Mould Design and Injection Moulding Operation	6	C	02	06	04	12
			O	00	00	00	00
3	Process Control, Applications & Defects in Injection Moulding	6	C	02	06	04	12
			O	00	00	00	00
4	Basics of Extrusion Blow Moulding	6	C	06	08	04	18
			O	00	00	00	00
5	Blow Moulding Operations	6	C	04	06	06	16
			O	00	00	00	00
Total		30	C	16	32	22	70
			O	00	00	00	00

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q.1 to Q.35	1R2	1U2	1U2	1U2	1A2	1A2	2R2	35/35
	2U2	2U2	2U2	2A2	2A2	3R2	3U2	
	3U2	3U2	3A2	3A2	4R2	4R2	4R2	
	4U2	4U2	4U2	4U2	4A2	4A2	5R2	
	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	2	-	-
CO2	3	-	-	1	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-
CO5	3	-	-	1	-	-	2	-	-
CO6									

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Handbook of Plastic Processes	Charles A. Harper, John Wiley & Sons, Inc., 1E, 2006.	13:978-0-471-662556 10: 0-471-66255-0
2	Plastics in packaging	A.S. Athaley, Tata McGraw-Hill,1E, 1992.	10: 0-07-460014-7
3	Rigid and Semirigid: Plastic Containers	J. H. Boriston, Longman Group Limited, 1E, 1994.	10: 0-582-01491-3
4	Handbook of package engineering	Joseph F. Hanlon , Robert J. Kelsey, Hallie Forcinio, CRC Press, Taylor & Francis Group, Third Edition, 1998.	13:978-1566763066 10: 1566763061
5	Advances in Plastic Packaging Technology	John Briston, Pira International, 1E, 1993	13: 9780902799967 10: 0902799967

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1 https://www.sorbentsystems.com/FlexiblePackageDesignGuide.pdf, Assessed on 18/10/2024
2 https://geminigroup.net/wp-content/uploads/2018/12/Plastic-Extrusion-Design-Guide.pdf, Assessed on 18/10/2024
3 https://www.dynisco.com/userfiles/files/Introduction_To_Extrusion.pdf, Assessed on 18/10/2024
4 https://personal.egr.uri.edu/vms/ISE%20240/Polymer_processing_VMS08.pdf, Assessed on 18/10/2024
5 https://crescent.education/wp-content/uploads/2019/02/MODULE-I-Injection-Molding-Process.pdf, Assessed on 18/10/2024

XVI List of Major Equipment/Machineries with Specification:

1. Injection molding machine.
2. Extrusion blow molding machine.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Head of Department, Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Lecturer in Packaging Technology (Rtd.)	Government Polytechnic, Nagpur.
4	Mr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
5	Mr. Prasad Balan Iyer	Director	SIES School of Packaging, Navi Mumbai – 400 705.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali Mohd Zeeshan MSM	Assistant Professor	Anjuman College of Engineering and Technology, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/MC/MT/PK/TX/AE
Course Category	:	GE
Course Code	:	CM391H
Course Title	:	Digital Marketing

I Rationale:

Digital marketing offers unparalleled opportunities for businesses to grow and succeed in the modern marketplace. Its ability to reach a wide audience, cost-effectiveness, and the potential for high engagement and measurable results make it an indispensable tool for any business looking to thrive in the digital age.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Use ethical and legal standards in computer engineering for digital marketing

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Explore** scope & necessity of digital marketing for various applications.

CO2: **Interpret** role of segmentation, Targeting and Positioning (STP) in digital marketing.

CO3: **Use** of Search Engine Optimization (SEO) for carrying out digital marketing.

CO4: **Analyze** Search engine marketing in context of digital marketing.

CO5: **Design** digital media campaign using appropriate mix of Face book and Twitter.

CO6: **Use** Web Analytic tool for different application.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

** Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Digital Marketing	1a	Identify the given marketing.	1.1	Evaluation of digital marketing: from traditional to modern marketing, premise of traditional marketing, Factors Impacting the Shift from Traditional to Modern Marketing, Advent of Modern Marketing Techniques	CO1
	1b	Select appropriate type of E-concept.	1.2	Growth of 'E' Concepts: from E-Business to Advanced E-Commerce, Understanding E-Models, difference between E-Business & E-commerce.	
	1c	Choose proper type of marketing strategy forthe given scenario.	1.3	Digital Marketing: an Introduction, Emergence of Digital Marketing as a Tool, Pull and Push Marketing, digital Marketing Applications and Benefits.	
	2a	Justify the need of segmentation	2.1	Segmentation: Concept , need and benefits of segmentation.	

UNIT II:Digital Marketing techniques	2b	Classify the given types of segmentation on the given criteria	2.2	Criteria for segmenting digital Audience-geographic, demographic, psychographic behavioral segmentation.	CO2
	2c	Choose the given marketing strategy based on condition	2.3	Targeting definition, Various target marketing strategies: mass marketing, segment marketing, niche marketing, micro marketing ,local marketing.	
	2d	Choose the use of Positioning in marketing context .	2.4	Positioning: definition of positioning in marketing, Types of positioning in marketing: pricing, quality, differentiation, convenience, customer service, user group.	
	2e	Identify the benefits of positioning.	2.5	Benefits of positioning in marketing: Create a strong competitive position, improve sales, define a target market, make more effective decisions, and connect to customer need.	
UNIT III: Search Engine Optimization (SEO)	3a	Select given terms related to SEO.	3.1	Introduction to SEO concept and role in digital marketing Understanding search engine optimization , common SEO techniques , content creation as SEO technique, SEO as marketing strategy	CO3
	3b	Select the given suitable method for given web page analysis in SEO.	3.2	Understanding search engine: search engine working, interaction of people with search engine,search engine marketing: keyword analysis,site popularity,web analytic & HTML tools, sponsored results.	
	3c	Choose proper tags in Search Engine Design in given example.	3.3	Search engine site design & development: indexablecontent, title tags, meta tags, link structure, Nofollow links, keyword usage, URL structure	

UNIT IV: Search Engine Marketing (SEM)	4a	Identify given terminologies in Social Media Marketing for given problem statement	4.1	Search Engine Marketing: concept of search engine marketing, terminology associated to SEM, Pay per click(PPC), Cost per click(CPC),Search engine result Page(SERP), Cost per mile(CPM), Landing page, SEO Vs PPC, Pay per click	CO4
	4b	Choose the given type of advertising tool for given product	4.2	Search engine advertising: Google Adwords, Bing Ads, Google search, google partners, google display network, campaign subtypes, specialized compaign subtypes: dynamic search ads, mobile apps, remarketing, engagement	
	4c	Select the steps for creating given adword account.	4.3	Google Adwords account setting: account access, linked accounts, notification setting, preferences Google AdWord account structure: Account, campaign ,Ad group	
	4d	Choose the use of given tool based on the problem statement.	4.4	Google Analytic: concept of Google Analytic, need of Google Analytic, how to set up a free Googleaccount,	
UNIT V: Social Media Marketing (SMM)	5a	Identify the difference for given social media websites on the given points.	5.1	Introduction to Social Media marketing, types of social media websites, mobile social media	CO5
	5b	Select steps for creating given page	5.2	Facebook : creating a facebook page, creating a facebook group	
	5c	Choose the proper terms used in twitter advertising .	5.3	Twitter Advertising: Use hashtags, retweet ,follow and get followed, Linkedln	
	5d	Choose the concept of Blogging for given senario.	5.4	Blogging: Types of blogs, blogging platforms, blogging recommendations, advertising on facebook, advertising on youtube	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
II	1	Prepare a report of a sample website with strategic flow for e-commerce/publication etc. with the use of: HTML,CSS,Javascript	02#	CO2
II	2	Apply role of STP for marketing of any product and prepare a detail report on it.	02#	CO2
III	3	Create account on Google Analytics or any other analytics tool	02#	CO3
III	4	Create the tracking id for web site and track links using Google Analytics tool	02#	CO3
III	6	Analyze web site traffic and leads using Analytics tool	02#	CO3
III	7	Prepare report on Search Engine Optimization(SEO) using Digital Marketing Platform	02#	CO3
IV	8	Demonstrate and install any Google Analytics plug-in for the website	02#	CO4
V	9	Use marketing features of any social media websites (eg. Facebook, Instagram .etc)	02#	CO5
V	10	Implement following using Google Analytics: Content Marketing and Website content optimization.	02#	CO5
V	11	Generate different type of reports through Google Analytic	02#	CO5
V	12	Analyze data using Google Analytics	02#	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Digital Marketing	6	C	04	06	04	14
			O	00	00	00	0
2	Digital Marketing techniques	6	C	02	06	06	14
			O	00	00	00	0
3	Search Engine Optimization (SEO)	6	C	04	04	06	14
			O	00	00	00	0
4	Search Engine Marketing (SEM)	6	C	02	06	06	14
			O	00	00	00	0
5	Social Media Marketing (SMM)	6	C	02	06	06	14
			O	00	00	00	0
Total		30	C	14	28	28	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	1R2	1U2	1U2	1U2	1A2	1A2	Q1 to Q35	
2	2R2	2U2	2U2	2U2	2A2	2A2	2A2		
3	3R2	3R2	3U2	3U2	3A2	3A2	3A2		
4	4R2	4U2	4U2	4U2	4A2	4A2	4A2		
5	5R2	5U2	5U2	5U2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Study of web pages and web site.	5
2	Installing and setting up a tool for web site	10
3	Interpretation of reports, result and conclusion	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	2	2	-	3	3	-
CO4	3	-	-	2	-	2	3	3	-
CO5	3	-	1	-	2	2	3	3	-
CO6	3	-	-	-	-	-	3		-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Fundamentals of Digital Marketing	Puneet Singh Bhatiya, Pearson publication	978-93-325-8737-3
2	Digital Marketing All in One for Dummies	Ryan Deiss	978-1-119-56023-4
3	Internet Marketing Pearson Education	Dave Chaffey,Kevin Johnston, Richard Mayer	978-81-31725191
4	Social Media Marketing All in One for Dummies	Jan Zimmerman and Deboarh	978-1-119-69687-2

XV e-References:

1. •http://www.smartinsights.com/digital-marketing-strategy/customer-segmentation-targeting/segmentation-targeting-and-positioning accessed on 13 July 2024
2. https://www.emarketinginstitute.org/free-ebooks/#google_vignette accessed on 13 July 2024
3. https://firstsiteguide.com/google-analytics-for-wordpress/ accessed on 13 July 2024
4. https://www.mageplaza.com/blog/positioning-in-marketing.html accessed on 13 July 2024

XVI List of Major Equipment/Machineries with Specification:

1. Computer system with all necessary peripherals and internet connectivity.
2. Web browser
3. Any Web Server(Tomcat)
4. Google Analytics

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr.M.V.Sarode	HOD,Computer Engineering	Government Polytechnic, Nagpur
2	Mrs.D.S.Nalinde	Lecturer in CM	Government Polytechnic, Nagpur
3	Mr.P.S.Thakre	Lecturer in CM	Government Polytechnic, Nagpur
4	Dr.U.B.Aher	Lecturer in CM	Government Polytechnic, Nagpur
5	Dr.Rakesh Kadu	Assistant Professor, I.T	Ramdeobaba College of Engg, and Management, Nagpur
6	Mr.Dipak Dhote	Operations Manager,	IT-Network Infosystems Pvt LTD,Nagpur
7	Mrs.V.A.Raje	System Analyst	MSBTE ,RO,Nagpur

(Dr. M. V. Sarode)
HOD & Chairman PBOS, CM

(Dr. G. V. Gotmare)
Member Sectretary PBOS, CM

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/PK/AI/MT/AE/TX
Course Category	:	GE
Course Code	:	MK391H
Course Title	:	Automotive Mechatronics

I Rationale:

This Generic Elective course is designed to introduce students from other branches to modern vehicle automation and electronic control systems. It covers fundamentals such as ECUs, sensors, actuators, transmission control, vehicle diagnostics, and emerging technologies like Drive-by-Wire and wireless communication protocols. The course enhances understanding of smart automotive systems, encouraging interdisciplinary learning and innovation in automation, essential for adapting to the evolving automotive industry and smart mobility solutions.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply knowledge of electronic control systems to analyze modern vehicle automation and diagnostic technologies.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** potential areas and recent technology of vehicular communication system.

CO2: **Classify** various types of sensors and actuators for automotive industry.

CO3: **Select** requirment of vehicular networking.

CO4: **Select** suitable various electronics accessories.

CO5: **Classify** the various type of electronically operated system.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Vehicular Applications	1a	Select the given electronic system for vehicular for specific application.	1.1	Electronic control unit (ECUs), ECU for fuel injector system.	CO1
	1b	Identify the given types of electronics control unit.	1.2	Engine system self – Diagnostics (On-Board Diagnostic) and EOBD.	
UNIT II: Sensors and Actuators	2a	Select the given types of sensors and actuator used in automotive industry.	2.1	Different types of Sensor and Actuator, example of various types of sensors.	CO2
	2b	Identify the given actuators used in industry.	2.2	Actuators: producing movement and other functions, Examples of different types of actuators, Electronics Control Unit (ECU) /actuator control signals.	

UNIT III: Driveline Infrotronic	3a	Select the given electronic system for driveline for specific application.	3.1	Selection of electronic system for driveline for specific application.	CO3
	3b	Identify the given types of transmission control systems.	3.2	Transmission control as a black box, Sensors and actuators used in transmission systems, Clutch electronic control.	
	3c	Select give types of hybrid vehicle.	3.3	Light hybrid power train, Technology: starter and generator. Electronic differential and four-wheel drive control.	
UNIT IV: Vehicle Networks and Data Exchange	4a	Select the various mode of vehicular communications.	4.1	Potential Wireless, Technologie ZigBee, UWB (ultra wideband), Bluetooth Wireless USB (Universal Serial Port) Wireless CAN.	CO4
UNIT V: Drive by wire System	5a	Identify the various component used in the drive by wire systems.	5.1	Introduction: Drive by Wire Systems, Current State of the art Advantages of drive by wire system.	CO5
	5b	Comapre given types of throttle wire systems.	5.2	Throttle By Wire Systems. Brake by wire system, electro-hyudraulic (EH). Electromechanical (EMg), Steer by wire system and safety monitoring/	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the variuos components of Electronics Control Unit (ECU)	2#	CO1
II	2	Identify colour coading of wires used for sensor connection.	2#	CO2
II	3	Identify various types of sensor used in automation industry.	2#	CO1
II	4	Identify colour coading of wires used for actuator connection.	2#	CO2
II	5	Identify various types of actuators used in automation industry.	2#	CO2
III	6	Prepare report on infotraonic vehicular system by visiting mechatronics industry. (Part I)	2#	CO3
III	7	Prepare report on infotraonic vehicular system by visiting mechatronics industry. (Part II)	2#	CO3
III	8	Prepare report on infotraonic vehicular system by visiting mechatronics industry. (Part III)	2	CO3
IV	9	Prepare report on application and use of various networking technologies and its interfacing with vehicle by visit. (Part I)	2#	CO4
IV	10	Prepare report on application and use of various networking technologies and its interfacing with vehicle by visit. (Part II)	2#	CO4
IV	11	Prepare report on application and use of various networking technologies and its interfacing with vehicle by visit. (Part III)	2	CO4
V	12	Identify various types of electronics cluches.	2#	CO5
V	13	Identify various types of electromechanical, Electo-hydraulic, electromagnetic cluches.	2#	CO5
V	14	Assemble and disassemble elecromechanical clutch.	2#	CO5
V	15	Assemble and disassemble electromagnetic clutch.	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Vehicular Applications	6	C	04	04	04	12
			O	00	00	00	0
2	Sensors and Actuators	6	C	04	02	08	14
			O	00	00	00	0
3	Driveline Infrotronic	6	C	04	04	08	16
			O	00	00	00	0
4	Vehicle Networks and Data Exchange	6	C	02	06	06	14
			O	00	00	00	0
5	Drive by wire System	6	C	04	06	04	14
			O	00	00	00	0
Total		30	C	18	22	30	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q. 1 to Q. 35	1R2	1R2	1U2	1U2	1A2	1A2	2R2	35/35
	2R2	2U2	2A2	2A2	2A2	2A2	3R2	
	3R2	3U2	3U2	3A2	3A2	3A2	3A2	
	4R2	4U2	4U2	4U2	4A2	4A2	4A2	
	5R2	5R2	5U2	5U2	5U2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	System diagram, selection of equipment	5
2	Performance	10
3	Identification of compenets	5
4	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	-	-	-	-	-
CO5	3	-	-	3	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Automobile Electrical and Electronics Systems	Tom Denton, Routledge, 5th edition, 2017	13: 978-0415725774
2	Automobile Electronics	Eric Chowanietz, Butterworth-Heinemann Ltd, 1995	13: 978-0750618786
3	Automotive Informatics and Communicative Systems: Principles in Vehicular Networks and Data Exchange	Huaqun Guo, Information Science Reference, 2009	13: 9781605663388
4	Intelligent Vehicle Technology and Trends	Richard Bishop, Artech House, Boston, 2005	13: 978-1630812737

XV e-References:

1. http://nptel.ac.in/courses/108105063/pdf/L-01(SM)(IA&C)%20((EE)NPTELJ.pdf, accessed on 4th July, 2024
2. http://nptel.ac.in/downloads/108105063/, accessed on 4th July, 2024
3. https://www.industrialautomation.us/ access on 24 April 2024
4. https://www.plantautomation-technology.com/ access on 23 April 2024
5. https://www.linak.com/ access on 22 April 2024
6. https://www.kathirsudhirautomation.com/ access on 22 April 2024
7. https://www.timotion.com/ access on 23 April 2024

XVI List of Major Equipment/Machineries with Specification:

1. Automated Guided vehicle
2. Automation load trasfer, wire guided.
3. Data capturing machine-plant code/option charactor recognition.
4. Demo kit of sensors, Electrical and pneumatic Actuators.
5. Diffrent types of Cluches

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. G.K. Awari	HOD, Mechatronics Engineering	Government Polytechnic, Nagpur
2	Ms. K. P. Thaware	Lecturer in Mechatronics Engg.	Government Polytechnic, Nagpur
3	Dr. Hemant B. Warkad	Junior Work Manager	OFA, Yatra India Ltd. Nagpur
4	Dr. Sachin M. Kale	Sr. Lecturer Electronics Telecomm.Engg.	Government Polytechnic, Nagpur
5	Prof.Vikash V. Mankar	I/C HOD Electronics Telecomm.	Priyadarshni Polytechnic, Nagpur
6	Mr.Kisanlal B. Badole	Design Engineer	Business Ready Solutions, Nagpur

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Member Secretary PBOS, MK

Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	DIPLOMA IN CE/ME/EE/EC/AE/MT/PK/TX/MK
Course Category	:	GE
Course Code	:	AI391H
Course Title	:	Machine Learning

I Rationale:

Machine Learning is a field within Artificial Intelligence in Computer Science that focuses on developing algorithms that mimic human learning processes. By leveraging statistical techniques, these algorithms are trained to make predictions based on data, enhancing the accuracy of software applications without requiring explicit programming for each task. Machine learning is a crucial skill in Data Science, enabling data scientists to harness historical data to predict outcomes. These predictions provide valuable insights that help businesses make informed decisions.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Comprehend the knowledge of the foundational concepts of AI.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** uses and applications of machine learning in real life.

CO2: **Implement** preprocessing steps on data to make it ready for analysis.

CO3: **Apply** classification algorithms and regression algorithms for predictive analysis

CO4: **Implement** clustering algorithms on data models and build them.

CO5: **Use** the concepts of ML in IoT.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	-	-

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Machine Learning	1a	Compare the given types of machine learning on given points.	1.1	Introduction to Machine Learning. Overview and History.	CO1
	1b	Compare the various types of Ml based on the given points.	1.2	Types of Machine Learning: Supervised, Unsupervised, Reinforcement Learning.	
	1c	Compare Training and Testing on the basis of given points.	1.3	Features, Labels, Training, Testing.Applications of ML.	
a and Datasets	2a	Distinguish between the various types of data based on given points.	2.1	Understanding Datasets: Types of Data, Cleaning Data, Handling Missing Values.	CO2
	2b	Select a suitable model for the given data with justification.	2.2	Feature Scaling and Normalization.	

UNIT II: Dat	2c	Analyse the process of feature extraction and engineering on the given data.	2.3	Encoding Categorical Data.	
	2d	Identify the criteria on which data splitting is based.	2.4	Splitting Data into Training and Testing Sets.	
UNIT III: Supervised Learning	3a	Choose supervised learning model for the given situation with justification.	3.1	Introduction to Supervised Learning.	CO3
	3b	Compare given regression algorithms on the basis of given points.	3.2	Regression Algorithms: Linear Regression, Polynomial Regression.	
	3c	Select a suitable algorithm for classifying the given data.	3.3	Classification Algorithms: K-Nearest Neighbors (KNN).	
UNIT IV: Unsupervised Learning	4a	Analyse unsupervised learning concept by considering the given real life situation.	4.1	Introduction to Unsupervised Learning.	CO4
	4b	Compare given types of learning based on the given criteria.	4.2	Clustering Algorithms: K-Means, Hierarchical Clustering.	
UNIT V: Role of ML in IoT	5a	State the applications of IoT.	5.1	Internet of Things, It's applications	CO5
	5b	Distinguish between the various activities carried out in ML and IoT on the basis of given points.	5.2	Working of IoT and ML.	
	5c	Select type of algorithm for the given situation.	5.3	Role of Machine Learning for IoT. Data Analysis Automation by Machine Learning, The Predictive Power of Machine Learning.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Use Python Basic Libraries such as Statistics, Math, Numpy and Scipy a) Usage of methods such as floor(), ceil(), sqrt(), isqrt(), gcd() etc.b) Usage of attributes of array such as ndim, shape, size, methods such as sum(), mean(), sort(), sin() etc. c) Usage of methods such as det(), eig() etc. d) Consider a list datatype (1D) then reshape it into 2D, 3D matrix using numpy e) Generate random matrices using numpy f) Find the determinant of a matrix using scipy. Find eigenvalue and eigenvector of a matrix using scipy	2#	CO1
II	2	Develop basic Python scripts, understanding data types, loops, functions, and libraries like NumPy, Pandas, and Matplotlib.	2#	CO2
II	3	Implement the following actions of Creating and Loading different types of datasets in Python using the required libraries. a) Creation using panda b) Loading CSV dataset files using Pandas c) Loading datasets using sklearn	2#	CO2
II	4	Develop a python program to compute Mean, Median, Mode, Variance, Standard Deviation using Datasets	2#	CO2
II	5	Execute various data pre-processing techniques for a given dataset. Develop a python program to compute a) Reshaping the data, b) Filtering the data,c) Merging the data, d) Handling the missing values in datasets , e) Feature Normalization: Min-max normalization	2#	CO2
III	6	Implement simple linear regression, train the model, and evaluate using Mean Squared Error (MSE).	2#	CO3
III	7	Implement the Multiple Regression for iris dataset.	2#	CO3
III	8	Implement KNN Classification model for a given dataset. Vary the number of k values and compare the results.	2#	CO3
IV	9	Develop a python program to implement K-Means clustering Algorithm. Vary the number of k values and compare the results.	2#	CO4

V	10	Implement a IoT based ML model using libraries like TensorFlow or Keras, understanding layers, activation functions, and backpropagation.	2#	CO5
V	11	Develop a mini project using IoT and ML for the medical application	2#	CO5
V	12	Execute the following - Choose a dataset, define a problem statement, apply machine learning algorithms, evaluate the models, and present findings.	2#	CO5
V	13	Implement an End-to-end machine learning project including data collection, preprocessing, model building, evaluation, and deployment.	2	CO5
V	14	Develop a mini project using IoT and ML for the commercial l application	2	CO5
V	15	Develop a mini project using IoT and ML for the Library application	2	CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Machine Learning	2	C	02	04	00	6
			O	0	0	0	0
2	Data and Datasets	6	C	02	06	00	8
			O	0	0	0	0
3	Supervised Learning	8	C	02	06	08	16
			O	0	0	0	0
4	Unsupervised Learning	8	C	06	10	08	24
			O	0	0	0	0
5	: Role of ML in IoT	6	C	04	06	06	16
			O	0	0	0	0
6			C				
			O				
Total		30	C	16	32	22	70
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C
Q 1 to Q 35	1R2	1U2	1U2	2R2	2U2	2U2	2U2	35/35
	3R2	3U2	3U2	3U2	3A2	3A2	3A2	
	3A2	4R2	4R2	4R2	4U2	4U2	4U2	
	4U2	4U2	4A2	4A2	4A2	4A2	5R2	
	5R2	5U2	5U2	5U2	5A2	5A2	5A2	

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Writing Program (Execution)	5
2	Performance	10
3	Viva Voce	10
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	3	3	3	-	3	-	-
CO2	3	-	3	3	3	-	3	-	-
CO3	3	-	3	3	3	-	3	-	-
CO4	3	-	3	3	3	-	3	-	-
CO5	3	-	3	3	3	-	3	-	-
CO6	3	-	3	3	3	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Machine Learning	SaikatDutt ,Subramanian Chandramouli, Amit Kumar Das, Pearson Education India, 2018	13:978-9353066697
2	Machine Learning for absolute begineers	Oliver Theobald , Scatterplot Press; 3rd edition , 2020	13:979-8558098426
3	Machine Learning	Tom M Mitchell, McGraw Hill, First edition, 1997	13:978-0070428072

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1. https://www.javatpoint.com/types-of-ai-agents, accessed on 29th July 2024
2. http://www.dkriesel.com/en/science/neural_networks, accessed on 29th July 2024
3. https://www.youtube.com/results?search_query=artificial+intelligence, accessed on 29th July 2024
4. https://www.youtube.com/watch?v=s-s9ilkMVj8, accessed on 29thJuly 2024
5. https://www.javatpoint.com/subsets-of-ai, accessed on 29th July 2024
6. https://www.youtube.com/watch?v=s-s9ilkMVj8, accessed on 29th July 2024

XVI List of Major Equipment/Machineries with Specification:

1. Computer system with latest configuration.
2. Software: opensource framework, AItools (ScikitLearn,TensorFlow,Auto ML,H2O,google ML kit)

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. A. R. Mahajan	HOD, Information Technology	Government Polytechnic, Nagpur
2	Dr.Paresh R. Kamble	Machine Learning specialist	OZ SportZ, Nagpur, HQ-Reykjavik, Iceland
3	Dr. Vijaya Balpande	Associate Professor	Ramdeobaba College of Priyadarshini College of Engg., Nagpur
4	Mrs. Shifa Azharuddin	Lecturer in IT	Government Polytechnic, Nagpur
5	Dr. S. S. Gharde	Lecturer in IT	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/IT/CM/PK/MT/AE/AI/MK/TX
Course Category	:	GE
Course Code	:	TR391H
Course Title	:	Tourism Resources of India

I Rationale:

This multidisciplinary course introduces students to India's adventure tourism potential, popular destinations, and activities. It promotes awareness of sustainability, safety, and environmental responsibility. Aligned with NEP 2020, the course develops transferable skills like strategic thinking, and risk assessment. It is relevant for students across disciplines such as environmental studies, sports, and highlights challenges and strategies in adventure tourism development.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Plan and conduct safe, equipment-based adventure tourism activities.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** tourism resources in India.

CO2: **Select** suitable topography and equipment for land based adventure tourism.

CO3: **Select** suitable equipment for water based adventure tourism cosidering physical fitness and safety measures required.

CO4: **Select** suitable equipment for air based adventure tourism cosidering physical fitness and safety measures required.

CO5: **Identify** various Artificial Advature activities.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
2	-	2	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70**	100	40	25	10	25	10	25	10

**Online Objective Type

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction	1a	Classify to various tourism resources in India.	1.1	Indroduction to various tourism resources: Natural resources, Cultural resources.	CO1
	1b	Identify given Natural resources in India.	1.2	Natural resources: National park, Beaches, GHill stations, Water fall, Mountains	
	1c	Identify given cultural resources in India.	1.3	Cultural Resources: Historical Monuments, Temples and Pligimage sites, Festivals and Celebrations.	
UNIT II: Land Based Activities	2a	Identify major land-based adventure activities and their suitable destinations in India.	2.1	Mountaineering, Trekking, Rock Climbing, Skiing. Preferable destinations for adventure activities in India.	CO2
	2b	Identify essential equipment for land based adventure activities and relate them to tourist fitness requirements.	2.2	Necessary equipment for adventure activities. Energy level and physical fitness of Tourist.	
	2c	Apply appropriate safety measures and assess dos and don’ts in land-based adventure activities.	2.3	Dos and don’ts for tourists while undergoing adventure activities. Safety measures for land-based adventure sports.	

UNIT III: Water Based Activities	3a	Identify major water-based adventure activities and their suitable destinations in India.	3.1	Rafting, Kayaking, Canoeing, Yachting, Water Scooter, Hovercraft, Surfing, Scuba diving. Water Resources of India – Rivers, Seas and Lakes. Preferable destinations for adventure activities in India.	CO3
	3b	Identify essential equipment for water-based adventure activities and relate them to tourist fitness requirements.	3.2	Necessary equipment for Water Based adventure Activities. Energy level and physical fitness of Tourist.	
	3c	Apply appropriate safety measures and assess dos and don’ts in water-based adventure activities.	3.3	Dos and don’ts for tourists while undergoing Water Based adventure activities. Safety measures for water based adventure sports.	
UNIT IV: Air Based Activities	4a	Identify major air-based adventure activities and their suitable destinations in India.	4.1	Hang gliding, Hot Ballooning, Para Jumping, Parasailing, Sky diving. Preferable destinations for air based adventure activities in India.	CO4
	4b	Identify essential equipment for air-based adventure activities and relate them to tourist fitness requirements.	4.2	Necessary equipment for air based adventure activities. Energy level and physical fitness of Tourist.	
	4c	Apply appropriate safety measures and assess dos and don’ts in air-based adventure activities.	4.3	Dos and don’ts for tourists while undergoing adventure activities. Safety Measures for Air Based activities.	
UNIT V: Artificial Advature Tourism	5a	Identify various Artificial Advature activities.	5.1	Theme parks, Escape rooms, indoor climbing, Ziplining, Virtual reality experiences.	CO5
	5b	Locate Artificial Advature activities in India on map.	5.2	Locations of Artificial Advature activities in India.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Collect data and visuals from secondary sources (books, tourism websites, brochures) related to tourism resources in India.	2#	CO1
I	2	Identify and locate tourism resources in India on a map.	2#	CO1
II	3	Practice High hill trekking destinations. (Part I)	2#	CO2
II	4	Practice High hill trekking destinations. (Part II)	2#	CO2
II	5	Practice Rock Climbing.	2#	CO2
III	6	Prepare an observation based key learning points in Kayaking/Water Scooter.	2#	CO3
III	7	Prepare a Presentation on water based adventure sports activities.	2	CO3
III	8	Identify various equipments used in on water based adventure activities.	2#	CO3
IV	9	Follow the expert instructions of Parasailing/Hang gliding expert.	2#	CO4
IV	10	Identify various equipments used in on air based adventure activities.	2#	CO4
IV	11	Perform air based advanture activities by following safety measures.	2#	CO4
V	12	Prepare a report on artificial advanture activity you have experienced.	2#	CO5
V	13	Prepare a brouchure using self-photographed pictures and related information of the artificial advanture activities.	2#	CO5
V	14	Design an advertisement/promotional campaign for any one theme Park..	2	CO5
I to V	15	Prepare an adventure tourism package.	2	CO2 to CO5

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction	4	C	02	04	04	10
			O	0	0	0	0
2	Land Based Activities	6	C	04	06	06	16
			O	0	0	0	0
3	Water Based Activities	6	C	04	06	06	16
			O	0	0	0	0
4	Air Based Activities	6	C	02	08	06	16
			O	0	0	0	0
5	Artificial Advature Tourism	8	C	02	04	06	12
			O	0	0	0	0
Total		30	C	14	28	28	70
			O	0	0	0	0

*C - Compulsory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
Q1 to Q 35	1R2	1U2	1U2	1A2	1A2	2R2	2R2	35/35	
	2U2	2U2	2U2	2A2	2A2	2A2	3R2		
	3R2	3U2	3U2	3U2	3A2	3A2	3A2		
	4R2	4U2	4U2	4U2	4U2	4A2	4A2		
	4A2	5R2	5U2	5U2	5A2	5A2	5A2		

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Performance	10
2	Overall Presentation of given assignment	10
3	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	3	-	3	-	-
CO2	3	-	-	-	3	-	3	-	-
CO3	3	-	-	-	3	-	3	-	-
CO4	3	-	-	-	3	-	3	-	-
CO5	3	-	-	-	3	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Tourism Resources in India	Dr. V.K. Rastogi, Laxmi Publications Pvt. Ltd., 2022	13: 978-9395172073
2	Adventure Tourism	R. Buckley, CABI, 2006	10: 1845931238, 13: 978184593123
3	Adventure Tourism: The New Frontier	Rakesh Kumar Sah, Random Publications, July 2014	10: 9351113256 13:978-9351113256
4	Tourism Resources in India (Part-I) [Education, Travel & Business]	Dr. Tuhin Mukherjee, Manorama Publishers; First Edition, 2025	13: 978-9394441866
5	Tourism Products of India: A National Perspective	Robinet Jacob, Abhijeet Publications; 1st Edition, 2012	13: 978-9381136621

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2. https://www.mptourism.com/pdf/guidlines-for-wildlife-tourism.pdf accessed on 16th Dec 2024
3. https://tourism.gov.in/sites/default/files/2020-02/1527867024_gallery_image.pdf accessed on 16th Dec 2024

XVI List of Major Equipment/Machineries with Specification:

1. NIL

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr.P. P. Virkhare	HOD, Travel and Tourism Department.	Government Polytechnic, Nagpur.
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4	Miss Erika Kar	Director	Pegasus Institute, Nagpur.
5	Mr Adityashekhar Gupta	Director	Horizon Safaris, Nagpur.
6	Dr Arvind Upasani	Visiting Lecturer	RSTM Nagpur University.

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Semester VI

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK305H
Course Title	:	Packaging of Pharmaceuticals

I Rationale:

This course equips learners with comprehensive knowledge of pharmaceutical packaging essential for drug safety and efficacy. It emphasizes the role of packaging in protecting products from environmental and physical hazards. Students explore various packaging systems suited to different drug forms and personal care products. The course highlights the importance of tamper-evident and child-resistant features to ensure consumer safety. It develops skills in evaluating packaging materials and understanding labeling requirements. Modern packaging trends and sustainability issues are introduced to align with industry practices. Learners also gain awareness of regulatory frameworks guiding pharmaceutical packaging. Overall, the course builds practical and analytical skills required for quality packaging solutions.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Integrate principles of pharmaceutical science with packaging technology to develop safe, functional, and regulatory-compliant packaging solutions

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** the various types of pharmaceutical products and the factors responsible for the spoilage of the same.

CO2: **Suggest** a suitable type of packaging, closing and dispensing system for the solid and semisolid pharmaceutical products.

CO3: **Suggest** a suitable type of packaging, closing and dispensing system for the liquid pharmaceutical products.

CO4: **Apply** the knowledge of functions of various regulatory bodies working for Pharmaceuticals in India for Packaging Development.

CO5: **Perform** Child Resistant and Senior- friendly Tests and identify Tamper Evident Packaging.

CO6: **Suggest** a suitable type of packaging, closing and dispensing system for the Personal Hygiene Products and evaluate it on corresponding parameters.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction	1a	Classify pharmaceutical products based on therapeutic use and market category.	1.1	Definition of pharmaceuticals, types of pharmaceutical products, ethical & proprietary medicines, OTC drugs.	CO1
	1b	Differentiate drugs by their origin: vegetable, animal, synthetic, and mineral.	1.2	Definition of drug, classifications of drugs: vegetable and animal origin, synthetic, mineral origin. Drug compendia. Drug delivery systems.	
	1c	Evaluate the impact of spoilage agents like moisture, light, and oxygen on drug stability.	1.3	Spoilage agents. Effect of moisture, light, oxygen, and heat.	
	1d	Illustrate the hazards encountered during distribution via various transport modes.	1.4	Distribution hazards: hazards of loading and unloading, movement; rail, sea and air. Climatic and biological hazards	

	1e	Justify preventive strategies against contamination and pilferage in pharmaceutical handling.	1.5	Contamination and pilferage: concept and causes.	
UNIT II: Solid and Semi-solid Product Packaging	2a	Classify solid dosage forms and correlate them with suitable packaging types	2.1	Solid pharmaceutical products: Classification, packaging consideration.	CO2
	2b	Compare primary packaging systems used for different solid pharmaceuticals	2.2	Packaging syetem: forms of containers for solid pharmaceuticals and specific material used for its manufacturing.	
	2c	Differentiate between packaging requirements of solid and semi-solid pharmaceuticals	2.3	Semi-solid pharmaceutical products: classification and packaging considerations.	
	2d	Illustrate packaging system components used for semi-solid products	2.4	Packaging syetem: forms of containers for semi-solid pharmaceuticals and specific material used for its manufacturing. Evaluation of packages.	
	2e	Evaluate effectiveness of various closures and dispensers used in solid and semi-solid drug packaging.	2.5	Closures & dispensers for solid pharmaceuticals. Modern trends (packaging)	
II: Liquid products	3a	Classify liquid pharmaceutical products and link them with appropriate packaging types.	3.1	Liquid harmaceutical products: classification and packaging considerations.	CO3
	3b	Justify the selection of materials and containers used for packaging liquid pharmaceuticals.	3.2	Packaging syetem: forms of containers for liquid pharmaceuticals and specific material used for its manufacturing. Evaluation of packages.	
	3c	Jusrfy the importance of sterilization methods.	3.3	Sterilization: importance and methods of Sterilization.	

UNIT I	3d	Compare closures and dispensers used for various liquid pharmaceutical packages	3.4	Closures & dispensers for Liquid pharmaceuticals	
	3e	Illustrate recent advancements and trends in packaging of liquid pharmaceuticals	3.5	Modern trends (packaging). Evaluation of Packages.	
UNIT IV: Child Resistant (CR) and Tamper Evident (TE) Packaging	4a	Justify the use of child-resistant packaging based on safety requirements	4.1	Child Resistant (CR) Packaging: Definition, need. Typical styles of CR packaging. Specific material used.	CO4
	4b	Apply child test protocol to evaluate the effectiveness of CR packaging	4.2	Child Test: Testing procedure, criteria for test, child test protocol, adult test, adult test protocol, assessment of results.	
	4c	Evaluate TE packaging through the Tylenol case study	4.3	Tamper Evident (TE) Packaging: Definition, importance. The Tylenol case-study.	
	4d	Compare various tamper-evident packaging systems in terms of effectiveness and material used	4.4	TE packaging requirements. TE packaging practices - types of containers, tamper evident systems.	
	4e	Justify selection of container materials in tamper-evident packaging design	4.5	TE packaging: types of containers, their specific material. Evaluation of TE packaging.	

UNIT V: Regulatory Requirements	5a	Analyze the role of CDSCO, NPPA, DCGI, ICMR, and FSSAI in pharmaceutical packaging regulation	5.1	Introduction to and functions of - Central Drugs Standard Control Organization (CDSCO), National Pharmaceutical Pricing Authority (NPPA), Drugs Controller General of India (DCGI), Indian Council for Medical Research (ICMR) and FSSAI.	CO5
	5b	Interpret legal requirements from acts and guidelines relevant to pharmaceutical packaging	5.2	Glimpses of - Drugs and cosmetics act 1940 and amendments, Schedule –T (GMP), the pharmacy act 1948, WHO (medicines).	
	5c	Evaluate pharmaceutical labels for compliance with mandatory information and layout	5.3	Labeling requirements for containers and packages for human use.	
	5d	Justify packaging licensing needs considering GMP and environmental guidelines	5.4	Licensing considerations for pharmaceutical primary packaging. Environmental issues.	
	5e	Assess FDA policies in identifying and reporting defective packaging and adulteration	5.5	FDA policy guidelines for Drug adulteration. Defective medicine report, report associated with packaging.	
Products	6a	Classify personal hygiene products and relate them with appropriate packaging types	6.1	Personal hygiene products: Definition of personal hygiene, classification of Personal hygiene products, Packaging considerations.	
	6b	Compare materials and closures used in packaging different hygiene products	6.2	Packaging of personal hygiene products: forms of containers, and their specific material. Types of closures and dispensers.	

UNIT VI: Personal Hygiene P	6c	Illustrate packaging design considerations for improving user experience in hygiene products	6.3	Packaging design considerations for personal hygiene products. Modern trends.	CO6
	6d	Evaluate packages of specific hygiene products based on performance parameters	6.4	Evaluation of Packages: Perfumes & Deodorants, Bathing soaps, Liquid soaps, Shampoo, Shaving cream.	
	6e	Differentiate packaging efficiency for various creams, powders, and haircare products	6.5	Evaluation of Packages: Face powder and Talcum powder, various creams & lotions, Hair oils, and hair dyes & hair conditioners.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Carry out a case study on drugs of vegetable, animal, synthetic, and mineral origin by visiting a nearby medical store or browsing online platforms, selecting at least two products from each origin, observing their characteristics and label information including brand name, drug content, manufacturer, and expiry date, and prepare a detailed comparative report.	2#	CO1
I	2	Perform a test to determine the effect of moisture on a solid pharmaceutical drug by selecting a suitable product, recording its initial physical characteristics such as appearance, weight, and texture, exposing it to high humidity conditions for a fixed period, and noting and analyzing the changes observed.	2#	CO1
I	3	Perform a test to determine the effect of oxygen or light on a pharmaceutical drug by selecting an appropriate product, documenting its original characteristics, exposing it to oxygen or light (natural or artificial) under controlled conditions, and recording the resulting changes for interpretation.	2#	CO1
II	4	Carry out a case study on pharmaceutical contamination and pilferage by researching at least one real-life incident using secondary sources like news articles, journals, or online reports, studying its causes, effects, and preventive measures, and presenting findings in a structured report.	2	CO2
II	5	Identify various types of primary containers used for packaging solid and semisolid pharmaceutical products by visiting a nearby pharmacy or online catalog, collecting or photographing at least three samples for each type, analyzing the material, shape, cap and closure type, and documenting observations in a tabular format.	2#	CO2
II	6	Carry out a case study on closures and dispensers used for packaging of solid and semisolid pharmaceuticals by collecting samples or images of at least three products of each category, studying their dispensing and sealing mechanisms, noting material of construction, and preparing a descriptive report with diagrams or pictures.	2#	CO2

III	7	Identify various primary containers used for packaging of liquid pharmaceutical products by observing at least three marketed items, noting their container type, material, closure system, and dispensing features, and preparing a comparative analysis in report form.	2	CO3
III	8	Perform case study of various sterilization methods applicable to liquid pharmaceutical packaging by referring to pharmacopeia or standard texts, preparing a comparative table covering dry heat, steam, filtration, and gas sterilization methods, and linking each method to suitable container types and materials.	2#	CO3
III	9	Evaluate modern packaging trends in liquid pharmaceuticals by analyzing at least five current products, studying features such as smart packaging, barrier materials, sustainability aspects, and ease of use, and compiling a report on their innovations and performance benefits.	2#	CO3
IV	10	Perform a Child Resistant Test on a pharmaceutical product by selecting a CR package sample, preparing sufficient testing materials, conducting tests at a primary school or under simulated conditions, following the standard child protocol, recording observations, and evaluating results as per guidelines.	2#	CO4
IV	11	Identify various tamper-evident packaging techniques by observing at least five pharmaceutical products, noting the type of tamper-evident system (e.g., induction seal, breakable cap, shrink band), the material used, its functionality, and prepare a report highlighting their importance and effectiveness.	2#	CO4
IV	12	Differentiate between child-resistant and tamper-evident packaging by collecting examples from real products or images, comparing the mechanisms and design logic of each system, and preparing a brief report with labeled illustrations explaining the key differences.	2#	CO4
V	13	Carry out a case study on pharmaceutical labeling by selecting one marketed product, reading the label thoroughly, identifying elements such as drug name, schedule, dosage, manufacturer details, batch number, manufacturing/expiry dates, and analyzing how they comply with regulatory guidelines.	2	CO5

V	14	Analyze the compliance of a selected pharmaceutical package with packaging and labeling regulations by checking alignment with standards such as CDSCO, DCA 1940, Schedule-T, and prepare a critical assessment report noting any gaps or good practices.	2#	CO5
VI	15	Evaluate the packaging of a personal hygiene product by selecting any one item such as shampoo, cream, or deodorant, noting the container type, material, closure and sealing system, and conducting basic physical tests such as GSM, bursting strength, or drop test to assess performance, compiling findings in a detailed report.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Research and Select the Best Primary Packaging Material: Select a dosage form (tablet, syrup, injection, ointment) and research suitable primary packaging materials (e.g., glass, plastic, foil). Justify your choice considering product compatibility, protection, cost, and regulatory requirements. Submit a report with supporting references.
2. Design a Folding Carton for a Pharmaceutical Product: Choose a pharmaceutical product and design a suitable folding carton (e.g., tuck end, snap lock). Prepare a CAD drawing or hand sketch showing dieline, dimensions, and key design features. Include space allocation for labels, dosage instructions, and regulatory markings.
3. Conduct a Grammage, Thickness, and Burst Strength Test on Paperboard Samples: Collect carton samples from pharmaceutical packaging. Test them using standard test methods. Compare your findings to industry specifications and comment on their suitability for intended use.
4. Investigate Quality Control Defects in Folding Cartons: Inspect pharmaceutical carton samples for common defects such as fishtailing, improper gluing, misprinting, or poor creasing. Photograph and document your findings, suggest possible causes, and recommend corrective actions.
5. Research Regulatory Labeling Requirements: Select one country's pharmaceutical packaging regulations (e.g., US FDA, EU EMA, India CDSCO) and list the mandatory labeling elements. Compare them with another region's requirements and highlight key differences.
6. Analyze Sustainable Packaging Solutions for Pharmaceuticals: Identify at least three sustainable material or design solutions for pharmaceutical packaging (e.g., recyclable blister packs, biodegradable films, reduced ink printing). Evaluate their pros and cons in terms of performance, cost, and compliance.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction	6	C	02	04	04	10
			O	00	04	06	10
2	Solid and Semi-solid Product Packaging	7	C	00	04	06	10
			O	02	04	00	6
3	Liquid products	7	C	02	04	06	12
			O	00	04	04	8
4	Child Resistant (CR) and Tamper Evident (TE) Packaging	7	C	02	04	04	10
			O	02	00	06	8
5	Regulatory Requirements	8	C	02	04	06	12
			O	00	04	00	4
6	Personal Hygiene Products	10	C	02	08	06	16
			O	00	00	04	4
Total		45	C	10	28	32	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	4R2	3R2	6R2	5R2	4R2	2R2	5	7
2	2U4	1U4	3U4	6A4	3A4			3	5
3	4U4	5U4	6U4	3U4	1U4			3	5
4	3A4	1U4	4A4	6U4	4U4			3	5
5	1A6	2A6	5A6					2	3
6	5A6	6A6	2A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	-	3	3	-	3	3	-
CO2	3	3	-	3	3	-	3	3	-
CO3	3	3	-	3	3	-	3	3	-
CO4	3	3	-	3	3	-	3	3	-
CO5	3	3	-	3	3	-	3	3	-
CO6	3	3	-	3	3	-	3	3	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Packaging of Pharmaceuticals and Personal Hygiene Products	H. Lockhart, F. Paine, Blackie Academic & Professional, 2009.	10: 0-7514-0167-6
2	The Wiley Encyclopedia of Packaging Technology	Kit L. Yam,, John Wiley & Sons Inc., 3E, 2010	13: 9780470541395
3	Pharmaceutical Packaging Technology	D A Dean, E R Evans, CRC Press, 2000.	13: 9780748404407
4	Handbook of Package Engineering	J. F. Hanlon, Technomic Pub., 2E, 1992.	10: 0-87762-924-2
5	Packaging of Cosmetics	IIP Notes	--

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1. https://en.wikipedia.org/wiki/Medication assessed on 03rd Aug 2024
2. https://library.scconline.org/journal-of-cosmetic-science/ assessed on 03rd Aug 2024
3. https://www.slideshare.net/slideshow/drug-degradation/6914546 assessed on 03rd Aug 2024
4. https://en.wikipedia.org/wiki/Child-resistant_packaging assessed on 03rd Aug 2024
5. https://www.astm.org/COMMIT/D10Presentations/D10_-_5.pdf assessed on 03rd Aug 2024
6. https://www.sciencedirect.com/science/article/pii/S2772416622001620 assessed on 03rd Aug 2024
7. https://www.grandviewresearch.com/industry-analysis/beauty-personal-care-products-market assessed on 03rd Aug 2024
8. https://www.liquid-pharma.com/ assessed on 03rd Aug 2024
9. https://vicihealthsciences.com/semi-solid-and-semi-liquid-dosage-forms/ assessed on 03rd Aug 2024
10. https://qualitymatters.usp.org/compendium-compendia-compendial-clearing-mystery-these-terms assessed on 03rd Aug 2024

XVI List of Major Equipment/Machineries with Specification:

1. Humidity Chamber.
2. Desktop Computer Systems.
3. Electronic weighing scale - least count 0.01g (minimum).
4. Gas Transmission Rate/Oxygen Transmission Rate Testing Machine.
5. Electronic Weighing Machine.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

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1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4	Dr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
5	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK306H
Course Title	:	Packaging Printing: Gravure and Flexography

I Rationale:

Packaging professionals must have the basic knowledge of aesthetics and printing methods used for printing. This course provides hands-on exposure to flexographic and gravure printing processes used in modern packaging. It enables students to design artwork, prepare inks, operate printing systems, and troubleshoot common defects. Through practical applications, learners gain technical skills in prepress operations, tonal image creation, reverse printing, and quality inspection, fostering industry-ready proficiency for packaging and label production across diverse substrates and formats.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge of printing and graphics techniques for packaging applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Design** flexographic artwork with appropriate trapping and prepare prepress files using CTP concepts.

CO2: **Simulate** flexographic printing using mounted plates.

CO3: **Prepare** flexographic inks, print on multiple substrates, and inspect prints for common defects.

CO4: **Create** gravure-compatible tonal images and perform reverse printing on suitable media.

CO5: **Construct** gravure layout mockups and demonstrate doctor blade and film treatment setups.

CO6: **Simulate** gravure ink transfer and evaluate defect samples for quality improvement.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction to Flexo Printing and Prepress Essentials	1a	Justify the principles of flexographic printing.	1.1	Principle of the flexographic printing process.	CO1
	1b	Compare the advantages and limitations of flexography.	1.2	Advantages and limitations of flexography and applications of flexography in packaging.	
	1c	Idnetify and compare image carriers used in flexography.	1.3	Types of plates: rubber, sheet photopolymer, and liquid photopolymer.	
	1d	Illustrate the CTP system in flexography.	1.4	Computer-to-Plate (CTP) systems and their benefits in flexography.	
	1e	Justify the importance of Plated distortion, applying trapping in flexographic plate making.	1.5	Plated distortion, applying trapping - Concept abd importance.	

UNIT II: Flexo Press and Key Components	2a	Identify the components of flexographic printing machines.	2.1	Flexographic printing process, Printing unit – construction and working.	CO2
	2b	Describe with justification the working of an Inline flexo-press.	2.2	Construction and working of Inline press.	
	2c	Distinguish between Stack press and CI Press.	2.3	Construction and working of Stack press and Common Impression Press.	
	2d	Identify the anilox rollers by cell structures.	2.4	Anilox roller: construction, cell structures.	
	2e	Compare different types of anilox rollers.	2.5	Specific applications of anilox rollers in flexographic printing.	
UNIT III: Flexo Inks and Print Quality	3a	Differentiate flexographic inks based on their types and compositional characteristics.	3.1	Types and composition of flexographic inks.	CO3
	3b	Classify types of flexo inks based on their applications in different packaging materials.	3.2	Applications of flexo inks in packaging.	
	3c	Illustrate the process flow of printed CFB box manufacturing.	3.3	Printed CFB (Corrugated Fiberboard) box manufacturing - Process flow chart.	
	3d	Analyze the suitability of different flexographic coatings for various packaging applications.	3.4	Applications of flexographic coatings in packaging.	
	3e	Idnetify and propose remedies for common flexographic printing defects.	3.5	Defects in flexographic printing, their causes, and remedies.	

UNIT IV: Overview of Gravure Printing	4a	Compare gravure printing with other printing processes based on working principles.	4.1	Principle of gravure printing. Printing Process.	CO4
	4b	Justify the advantages and limitations.	4.2	Advantages and limitations of gravure printing.	
	4c	Justify how reverse printing contributes to image protection and long-term visual appeal.	4.3	Reverse printing: concept and process.	
	4d	Analyze the sequence in multicolor gravure printing.	4.4	Sequence in multicolor gravure printing.	
	4e	Justify the applications of gravure printing in modern packaging.	4.5	Applications of gravure printing in packaging.	
UNIT V: Gravure Cylinder and Press Systems	5a	Classify different types of gravure cylinders based on structure and usage.	5.1	Gravure cylinder (image carrier)- construction and types.	CO5
	5b	Differentiate between carbon tissue, electro-mechanical, and laser engraving techniques.	5.2	Cylinder-making methods: chemical (carbon tissue), electro-mechanical, and laser engraving.	
	5c	Illustrate the role of the doctor blade in gravure printing.	5.3	Doctor blade assembly: construction and working, doctor blade angle.	
	5d	Compare traditional and advanced ESA systems in terms of their impact on printing results.	5.4	Imortance of electrostatic assist in gravure printing, there advancements.	
	5e	Justify the improtanace of film treatment and web tension control.	5.5	Film treatement- Corona Treatment and web tension control; basics.	

UNIT VI: Gravure Inks, Defects, and Sustainability	6a	Classify gravure inks based on their composition and applications.	6.1	Gravure inks; Types and composition.	CO6
	6b	Justify how gravure ink properties influence their application on different packaging materials.	6.2	Properties and applications of gravure inks in packaging.	
	6c	Identify common defects in gravure printing and their causes.	6.3	Common defects in gravure printing: causes and remedies.	
	6d	Review common quality control methods in gravure operations.	6.4	Quality control in gravure printing.	
	6e	Evaluate innovations in gravure printing in terms of sustainability, efficiency, and quality.	6.5	Innovations and sustainability in gravure printing.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Create Flexo Artwork and Perform Color Separation. Design a simple one-color artwork using CorelDRAW or Illustrator, following flexographic requirements such as minimum line weight, font size, and no fine gradients.	2#	CO1
I	2	Create Flexo Artwork and Perform Color Separation: Perform basic color separation and apply trapping to overlapping colors. Simulate slight misregistration and observe how trapping prevents visible gaps..	2	CO1
I	3	Generate Prepress Files and Observe Plate Making for Flexographic printing: Convert the artwork into a print-ready PDF with correct resolution, registration marks, and apply plate distortion if applicable.	2	CO1
I	4	Generate Prepress Files and Observe Plate Making for Flexographic printing: Observe the photopolymer plate-making process through a vendor or video, noting steps such as exposure, washout, drying, and post-curing.	2	CO1
I	5	Inspect Photopolymer Plate and Mount on Simulated Cylinder Flexographic printing: Examine the developed photopolymer plate for image clarity, relief quality, and surface defects. Identify image and non-image areas and Mount the plate onto a 5-inch PVC pipe, aligning it carefully using marks or guides, and secure it to simulate a flexo plate cylinder.	2#	CO1
II	6	Apply Ink and Produce Print Impressions for Flexographic printing: Use a sponge roller or ink pad to apply ink onto the mounted plate and study the ink pickup and coverage characteristics and take print impressions by manual rolling or stamping, varying the impression pressure to observe effects on image sharpness and dot gain.	2#	CO2
III	7	Identify Print Defects and Analyze Causes for Flexographic printing: Examine print samples to identify common flexographic defects such as halo, slur, pinholing, and excessive dot gain.	2#	CO3

III	8	Simulate Ink Transfer and Evaluate Trap Effectiveness for Flexographic printing: Use a textured roller or patterned object to simulate anilox roller behavior and transfer ink onto a substrate, observing uniformity and Print overlapping designs with slightly misaligned registration to evaluate the effectiveness of trap settings in preventing visual gaps.	2#	CO3
III	9	Mix Inks and Measure Viscosity for Flexographic printing: Simulate ink formulation by mixing colored paints or dyes to create desired shades, focusing on color strength and opacity and Use a Zahn cup to measure viscosity of the prepared inks and record flow time. Relate viscosity levels to expected ink behavior during printing.	2#	CO3
III	10	Print on Multiple Substrates and Audit Quality with Flexographic printing: Use the same plate and ink to print on various substrates such as kraft paper, coated board, tracing paper, or foil and Compare the prints across substrates, evaluate differences in ink holdout and sharpness, and complete a mock print job quality audit sheet.	2#	CO3
III	11	Digital demonstration of CTP (Computer to plate) systems for Flexographic printing: Watch online demonstrations of CTP systems and analyze their features and benefits in a group discussion. Write a brief report.	2#	CO3
IV	12	Design Gravure-Compatible Artwork and Prepare Tonal Images: Create a grayscale or tonal image in Photoshop or CorelDRAW suitable for gravure, focusing on smooth gradients, photographic detail, and contrast and Adjust the tonal curve and resolution for gravure prepress, simulate dot gain using the curves tool, and sharpen for reproduction clarity.	2#	CO4
IV	13	Demonstrate Reverse Printing Concept in Gravure Printing – Prepare a mirror image of a design and simulate reverse printing by transferring the inked image onto the backside of a transparent film or acetate sheet. Observe how the image appears correctly from the front side. Discuss why reverse printing is essential for flexible packaging and laminated structures.	2#	CO4
V	14	Simulate Gravure Cell Structures and Engraving Techniques – Study various gravure cell geometries (e.g., elongated hexagonal, square, or diamond) using online visuals or magnified print samples. Sketch cell patterns manually.	2#	CO5

V	15	Watch and Analyze Gravure Cylinder Making Videos: View industrial videos showing copper plating, electromechanical or laser engraving, and chrome polishing processes for gravure cylinders and Write a brief summary or conduct a group discussion covering key stages, technical terms (e.g., stylus, cell depth), and quality control steps.	2	CO5
V	16	Demonstrate Doctor Blade Function - Simulate the action of a doctor blade by using a thin plastic or metal strip to wipe excess ink off a textured or engraved surface (e.g., etched plastic or wooden pattern). Observe how the blade ensures ink remains only in recessed areas, mimicking gravure's precise ink metering. Show the actual blades, discuss types of blades (steel, plastic) and their edge profiles.	2	CO5
VI	17	Common Gravure Defects through Samples and Images: Examine digital or printed samples showing defects like mottle, streaks, haze, and skips. Identify each visually and Identify the probable causes of defects and suggest remedies based on print conditions like doctor blade setting, drying, and viscosity.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Comparing printing mechanisms theoretically: Create detailed sketches comparing gravure and flexographic printing mechanisms.
2. Gravure ink testing on diverse substrates: Prepare mock gravure inks and test them on materials like plastic, metal foil, and coated paper. Evaluate and compare ink behavior, such as drying time, adhesion, and print clarity. Summarize results in a report with supporting images
3. Modeling flexographic printing unit construction: Build a basic model of a printing unit using craft materials to understand its components.
4. Create a Quality Control Checklist and Application: Develop a quality control checklist for gravure printing. Use it to evaluate print samples, identifying different defects.
5. Gravure Ink Testing on Diverse Substrates; Prepare mock gravure inks and test them on materials like plastic, metal foil, and coated paper. Evaluate and compare ink behaviour, such as drying time, adhesion, and print clarity. Summarize results in a report with supporting images
6. Multicolour Gravure Simulation: Simulate multicolour gravure printing by layering different colours using handmade cylinders or textured rollers. Align the layers accurately to demonstrate registration control. Document the process with step-by-step photos and a final print sample.
7. Flexographic Ink Composition Testing: Mix paints or dyes to simulate different types of flexographic inks (water-based, solvent-based, UV). Test these inks on prepared substrates, evaluating drying time, opacity, and adhesion. Present findings in a visual report with photos of the results.
8. Comparative Analysis of Substrate Preparation: Collect different substrates (paper, plastic, cardboard) and prepare them for printing. Create and test prints using manual stamping methods. Develop a report comparing the effects of substrate types on print quality.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Flexo Printing and Prepress Essentials	6	C	2	4	6	12
			O	2	4	0	6
2	Flexo Press and Key Components	9	C	2	4	6	12
			O	0	0	4	4
3	Flexo Inks and Print Quality	8	C	2	4	6	12
			O	0	4	0	4
4	Overview of Gravure Printing	6	C	2	4	4	10
			O	0	4	6	10
5	Gravure Cylinder and Press Systems	8	C	2	4	6	12
			O	0	0	4	4
6	Gravure Inks, Defects, and Sustainability	8	C	0	4	8	12
			O	2	4	6	12
Total		45	C	10	24	36	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	5R2	1R2	6R2	5	7
2	1U4	2U4	6U4	4U4	5A4			3	5
3	4U4	6A4	3U4	1U4	2A4			3	5
4	4A4	5U4	6A4	3U4	6U4			3	5
5	1A6	2A6	6A6					2	3
6	3A6	5A6	4A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	3	-	3	3	-
CO2	3	-	-	3	3	-	3	3	-
CO3	3	-	-	3	3	-	3	3	-
CO4	3	-	-	3	3	-	3	3	-
CO5	3	-	-	3	3	-	3	3	-
CO6	3	-	-	3	3	-	3	3	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	The Wiley Encyclopedia of Packaging Technology	Kit L. Yam,, John Wiley & Sons Inc., 3E, 2010	13: 9780470541395
2	Handbook on Printing Technology (Offset, Flexo, Gravure, Screen, Digital, 3D Printing with Book Binding and CTP)	Asia Pacific Business Press Incorporated, 4th Revised Edition	13: 9788194099505, 10: 8194099501
3	The Complete Book on Printing Technology	NIIR Project Consultancy Services	13:9788178330525, 10: 8178330520
4	Hand Book of Offset Printing Technology	Engineers India Research Institute	13:9788186732823, 10: 8186732829
5	FLEXOGRAPHY 101 - An Introduction to Flexography	Flexographic Technical Association	13:9781484816936 10: 1484816935
6	Hand Book of Printing, Packaging and Lamination	Notion Press	13:9781644292518 10: 1644292513
7	Flexography Principles and Practices 6.0	Foundation of Flexographic Technical Association	13:9780989437417 10: 0989437418

XV e-References:

1. https://ordant.com/what-is-flexographic-printing/ assessed on 26th Aug 2024
2. https://www.youtube.com/watch?v=vuGptR330VU assessed on 26th Aug 2024
3. https://www.youtube.com/watch?v=VKVjnYNFt1M assessed on 26th Aug 2024
4. https://blog.luminite.com/blog/how-flexographic-printing-works-a-step-by-step-guide assessed on 26th Aug 2024
5. https://blog.focuslabel.com/the-flexo-printing-process-explained assessed on 26th Aug 2024
6. https://en.wikipedia.org/wiki/Rotogravure assessed on 26th Aug 2024
7. https://www.youtube.com/watch?v=gIlC3vrPcIQ assessed on 26th Aug 2024
8. https://www.britannica.com/technology/gravure-printing assessed on 26th Aug 2024
9. https://www.ohiogt.com/company/gravure_about.html assessed on 26th Aug 2024
10. https://www.gellnerindustrial.com/blog/what-is-gravure-printing/ assessed on 26th Aug 2024

XVI List of Major Equipment/Machineries with Specification:

1. Portable/ Baby Flexographic Press
2. Portable/ Baby Gravure Press
3. Plate Exposing Machine
4. Gravure Cylinder with Doctor blade Assembly
5. Flexographic Proofing Machine

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology.	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4	Dr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
5	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

(Mr. Syed Imran Ahmed K.)
HOD & Chairman PBOS, PK

(Dr. G. V. Gotmare)
Member Sectretary PBOS, PK

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSC
Course Code	:	PK307H
Course Title	:	Logistics & Supply Chain Management

I Rationale:

In today's competitive market, delivering quality products requires efficient packaging, meticulous distribution planning, and cost-effective transport modes. Effective logistics ensures products reach the right destination on time while maintaining quality. Tracking and monitoring during transit are crucial for accurate deliveries. Key elements like packaging, transportation, warehousing, inventory management, and tracking work together to build a robust supply chain system. Addressing these challenges is vital for business success. This course equips learners with essential knowledge and skills to excel in the dynamic field of logistics and supply chain management.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply the knowledge of managing warehousing, distribution and logistics operations.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Analyse** the Components and Functions of Logistics Management.

CO2: **Apply** Knowledge of Containerization Standards.

CO3: **Evaluate** Transportation Models and Optimization Techniques.

CO4: **Analyse** the Role of Inventory in Logistics and supply chain management.

CO5: **Apply** CPM and PERT in Logistics Planning.

CO6: **Evaluate** the Role of IT in Supply Chain Efficiency.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Overview of Logistics	1a	Apply logistics concepts and operational objectives to plan efficient supply chain strategies.	1.1	Introduction, Logistics concept, Operational objectives.	CO1
	1b	Apply knowledge of logistics components and functions to organize and manage logistics operations.	1.2	Components of logistics management, functions of logistics management.	
	1c	Apply suitable logistics types based on product flow and organizational needs.	1.3	Inbound, outbound and third party logistic, its characteristics and advantages.	
Packaging for Transport	2a	Justify the given type of supply packages.	2.1	Types of supply packages: unitization, Palletization, shrink and stretch wrapping, loading, unloading equipment.	CO2
	2b	Identify given terminology used for Containerization.	2.2	Containerization -Terminology, container dimensions and weights, sizes, type code, operational markings and its arrangements.	

UNIT II:	2c	Classify given containers.	2.3	Classification of containers, advantages of containerization, management of container services.	
UNIT III: Transportation Systems	3a	Compare given modes of transportation on given points.	3.1	Transportation system - Road, Rail, water, air, pipelines, ropeways, etc. comparison.	CO3
	3b	Select given type of transportation mode and network on given basis.	3.2	Elements of transportation cost, multimodal transport, selection of transportation mode, transportation network.	
	3c	Use given method to minimize total transportation cost.	3.3	Transportation model: North-West Corner Method (NWCM), Least Cost Method (LCM). Calculation of Optimization cost of transportation.	
UNIT IV: Inventory and Warehousing	4a	Describe the given types and cost of inventory.	4.1	Inventory - Introduction, concept, types, inventory costs.	CO4
	4b	Use given type of inventry management technique.	4.2	Functions of inventory in logistics and supply chain management, inventory management.	
	4c	Identify given type of warehousing.	4.3	Types of warehouse, concept of warehousing, functions of warehousing, characteristics and warehousing facilities requirements.	
	4d	Evaluate warehousing cost.	4.4	Elements of warehousing cost, operational mechanism of warehouse.	
V: Physical Distribution & Product Identification	5a	Construct a network diagram for given activities.	5.1	Distribution channels, Distribution, Resources planning, master scheduling, CPM & PERT charts.	CO5
	5b	Identify critical path of a given network.	5.2	Simple numerical on transportation Model, CPM & PERT.	
	5c	Apply bar code generation techniques to identify pakages.	5.3	Bar code- concept, types, generation and applications.	

UNIT	5d	Apply RFID techniques for tracking pakages.	5.4	RFID-Concept, principle, types and application.	
UNIT VI: Supply Chain Management	6a	Use various terminologies of supply chain management.	6.1	Definition of Supply chain Management, Importance of supply chain flows; Examples of supply chains.	CO6
	6b	Describe the given elements of supply chain management.	6.2	Elements of supply chain; summering role of different components involved in supply chain management.	
	6c	Justify the role of IT in supply chain management.	6.3	Role of IT in supply chain, Supply chain IT framework.	
	6d	Justify the role of supply chain management in e-shopping.	6.4	Introduction to application of logistic and supply chain management in e-shopping. Supply chain management in popular e-commerce platforms, and their comparative study.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Prepare a report on inbound, outbound and third party logistics, include cocept, activities involved and actual industries involved in such activities in nagpur.	2#	CO1
I	2	Prepare a report on logistics management include concept, components and functions of each component.	2#	CO1
II	3	Analyze a standard container by measuring its dimensions, observing its accessories, and studying its structural features.	2#	CO2
II	4	Prepare a report on Container Features and Measurement performed in practical number 3.	2#	CO2
III	5	Identify and select the most suitable mode of transport for a specific product by analyzing its packaging, weight, quantity, delivery requirements, and available alternatives.	2#	CO3
III	6	Evaluate the selected mode of transport for an assigned product based on package specifications, delivery requirements, with cost considerations.	2#	CO3
III	7	Perform the Comparitive analysis between selected mode of transportation from practical 3 with other alternatives with cost analysis and suitability.	2	CO3
IV	8	Carry out a case study on warehousing, visit to a ware house/store, Observe warehousing practices, Prepare a report on it.	2#	CO4
IV	9	Carry out a case study of local warehouse to understand its operational mechanisms, cost elements, and facilities requirements.	2	CO4
IV	10	Carry out a case study on “Inventory Management” in small/medium scale industry, Visit to a ware house/store, Observe Inventory management practices, Prepare a report on it.	2#	CO4
V	11	Carry out a case study on distribution practices for a consumer product, Visit, to Refrigerator/Air Conditioner/Television distributor, Collect information about practices a distributor follow for distribution of product, Prepare a report on it.	2#	CO5

V	12	Find out distribution channels for perishable products, Identify products and its characteristics, Identify origin & destination, Gather information on existing practices, prepare a report on it.	2	CO5
V	13	Perform bar code generation, scanning OR Verify practices followed for RFID at visited place. Visit to a user of Bar-code or RFID, Observe practices followed by user, Collect information on barcode/RFID type, Generate barcode and tag it, add information on tagged product/identify RFID type, list advantages and disadvantages for that product, Prepare a report.	2#	CO5
VI	14	Carry out a case study on use of logistic and supply chain management for e-shopping, Search for available options for e-shopping. List them, note down type of commodity handled by e-shopper, Collect information on practices followed by e-shopping for storage & distribution, delivery period & variable charges on delivery period, E-commerce practices, Prepare a report.	2#	CO6
VI	15	Conduct a detailed comparison of the supply chain management strategies of Amazon and Flipkart also apllication of IT in supply chain management.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Research and document the logistics operations of a well-known company (e.g., Amazon, Flipkart, or FedEx).
2. Select a company and investigate its inbound and outbound logistics processes. Write a report on it.
3. Conduct a field visit or research to observe the use of palletization and shrink/stretch wrapping in warehouses.
4. Create a report on container types, sizes, weights, and operational markings.
5. Develop a comparative analysis of road, rail, water, and air transportation systems for a specific product or industry.
6. Visit a local warehouse or distribution center and study their inventory management system.
7. Research or visit a warehouse to analyze its operational mechanisms, cost elements, and facility requirements.
8. Select a real-world logistics project and apply CPM (Critical Path Method) and PERT (Program Evaluation and Review Technique) to plan and optimize the project timeline.
9. Prepare a report on use of barcodes and RFID technology in a supply chain setting (e.g., retail stores or manufacturing plants).
10. Conduct a detailed comparison of the supply chain strategies employed by Amazon and Flipkart.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Overview of Logistics	6	C	2	4	4	10
			O	2	0	6	8
2	Packaging for Transport	8	C	2	4	6	12
			O	0	4	0	4
3	Transportation Systems	8	C	2	8	4	14
			O	0	0	6	6
4	Inventory and Warehousing	8	C	2	4	6	12
			O	0	4	4	8
5	Physical Distribution & Product Identification	7	C	0	4	6	10
			O	2	4	0	6
6	Supply Chain Management	8	C	2	4	6	12
			O	0	4	4	8
Total		45	C	10	28	32	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	2R2	3R2	4R2	6R2	1R2	5R2	5	7
2	1U4	2U4	3U4	2U4	4U4			3	5
3	3U4	4U4	5U4	5U4	6U4			3	5
4	6U4	1A4	3A4	4A4	6A4			3	5
5	2A6	4A6	1A6					2	3
6	5A6	6A6	3A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	-	3	-	-	3	3	-
CO2	3	3	-	3	-	-	3	3	-
CO3	3	3	-	3	-	-	3	3	-
CO4	3	3	-	3	-	-	3	3	-
CO5	3	3	-	3	-	-	3	3	-
CO6	3	3	-	3	-	-	3	3	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Supply Chain Management	Sunil Chopra and Peter Meindl, Education., 8E, 2009	10: 81-297-1072-3
2	The Management of Business Logistics	Coyle, Birdie, Langley Jr. Thomson S W Publish., 2001.	13: 978-0324007510
3	Supply Chain Logistics Management	D. Bowersox, David Closs, Tata McGraw Hill , 2003	13: 9780071232074
4	Logistics Management	Bhattacharya S.K., S. Chand Co.,2010	10: 8121928850
5	Logistics Management	Shardul Chaubey, Discovery Publishing House Pvt. Ltd.	10: 8183567940

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2. https://prezi.com/cto29tsofuwk/market-logistics-and-supply-chain-management/ assessed on 19/9/2024.
3. https://transportgeography.org/contents/chapter3/transport-costs/ assessed on 19/09/2024.
4. https://www.shipbob.com/blog/inbound-and-outbound-logistics/ assessed on 19/09/2024.
5. https://en.wikipedia.org/wiki/Third-party_logistics assessed on 19/09/2024.
6. https://www.educationlessons.co.in/notes/transportation-model-introduction assessed on 19/09/2024.
7. https://egyankosh.ac.in/simple-search?query=SUPP assessed on 19/09/2024.
8. https://dorksdelivered.com.au/functional-roles-of-it-in-supply-chain-management/ assessed on 19/09/2024.
9. https://www.economicsdiscussion.net/distribution-channels/what-is-physical-distribution/32208 assessed on 19/09/2024.
10. https://scmwizard.com/supply-chain-flows/ assessed on 19/09/2024.

XVI List of Major Equipment/Machineries with Specification:

1. Measuring Tape.
2. Weighing Machine.
3. Bar code scanner setup with computer system.
4. Desktop computers with high configuration along with internet connectivity.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Anup P. Pardey	Sr. Lecturer, Paper technology	Government Polytechnic, Nagpur.
3	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology.	Government Polytechnic, Nagpur.
4	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
5	Dr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
6	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
7	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
8	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSE
Course Code	:	PK308H
Course Title	:	Green Packaging

I Rationale:

The Green Packaging course equips students to address environmental challenges in packaging through clear concepts and practical experience. The theory part builds understanding of eco-friendly materials, sustainable design principles, innovative technologies, and green manufacturing methods. This knowledge enables learners to make informed choices in material selection, design, and production processes that reduce environmental impact.
The practical component strengthens learning through activities such as material testing, prototype development, process mapping, and comparative studies. These exercises develop problem-solving, critical thinking, and environmental responsibility. By combining theory and practice, the course prepares students to meet industry needs in sustainable packaging and empowers them to contribute to greener, smarter packaging innovations.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Apply environmental ethics and sustanability concerns in packaging applications

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** eco-friendly packaging approaches and their environmental impacts.

CO2: **Select** sustainable packaging materials based on performance and biodegradability.

CO3: **Apply** design principles to create functional and sustainable packaging solutions.

CO4: **Analyze** eco-friendly manufacturing processes for packaging.

CO5: **Investigate** emerging green packaging technologies and trends.

CO6: **Interpret** packaging test results to determine sustainability outcomes.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT 1: Introduction to Green Packaging	1a	Identify the meaning and scope of green packaging.	1.1	Green packaging as an umbrella term for all eco-friendly packaging efforts; relation to sustainable packaging.	CO1
	1b	Compare conventional and green packaging on the basis of given points..	1.2	Material types, waste generation, and environmental impact.	
	1c	Justify the need for green packaging practices.	1.3	Pollution issues, resource depletion, climate change link.	
	1d	Recognize principles of green packaging.	1.4	Reduce, Reuse, Recycle, plus Redesign, Recover, Rethink.	
	1e	Illustrate real-world examples of green packaging.	1.5	FMCG, e-commerce, and food industry eco-initiatives.	

Unit 2: Green Packaging Materials	2a	Identify eco-friendly packaging materials.	2.1	Biodegradable plastics, paper, cardboard, glass.	CO2
	2b	Compare renewable resource materials on given points.	2.2	Bamboo, hemp, PLA (polylactic acid).	
	2c	Recognize innovative natural materials.	2.3	Mycelium, seaweed-based films, plant-based plastics.	
	2d	Evaluate environmental benefits of alternatives.	2.4	Compostability, recyclability, lower carbon footprint.	
	2e	Identify material challenges.	2.5	Availability, cost, strength, shelf-life limitations.	
Unit 3: Green Packaging Design	3a	Identify eco-design principles for packaging.	3.1	Minimalism, modularity, easy-to-disassemble.	CO3
	3b	Recognize lifecycle thinking in design.	3.2	From raw material to disposal/recycling.	
	3c	Compare given ways to reduce material use on the basis of given points..	3.3	Lightweighting, material substitution.	
	3d	Evaluate designs for sustainability.	3.4	Recyclability, durability, biodegradability (at basic level).	
	3e	Illustrate sample eco-friendly designs.	3.5	Folding cartons with less glue, refill packs, compostable trays.	

Unit 4: Green Packaging Manufacturing & Processes	4a	Identify eco-friendly manufacturing practices.	4.1	Energy-efficient equipment, water conservation.	CO4
	4b	Recognize waste reduction methods.	4.2	Material reuse, process optimization.	
	4c	Compare traditional vs. green processes on the basis of given points.	4.3	Impact on waste, energy, cost.	
	4d	Identify challenges in implementing green processes.	4.4	Cost, technology availability, skill gaps.	
	4e	Illustrate innovations in green packaging manufacturing.	4.5	Use of renewable energy, biodegradable inks, automated waste sorting.	
Unit 5: Innovations & Future Trends in Green Packaging	5a	Identify smart packaging technologies.	5.1	Sensors, freshness indicators, QR codes for recycling info.	CO5
	5b	Recognize compostable and edible packaging solutions.	5.2	Seaweed films - Edible films, edible cups/plates, corn-starch wraps.	
	5c	Recognize compostable and edible packaging solutions.	5.3	Compostable laminates, plant-based coatings.	
	5d	Compare traditional vs. advanced recycling methods on given points.	5.4	Chemical recycling, enzymatic recycling.	
	5e	Identify AI/IoT applications in packaging.	5.5	AI-based design tools, Automated sorting, supply chain tracking. Nanomaterials for packaging.	

Unit 6: Quality and Evaluation in Green Packaging	6a	Identify major Indian policies related to green packaging.	6.1	Plastic Waste Management Rules, Extended Producer Responsibility (EPR), ban on certain single-use plastics.	CO6
	6b	Compare between key international packaging regulations on given points.	6.2	EU Packaging Waste Directive, Japan's Recycling Law, US eco-packaging initiatives.	
	6c	Identify common eco-labels and certifications.	6.3	FSC (Forest Stewardship Council), Green Seal, compostable packaging logos, recycling symbols.	
	6d	Recognize the role of environmental packaging standards.	6.4	Overview of ISO 18600 series and BIS eco-packaging standards for identification purposes only.	
	6e	Illustrate examples of packaging compliant with green policies.	6.5	Real-world examples from FMCG, e-commerce, and food packaging that meet eco-standards.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify and classify different packaging materials in your surroundings based on their recyclability and environmental impact.	2#	CO1
I	2	Compare the environmental impact of glass jars versus plastic containers using a simple carbon footprint calculator.	2#	CO1
I	3	Compare packaging waste generated from different product categories (e.g., snacks, beverages, electronics) and suggest reduction methods.	2	CO1
II	4	Measure the biodegradability of packaging peanuts made from cornstarch versus polystyrene by immersing them in water.	2#	CO2
II	5	Determine the bursting strength of bamboo paper versus conventional kraft paper.	2#	CO2
III	6	Demonstrate creative reuse by transforming used cardboard boxes into a new packaging solution.	2#	CO3
III	7	Design a packaging prototype for a fragile item using eco-friendly materials like corrugated cardboard and shredded paper.	2#	CO3
IV	8	Create a flow diagram of a green manufacturing process for a specific packaging material, such as PLA film.	2#	CO4
IV	9	Construct a simple package using pulp molding techniques with recycled paper.	2#	CO4
IV	10	Map the energy and material flow in a small-scale green packaging process to identify areas for improvement.	2	CO5
V	11	Test smart materials by a thermochromic ink on a paper or plastic surface to observe color changes with temperature.	2#	CO5
V	12	Analyze the recycling process for multilayer packaging (e.g., Tetra Pak) and propose technological improvements.	2#	CO5
V	13	Evaluate the composting process of a certified compostable package and record decomposition time.	2	CO6

VI	14	Conduct a tensile test to compare the durability of bioplastic versus conventional plastic packaging.	2#	CO6
VI	15	Perform a water absorption test on paper-based and wax-coated packaging materials.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Explore plant-based alternatives by creating a thin film using gelatin and glycerin and observing its properties.
2. Research and present on innovative materials like seaweed packaging and their applications in the industry.
3. Perform a lifecycle analysis of a common packaging material and suggest design improvements for sustainability.
4. Explore production efficiency by simulating a manufacturing process for eco-friendly bags from kraft paper.
5. Document the challenges in transitioning from traditional to green manufacturing techniques in a hypothetical scenario.
6. Design a concept for IoT-enabled smart packaging that monitors freshness or environmental conditions.
7. Evaluate advanced recycling methods by researching chemical recycling and its benefits over traditional methods.
8. Test for biodegradability of various materials by simulating landfill conditions.
9. Design efficient packaging system to reduce waste and optimize space for storage
10. Evaluate tensile strength of different sustainable materials like jute bags and hemp paper.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Introduction to Green Packaging	6	C	02	04	04	10
			O	00	04	06	10
2	Green Packaging Materials	8	C	00	04	06	10
			O	02	04	00	6
3	Green Packaging Design	8	C	02	04	06	12
			O	00	04	04	8
4	Green Packaging Manufacturing & Processes	8	C	02	04	04	10
			O	02	00	06	8
5	Innovations & Future Trends in Green Packaging	7	C	02	04	06	12
			O	00	04	00	4
6	Quality and Evaluation in Green Packaging	8	C	02	08	06	16
			O	00	00	04	4
Total		45	C	10	28	32	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	2R2	3R2	4R2	5R2	5R2	1R2	2R2	5	7
2	2R4	1U4	2A4	4U4	3A4			3	5
3	5R4	2U4	3U4	5U4	5A4			3	5
4	5U4	6U4	6U4	6U4	6A4			3	5
5	4U6	2A6	3A6					2	3
6	3A6	5A6	6A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	3	-	3	3	-
CO2	3	-	-	3	3	-	3	3	-
CO3	3	2	2	3	-	-	-	3	2
CO4	3	-	2	-	3	-	3	-	-
CO5	3	-	2	3	3	-	3	-	2
CO6	3	2	-	3	3	-	3	3	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Textbook on Green Packaging Solution	Miquel Abellian, Monsa publication, 10th, 2020	10: 8416500371
2	A Textbook on Sustainable Packaging	S.S.Muthu, Environmental Footprints and Eco-design of Products, Springer,2021	13: 978-8121901048
3	A Textbook on Sustainable material for food packaging and preservation	Tabli Ghosh, Ruchir Priyadarshi, Swarup Roy,springer,1st, 2024	13: 9780443135675
4	A Textbook on Green Packaging-An ecofriendly approach towards sustainable developments	Dr.G.Hesil Jerda and Dr.S.Sahayaselvi, Notion press, 2021	10: 1684945860
5	A Textbook on Sustainable Packaging Materials	Muhammad Rabnawaz,Flexiber Einband,10th,2023	13: 978-1-56990-162-5

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1. http://nptel.ac.in/courses/108108076/1 , accessed on 11st July , 2024
2. http://www.greenpackaging4u.com , accessed on 24th July , 2024
3. http://onlinecourses.nptel.ac.in
4. http://archive.nptel.ac.in/courses/112/105/112105267/
5. https://sites.google.com/site/profswapnilambade assesed on 25/07/2024
6. http://www.westrock.com
7. https:www.sciencedirect.com
8. https://link.springer.com

XVI List of Major Equipment/Machineries with Specification:

1. Autocad Software for design
2. Biodegradable material testing machine
3. Green pad packing machine
4. Biodegradable bag making machine, Automatic, 40 pieces per hour

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology.	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4	Dr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
5	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	DSE
Course Code	:	PK309H
Course Title	:	Refrigeration in Packaging

I Rationale:

Year-round food preservation in packaging relies on efficient refrigeration and cold storage. Technicians need strong foundations in thermodynamics, heat transfer, and gas laws. Understanding refrigerants, their properties, and safe handling is essential. The course covers air, vapour compression, and absorption refrigeration systems. Air conditioning principles and systems for controlled packaging environments are included. Cold storage design, equipment, and operational practices are addressed. Practical sessions involve system charging, leakage testing, performance measurement, and field visits. This blend of theory and practice prepares learners for technical roles in food preservation and packaging.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Identify the simple troubles in refrigerator and air conditioning system.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** and specify given refrigeration equipment.

CO2: **Suggest** suitable cold storage for a specific product of needed capacity.

CO3: **Identify** various components of a refrigeration system and their functions.

CO4: **Carry** out general troubleshooting in a refrigeration and air conditioning system & observe safety measures.

CO5: **Detect** leakage of refrigerant using appropriate technique and charge the system with suitable refrigerant.

CO6: **Use** refrigeration system and air conditioner test rigs.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
3	-	2	1	6	3

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
30	70	100	40	25	10	25+	10	25	10

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Basic Thermodynamics	1a	Justify the basics of thermodynamics in refrigeration and air conditioning.	1.1	Thermodynamic system, surrounding & universe – definitions and examples, Properties of a system – extensive & intensive properties, State of a system, Heat, specific heat, latent heat, sensible heat – definitions & their units, Work & thermodynamic work– definitions & units, Energy- definition, types & units, Perfect gas- definition & examples, specific heats of a gas, general gas equation, characteristic gas equation.	CO1
	1b	Apply various gas equations & laws governing the behavior of gases.	1.2	Laws of perfect gas – Boyle's law, Charle's law, Gay-Lussac law, Definitions of enthalpy & entropy.	
	1c	Represent various thermodynamic processes on p-v & T-s planes.	1.3	Representation of following thermodynamic processes on p- v & T-s planes – constant volume, constant pressure, and constant temperature, isentropic.	

	1d	Apply given law in refrigeration in packaging..	1.4	Thermodynamic cycle – definition & its types. Laws of thermodynamics – Zeroth law, First law & Second law.	
UNIT II: Refrigerants	2a	Classify given refrigerants.	2.1	Refrigerants – Definition, desirable properties, classification, examples.	CO2
	2b	Identify characteristics of a given refrigerant.	2.2	Primary, secondary, halo-carbon, Azeotrope, inorganic and hydro-carbon refrigerants – examples of commonly used refrigerants, general characteristics, leakage detection.	
	2c	Determine leakage of refrigerant from a system.	2.3	General thermodynamic of refrigerant, physical & chemical properties desirable in a refrigerant.	
	2d	Identify various properties of a refrigerant.	2.4	Designation system of refrigerants, various properties of refrigerants.	

UNIT III: Air Refrigeration	3a	Distinguish between heat pump and heat engines on given points.	3.1	Refrigeration – definition, necessity, applications. Heat pump, heat engine, refrigerator- Definition, purpose, comparison, uses & applications.	CO3
	3b	Evaluate COP of refrigerator from given data.	3.2	Unit of refrigeration, coefficient of performance (COP) of refrigerator, refrigerating effect– definition & unit.	
	3c	Compare given refrigeration cycles on given points.	3.3	Methods of refrigeration - Air refrigeration cycles – open, closed, reversed Carnot, Bell-Coleman. Air refrigeration system – limited to simple air cooling system.(No numerical). Advantages and disadvantages of Air refrigeration system.	
apour Refrigeration System	4a	Use P-H and T-S diagram.	4.1	Vapour compression cycle – principle, working, different processes. Representation on P-H and T-S diagram.	CO4
	4b	Calculate Actual and theoretical COP of given Vapour compression cycle.	4.2	Types of theoretical vapour compression cycles, Actual vapour compression cycle - description. Differences between actual & theoretical cycles. Simple vapour compression refrigeration system – advantages & disadvantages over air refrigeration, main components, their functions and working. Compound vapor compression system - need, advantages and their types.	

UNIT IV: Va	4c	Compare given vapour compression systems on given points.	4.3	Vapour Absorption Cycle, principle, its component, working of Aqua — Ammonia Vapour absorption system, working of Li-Br absorption system, Electrolux refrigerator- working, main components, applications. Comparlson between Vapour Compression system. and Vapour absorption system. Trouble shooting of refregeration system.	
UNIT V: Air Conditioners	5a	Classify given AC Systems.	5.1	Air conditioning – definition, factors controlled in air conditioning. Air conditioning system – definition, main parts & their function, classification & their definitions.	CO5
	5b	Identify componets of given air conditioners.	5.2	Summer air conditioner, winter air conditioner, year round air conditioning system - schematic arrangement & working.	
	5c	Distinguish between given air conditioning systems.	5.3	Split air conditioner – main parts & working. Unitary air conditioning system- types & description. Central air conditioning system– uses, advantages, description and working. Trouble shooting of air conditioning system.	

UNIT VI: Cold Storage	6a	Apply the concept of temperature zones to categorize products requiring cold storage solutions.	6.1	Introduction to Cold Storage: Definition, necessity, temperature zones, and products requiring cold storage (e.g., food, pharmaceuticals)	CO6
	6b	Select given types of cold storage facilities based on product requirements and infrastructure layout.	6.2	Cold Chain Infrastructure: Types of cold storage (walk-in, portable, refrigerated transport), layout & insulation	
	6c	Evaluate given packaging materials for their compatibility with cold storage environments, considering condensation and insulation factors.	6.3	Packaging Requirements for Cold Storage: Suitable materials, condensation management, labeling, packaging design challenges.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Determine relative humidity of the atmosphere using Dry bulb and wet bulb thermometer method and confirmation of the same using internet. Part - 1	2#	CO1
I	2	Determine relative humidity of the atmosphere using Dry bulb and wet bulb thermometer method and confirmation of the same using internet. Part - 2	2#	CO1
II	3	Perform an activity of charging in a refrigeration/ air conditioning system, carry out the repairs and recharge the sysem, prepare a report on it.	2	CO2
II	4	Perform a test used to detect leakage in a refrigeration system. Write a report on it.	2#	CO3
III	5	Carry out a case study on Refrigeration system in Aircraft. Prepare a report.	2#	CO3
IV	6	Prepare a report on a Vapour absorption refrigeration system: Visit an industry which has vapour absorption system, Observe refrigeration system. Part 1	2	CO4
IV	7	Prepare a report on a Vapour absorption refrigeration system: Identify various parts of the system, Sketch the parts, label them stating their functions. Prepare a report. Part 2	2	CO4
IV	8	Prepare a report on a Domestic refrigerator: Observe a refrigerator, draw the sketch, identify various parts and understand their functions.	2#	CO4
IV	9	Prepare a report on a Domestic refrigerator describing various controls used in it.	2#	CO4
V	10	Operate vapour compression refrigeration system with different settings - Record readings of temperature, humidity, air flow velocity, etc. Part - 1	2#	CO4
V	11	Operate vapour compression refrigeration system with different settings - Record readings of temperature, humidity, air flow velocity, etc. Write a report. Part - 2	2#	CO4
V	12	Prepare a report on a refrigerated vehicle (Van): Observe a refrigerated van, Identify the type of refrigeration system mounted on it. identify various components of refrigerated van system. Part 1	2#	CO5

V	13	Prepare a report on a refrigerated vehicle (Van): Observe a refrigerated van, Identify the type of refrigeration system mounted on it. identify various components of refrigerated van system. Part 2	2#	CO5
V	14	Identify the components of a Split AC - observe the parts, study the functions of the components. Prepare a report.	2#	CO5
VI	15	Visit to a nearby cold storage warehouse prepare a report on mechanism used and control parameter.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare a model of house hold refrigerator.
2. Prepare a demonstration model of cold storage system.
3. Download catalogue of Refrigeration compressors and prepare a report on it.
4. Collect different air outlet devices used in Central air conditioning system and prepare a report.
5. Prepare a report of types of refrigerant used in commercial and Industrial applications.
6. Conduct market survey and prepare a report of window air conditioner make, capacity, arrangement, features, commercial terms etc.
7. Perform comparative study of different types of refrigerants with properties, designation, selection & applications and prepare a report.
8. Conduct a market survey of Packaging Requirements for Cold Storage.
9. Perform comparative study of different types of split air conditioners available in market and prepare a report.
10. Perform comparative study of different types of central air conditioning systems available in market and prepare a report.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Basic Thermodynamics	6	C	02	04	04	10
			O	00	04	06	10
2	Refrigerants	7	C	00	04	06	10
			O	02	04	00	6
3	Air Refrigeration	8	C	02	04	06	12
			O	00	04	04	8
4	Vapour Refrigeration System	8	C	02	04	04	10
			O	02	00	06	8
5	Air Conditioners	8	C	02	04	06	12
			O	00	04	00	4
6	Cold Storage	8	C	02	08	06	16
			O	00	00	04	4
Total		45	C	10	28	32	70
			O	4	16	20	40

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

Q. No.	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Options	
	TLM	TLM	TLM	TLM	TLM	TLM	TLM	C	O
1	1R2	4R2	3R2	6R2	5R2	4R2	2R2	5	7
2	2U4	1U4	3U4	6A4	3A4			3	5
3	4U4	5U4	6U4	3U4	1U4			3	5
4	3A4	1U4	4A4	6U4	4U4			3	5
5	1A6	2A6	5A6					2	3
6	5A6	6A6	2A6					2	3

*T- Unit/Topic Number L- Level of Question M- Marks
*R – Remember U – Understand A – Analyze / Apply
*1R2 means Unit Number No- 1, Level of Question –Remember, Marks – 2 Marks

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Attendance & Punctuality	5
2	Regular Lab Performance	5
3	Record/Journal Submission (Quality of work / Neatness)	5
4	Viva Voce (During Sessions)	5
5	Internal Practical Test (Mock)	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Performance of Assigned Task(s)	5
2	Neat and accurate write-up including drawings, tables, calculations, and result or conclusion	5
3	Correctness and quality of result and execution	5
4	Viva Voce	10
	TOTAL	25

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	3	-	-	3	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	-	-	3	-	-	3	-	-
CO5	3	-	-	3	-	-	3	-	-
CO6	3	-	-	3	-	-	3	1	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Refrigeration and Air Conditioning	R.S.Khurmi, S.Chand and Co., 2001	10: 81-219-1687-9
2	Refrigeration and Air Conditioning	C. P. Arrora, McGraw Hill Education; 3 E, 2017	10: 9351340163 13: 978-9351340164
3	Refrigeration and Air Conditioning	Manohar Prasad, New Age Publications, 2009	13: 788122414295
4	Refrigeration and Air Conditioning	P.N.Ananthanarayanan; TataMcGraw Hill, 4E, 2015	10: 1259062708 13: 9781259062704
5	Principles of Refrigeration	Roy Dossat, Pearson Education, 5E, 2001	10: 0130272701 13: 978-0130272706
6	Audels Refrigeration and Air Conditioning Guide, V2, Sections 3-4: Commercial Industrial Plants, and Air Conditioning Systems	Edwin P Anderson, Literary Licensing, LLC, 2013	13: 978-1258694234

XV e-References:

1. https://en.wikipedia.org/wiki/Relative_humidity, assessed on 22 September 2024.
2. https://en.wikipedia.org/wiki/Air_conditioning, assessed on 23 September 2024.
3. nptel.ac.in/courses/112105129/pdf/RAC%20Lecture%209.pdf, assessed on 25 September 2016.
4. https://www.youtube.com/watch?v=Ll8Ku-mFQx, assessed on 27 September 2024.
5. https://www.youtube.com/watch?v=gt1OVt1JWwI, assessed on 27 September 2024.
6. https://www.youtube.com/watch?v=34K61ECbGD4, assessed on 28 September 2024.
7. https://www.youtube.com/watch?v=r7qIL4bk66A, assessed on 29 September 2024.
8. https://www.youtube.com/watch?v=Ghp-O1bMMuU, assessed on 30 September 2024.
9. https://www.youtube.com/watch?v=dBgk74o6wwA, assessed on 01 October 2024.
10. https://www.youtube.com/watch?v=AUvt-lJcGsM, assessed on 03 October 2024.

XVI List of Major Equipment/Machineries with Specification:

1. Pressure gauge.
2. Temperature recording device/ thermometer.
3. Vapour compression refrigeration system.
4. Air conditioning test rig

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
2	Mr. Subhash N. Madhugiri	Rtd. Head of Department, Packaging Technology.	Government Polytechnic, Nagpur.
3	Mr. Rajesh S. Raool	Rtd. Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4	Dr. Milind S. Deshpande	Lecturer in Mechanical Engineering.	Government Polytechnic, Arvi.
5	Mr. Prasd B. Iyer	Director	SIES School of Packaging, Mumbai.
6	Mr. Uday D. Raut	Managing Director	B.R. Plastic Industries, MIDC, Nasik.
7	Mr. Ali M. Zeeshan M.S.M	Assistant Prof. in Mechanical Engineering	Anjuman College of Engineering Nagpur.

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GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
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COURSE CURRICULUM

Program	:	Diploma in PK
Course Category	:	SEC
Course Code	:	PK352H
Course Title	:	Capstone Project

I Rationale:

The Capstone Project curriculum bridges academic theory with practical application, offering diploma engineering students real-world experience in project planning, execution, and analysis. By engaging in teamwork and problem-solving, students apply technical knowledge, innovate solutions, and develop essential skills in technical communication through detailed report writing. Professional presentation practice builds confidence and clarity, preparing students to effectively convey and defend their work. This curriculum fosters adaptability, critical thinking, and self-directed learning, equipping students with the competencies necessary for success in engineering roles within industry or further academic study.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Plan and execute packaging projects effectively and create technical documentation.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Develop** a feasible project proposal addressing relevant engineering problem(s).

CO2: **Plan** and organize project activities, including timeline, resource allocation, and budgeting.

CO3: **Compile** a literature review and methodology relevant to the project.

CO4: **Execute** project tasks systematically to achieve desired engineering outcomes.

CO5: **Test,** troubleshoot, and refine project components to ensure accuracy of results.

CO6: **Prepare** and present project report, effectively communicating goals, methodology, and results.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	4	-	4	2

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	50	20	50+	20	-	-

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
Unit I: Proposal	1	Form project teams of four to five students, as per the guidelines of your program.	2#	CO1
	2	Conduct initial survey to identify a relevant engineering problem and define the problem scope, objectives, and key challenges.	2#	CO1
	3	Hold team brainstorming sessions to explore potential approaches and solutions and evaluate each approach's feasibility and effectiveness in addressing the problem.	2#	CO1
	4	Analyse project requirements: materials, technology, cost, time, and human resources and identify potential risks and develop mitigation strategies.	2#	CO1
	5	Present the preliminary proposal to the project guide and revise the proposal based on feedback, refine the problem statement and solution approach (if required).	2#	CO1
	6	Prepare a formal proposal document in prescribed format and submit it for approval by the mentor (project guide).	2#	CO1

Unit II: Planning	7	Create a Gantt chart or project schedule outlining major tasks, milestones, and deadlines and set target dates for each phase, considering project scope.	2#	CO2
	8	Identify the necessary tools, equipment, materials, and software for project completion and assign team members to tasks based on skill sets and project needs.	2#	CO2
	9	Calculate costs for materials, equipment rentals, software licenses, and miscellaneous expenses and set a budget for each phase of the project to ensure cost-effective planning.	2#	CO2
	10	Estimate the required hours for each team member based on project needs and timelines and monitor resource usage throughout the project to stay within budget and schedule.	2#	CO2
Unit III: Liturature Survey	11	Search for academic papers, industry reports, and case studies related to the project topic and analyse collected resources and summarize findings, noting insights that inform project design.	2#	CO3
	12	Evaluate existing research to identify areas that lack sufficient study or solutions and define how the project will address these gaps and contribute new insights.	2#	CO3
	13	Choose appropriate methods for data collection, experimentation, or analysis to achieve project objectives and justify the chosen methodology based on similar studies and project requirements.	2#	CO3
	14	Compile a written review summarizing relevant literature, key insights, and the project's methodological approach and submit the literature review and methodology for mentor feedback and revision.	2#	CO3
V: Project Work	15	Divide the project into specific, manageable tasks aligned with the project plan and assign each task to team members according to skill and expertise.	2#	CO4
	16	Begin hands-on work, such as prototyping, coding, or constructing components, according to the project methodology and ensure all steps align with technical requirements and desired outcomes.	2#	CO4
	17	Continue project task.	2#	CO4
	18	Continue project task.	2#	CO4
	19	Continue project task.	2#	CO4
	20	Continue project task.	2#	CO4
	21	Continue project task.	2#	CO4

UNIT I	22	Continue project task.	2#	CO4
	23	Regularly review each task's progress to ensure alignment with specifications and quality standards and use checklists or logs to document completion and quality of each task.	2#	CO4
	24	Record steps taken, materials used, results, and any challenges faced in a project log and ensure all documentation is clear for future reference or report preparation.	2#	CO4
UNIT V: Testing	25	Perform functionality tests on individual components or subsystems to identify any issues and compare test results against expected outcomes to assess accuracy.	2#	CO5
	26	Apply systematic troubleshooting techniques to isolate the root causes of errors (if any) and modify component settings, recalibrate, or replace parts if needed to resolve issues.	2#	CO5
	27	Prepare detailed records of testing procedures, troubleshooting steps, and final adjustments and include annotated test results to support final project reporting.	2#	CO5
UNIT VI: Report Writing	28	Document project goals, methodology, findings, analysis, and conclusions in a structured report format which includes following. •Title Page which includes: Project Title, Purpose of submission, Institute logo, Students Name, Guide Name, Program, and Institute Name •Certificates: Student declaration, Certificate from guide •Acknowledgement •Table of contents •List of Tables •List of Figures •List of abbreviations and acronyms (if any) •Text 1.Introduction, objectives 2.Literature Survey 3.Methodology/Materials/Methods/Estimate. 4.Results 5.Summary/Conclusion. 6.References	2#	CO6
	29	Submit the project report to the project guide and revise the report based on feedback. Perform plagiarism check from any free internet site and submit report of plagiarism check to the guide.	2#	CO6
	30	Submit prited copies of project repiort to the guide as per policy of program.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Selection of topic, project proposal, planning, and organizing	10
2	Compilation of Literature Review and Methodology	5
3	Execution of project work and testing	25
4	Report writing and viva voce	10
	TOTAL	50

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	-	-	3	3	-	-
CO2	-	-	-	-	-	3	3	-	-
CO3	-	-	-	-	-	3	3	-	-
CO4	2	2	2	2	2	3	3	-	-
CO5	2	2	2	2	2	3	3	-	-
CO6	-	-	-	-	2	3	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	The Big Book Of Packaging	Sandeep Kumar Goyal, Sanex Packaging Connections Pvt. Ltd., 2016	13: 978-9385010033
2	The Packaging Development Process: A Guide for Engineers and Project Managers	Kristine DeMaria, CRC Press; 1st Edition, 1999	13: 978-1566768016

XV e-References:

XVI List of Major Equipment/Machineries with Specification:

1. Equipment as per project requirement.

XVII List of Industry Experts and Faculties who contributed for this curriculum:

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1	Mr. Syed Imran Ahmed K.	I/c. Head of Packaging Technology.	Government Polytechnic, Nagpur.
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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/CM/IT/AE/MT/PK/TX/MK/AI
Course Category	:	INP
Course Code	:	IN352H
Course Title	:	Internship (Report Writing)

I Rationale:

The internship course is a critical component of the diploma program, providing students with hands-on experience in a real-world industry setting. The internship takes place after the fourth semester during summer vacation and involves working in a small, medium, or large-scale industry related to the student's field of study. The course is designed to bridge the gap between academic learning and industrial application, allowing students to apply theoretical knowledge in a practical environment. For ease, assessment this course is devided into two semester, semimar assessment in fifth semester and report writing in sixth semester.

The report writing component of the internship course is designed to enhance students' technical writing skills. This part of the course requires students to document their internship experience in a comprehensive report, demonstrating their ability to organize and present technical information clearly and accurately. The report serves as a formal record of the student's industrial experience and is an essential skill for any engineering professional.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Bridge theoretical knowledge with practical experience in a professional environment.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Evaluate** the organization's structure, processes, safety protocols, and industry standards to determine operational effectiveness.

CO2: **Apply** industry-specific tools, technologies, and skills to perform various operations.

CO3: **Contribute** to organizational goals by handling projects/ tasks under mentor guidance, applying learned skills.

CO4: **Analyze** technical challenges, addressing industry-specific issues effectively.

CO5: **Prepare** a internship report, ensuring accuracy and clarity.

CO6: **Submit** internship report in prescribed format.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	2	10	12	6

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	-	-	25	10	50	20

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)	Topics and Sub-topics	Aligned Cos

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Learn the organization's structure, operational workflow, safety standards, industry practices, methodologies, technologies, and workplace processes to analyze operational efficiency and compliance requirements.	30#	CO1
II	2	Undergo training on industry-specific tools, technologies, and software, while gaining hands-on experience in performing basic operations, troubleshooting, and maintenance tasks, applying relevant skills to real-world industry scenarios and challenges.	60#	CO2
III	3	Participate in daily operations under mentor guidance, handling assigned projects or tasks aligned with industry needs, applying learned skills to contribute to organizational goals and gaining practical experience in real-world scenarios.	150#	CO3

IV	4	Identify and analyze technical challenges in industry, and address industry-specific issues (if any).	60#	CO4
V	5	Prepare a comprehensive internship report that effectively documents work experiences, technical tasks, and key achievements throughout the internship. Ensure the accuracy of the content by cross-referencing with project details. Organize the report clearly, following industry standards.	20#	CO5
VI	6	Submit the internship report following the prescribed format, ensuring all required sections are included, such as introduction, methodology, project details, analysis, conclusions, and recommendations, while adhering to formatting and submission guidelines.	10#	CO6

Note: # Compulsory. Unit No. I to IV during summer vacation in industry and Unit No. V and VI during Sixth Sem.

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. During the summer vacations, after the 4th Semester, students are required to undergo internship with industry/ NGO"s/ Government organizations/ Micro/ Small/ Medium enterprises to make ready for the industry.

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Accuracy, relevance of content	10
2	Organization and Structure	5
3	Technical Writing	5
4	Presentation and Formatting	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Selection of industry	5
2	Work done and Feasibility of work	25
3	Daily diary and supervisor remark	10
4	Problem identification	10
	TOTAL	50

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	-	-	-	-	3	3	-	-
CO2	-	-	-	-	-	3	3	-	-
CO3	-	-	-	-	-	3	3	-	-
CO4	-	-	-	-	3	3	3	-	-
CO5	-	-	-	-	-	3	3	-	-
CO6	-	-	-	-	-	3	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Industrial Training and Education	Lokesh Choudhary, Mittal Publications, 2007	10: 8183242367 13: 9788183242363
2	Training Practice	Penny Hackett, McGraw-Hill Education, September 2003	10: 0852929803 13: 9780852929803
3	AICTE Internship Policy: Guidelines & Procedures	All India council of Technical Education New Delhi	-

XV e-References:

1. https://internship.aicte-india.org/ assessed on 23rd April 2024
2. https://www.coursera.org/articles/computer-science-internships assessed on 23rd April 2024

XVI List of Major Equipment/Machineries with Specification:

1. Desktop computers
2. Laser Printer
3. DLP

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. R. P. Mogre	Principal	Government Polytechnic, Nagpur
2	Dr. M. V. Sarode	HoD, Computer Engineering and I/C Trainining & Placement Officer	Government Polytechnic, Nagpur
3	Dr. G. V. Gotmare	I/C Curricullum Development Cell	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/PK/MT/IT/AE/CM/TR/TX/MK/AI
Course Category	:	VEC
Course Code	:	VE352H
Course Title	:	Indian Knowledge System

I Rationale:

This course on "Indian Knowledge System" for diploma students is designed as per the requirements of the National Education Policy (NEP) 2020. It aims to provide a comprehensive understanding of India's rich heritage in knowledge, covering areas like philosophy, mathematics, science, engineering, town planning, and Vastu-sastra. By exploring these diverse fields, students will gain insights into the holistic and unique approaches that shaped Indian civilization. The course bridges ancient wisdom with modern technological practices, fostering an appreciation for India's significant contributions to global knowledge.

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Exhibit a comprehensive grasp of Indian knowledge systems, applying their principles across various domains of technology and philosophy.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Exhibit** comprehension of Indian knowledge systems' significance, evolution, and unique holistic approaches.

CO2: **Explore** philosophical principles of Vedic and Non-Vedic schools, emphasizing their significance and unique approaches.

CO3: **Analyze** the Indian numeral system, measurement units, and Bhaskaracarya's contributions to the decimal system.

CO4: **Apply** ancient Indian mathematical methods and principles, emphasizing contributions and practical problem-solving techniques.

CO5: **Analyze** India's science, engineering, and metalworking heritage, emphasizing technological advancements and artistic craftsmanship.

CO6: **Analyze** ancient town planning and architecture while exploring the key principles of Vastu-sastra.

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
-	-	2	-	2	1

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	25	10	25	10	-	-

VI Classroom Learning Content:

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Organize a report showcasing ancient Indian knowledge's significance in mathematics, astronomy, medicine, architecture, and global influence.	2#	CO1
I	2	Categorize education features and institutes during Vedic, medieval, and colonial periods, emphasizing methodologies, curricula, and societal impact.	2#	CO1
I	3	Compile a report on Indian knowledge's uniqueness, including holistic approaches, sustainability, ethics, and integration of science and spirituality.	2#	CO1
II	4	Analyze the salient features of philosophical systems belonging to the Vedic school, emphasizing their principles and contributions.	2#	CO2
II	5	Examine the salient features of philosophical systems belonging to the Non-Vedic school, highlighting their distinctive approaches and significance.	2#	CO2
III	6	Investigate the Indian Numeral System and traditional units of measurement, emphasizing their historical development and applications.	2#	CO3

III	7	Explore Bhaskaracarya's Lilavati, focusing on the decimal system and the concept of place value.	2#	CO3
III	8	Compile a report on ancient Indian mathematicians and their significant contributions to mathematics and related fields.	2	CO3
IV	9	Apply Aryabhata's method to find the square root of numbers and verify the results.	2#	CO4
IV	10	Use the Bhakshali method to calculate square roots and verify accuracy through practical examples.	2#	CO4
IV	11	Construct a five-letter binary word table using Pingala's Prastara and explain its systematic arrangement.	2	CO4
V	12	Investigate the science, engineering, and technology heritage of ancient and medieval India, highlighting key achievements.	2#	CO5
V	13	Examine ancient practices in metalworking, metal arts, and idol making, focusing on techniques and innovations.	2#	CO5
VI	14	Analyze the historical development of town planning and architecture in ancient India, highlighting key principles.	2#	CO6
VI	15	Explore the basic limbs of Vastu-sastra, focusing on its foundational concepts and applications.	2#	CO6

Note: # Compulsory

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

IX Specification Table for Classroom Learning Assessment:

X Question Paper Format for Summative Assessment (SA):

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Performance	10
2	Report Writing	10
3	Viva Voce	5
	TOTAL	25

XII Scheme of Self-Learning Summative Assessment (SA):

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	3	-	-
CO6	3	-	-	-	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Introduction to Indian Knowledge System	Dr. Rohidas Nitonde, Notion Press, 2024	!3: 979-889544408-5
2	Introduction to Indian Knowledge System Concept and Applications	B. Mahadevan, Vinayak Rajat Bhat, Narendra Pavana R.N., PHI Learning Private Limited, Delhi, 20124	13: 978-93-91818-20-3

XV e-References:

1. https://onlinecourses.swayam2.ac.in/ntr24_ed78/preview accessed on 15th December, 2024
2. https://www.bing.com/videos/search?q=NPTEL+swayam+indian+knowledge+system&qpvt=nptel+swayam+indian+knowledge+system&FORM=VDRE
3. https://www.bing.com/videos/riverview/relatedvideo?q=NPTEL+swayam+indian+knowledge+system&qpvt=NPTEL+swayam+indian+knowledge+system&vie

XVI List of Major Equipment/Machineries with Specification:

1. Computer System Latest Version

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. R.P. Mogre	Principal	Government Polytechnic, Nagpur
2	Dr. Prasad Gokhale	Professor	Kavikulaguru Kalidas Sanskrit University, Ramtek
3	Dr. P. P. Virkhare	HOD, Travel and Tourism	Government Polytechnic, Nagpur
4	Dr. G. V. Gotmare	I/C, Curriculum Development Cell	Government Polytechnic, Nagpur

(Dr. G. V. Gotmare)
HOD & Chairman PBOS, COMMON

(Dr. G. V. Gotmare)
Member Secretary PBOS, COMMON

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Government of Maharashtra
GOVERNMENT POLYTECHNIC, NAGPUR
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in CE/ME/EE/EC/IT/MT/TX/AE/PK/CM/MK/AI
Course Category	:	INP
Course Code	:	IN353H
Course Title	:	Entrepreneurship and Startup

I Rationale:

Engineering curriculum is a dynamic process. It continuosly evolves itself reflecting the needs and aspiration of learners. In recent times, our society is influenced by knowledge creation and techological advancements. Competencies affecting Innovation and creativity have become important in all walks of life, including business context. This makes entrepreneurship education even more important for enhancing quality of life. Entrepreneurship plays an influential role in the economic growth and development of the country. As the world economy is changing so is the dynamism of the business world. The aim of this course is to inculcate the spirit of Entrepreneurship among the students. The idea of this course is to create "Job providers rather than job seekers."

II Industry Identified Competency:

The Student will be able to do in Industry at entry level:

Inculcate entrepreneur inclination among students.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Develop** entrepreneur mindset among engineering students.

CO2: **Develop** entrepreneural traits for self employment and startup.

CO3: **Establish** problem solving technique to the challenges.

CO4: **Inculcate** characteristic for inovation and developing research mindset.

CO5: **Identify** the need of break even analysis for startups.

CO6: **Explore** business law and trade rules for startup units

IV Learning Scheme:

Classroom Learning (CL)	Tutorial Learning (TL)	Laboratory Learning (LL)	Self-Study Learning (SL)	Notional Learning Hours (NLH)	Credits
1	-	-	1	2	1

V Assessment Scheme:

Classroom Learning				Tutorial/Laboratory Learning				Self-Study Learning	
FA	SA	Total		FA		SA		SA	
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min
-	-	-	-	-	-	-	-	100	40

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: Introduction	1a	Develop Entrepreneur mindset among students.	1.1	Concept of entrepreneurship - definition of entrepreneurship by many researcher	CO1
	1b	Examine the process of entrepreneurship	1.2	Function of entrepreneur, Entrepreneurship as a carreer, Need of entrepreneurship in economic, Current scenerio of entrepreneur activity in India.	
UNIT II: An Entrepreneur Journey	2a	Identify the types of entrepreneurs	2.1	Entrepreneur- Types of entrepreneur, Motivation to become an entrepreneur, competencies of an entrepreneur	CO2
	2b	Develop given entrepreneurship traits.	2.2	Entrepreneural skills- Innovative idea generation	
UNIT III: Innovative Entrepreneurship	3a	Establish problem solving technique to given challanges.	3.1	Role of entrepreneurs - problem solvers, Innovations and startups, improve GDP of nation, Working with NGO	CO3

UNIT IV: Marketing	4a	Inculcate given innovation and market research among students.	4.1	Concept of market - elements of market enviornment, micro & macro level of marketing for innovative product	CO4
	4b	Identify given micro and macro market enviornment.	4.2	Conncept of marketing mix and its advantages of innovative product.	
UNIT V: Business Finance	5a	Suggest the sources of finance for given starup.	5.1	Sources of Finance - Advanatage and disadvantages, costing of the product	CO5
	5b	Identify the need of break even analysis for startup and innovative product	5.2	Costing - types of costing, cost of componant and operational cost. Break even analysis of product develop in startup	
UNIT VI: Resources of startup & Managemet	6a	Formulate a comprehensive business setup plan by integrating infrastructure, manpower, machinery placement, and trial production processes.	6.1	Sources to set up business startup- land, power and infrastucture. Organising business setup from placement of manpower, placement of machineries and trial production for the new startup product.	CO6
	6b	Explore basic business law and trade rule for given startup.	6.2	Laws related to business and starup- Trade rule & policy of Government of India	
	6c	Prepare detailed project report	6.3	Various government schemes implemented by MSME, KVIC, DIC, and DST. Write-up for detailed project report for PMEGP, CMEGP.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)	Hours	Aligned COs

VIII Self-Study Learning (SLO in Cognitive/Psychomotor/Affective Domain)

1. Prepare a deailed project report (DPR) for any one project on any business/ start-up as you desire. Perform following activities: Market reasearch of the product, Identify demand and supply for the product, Identify area to launch the product, prepare the chart for financing the project, Interact with the bankers for financing the project, Visit to MIDC for land allocation, Prepare the Diagonstic Study Report (DSR), Interact with local government agencies like MSEDCL, Udhyog Registration, and NOC from Polution Board (if required), Collect DPR format from local DIC Centre and submit the complete report for evaluation.

IX Specification Table for Classroom Learning Assessment:

Unit No.	Units	Classroom Learning Hours	C/O	Levels from Cognition Process Dimension			Total Marks
				R	U	A	
1	Entrepreneurship Concept & Importance	3	C	0	0	0	0
			O	0	0	0	0
2	An Entrepreneur journey	2	C	0	0	0	0
			O	0	0	0	0
3	Entrepreneurship as innovation and startup	3	C	0	0	0	0
			O	0	0	0	0
4	Marketing of Innovative & startup product	2	C	0	0	0	0
			O	0	0	0	0
5	Business finance for startup	2	C	0	0	0	0
			O	0	0	0	0
6	Resources of startup & Managemet	3	C	0	0	0	0
			O	0	0	0	0
Total		15	C	0	0	0	0
			O	0	0	0	0

*C - Compusory O - Optional
*R – Remember U – Understand A – Analyze / Apply

X Question Paper Format for Summative Assessment (SA):

-----NA-----

XI Scheme of Laboratory Formative Assessment (FA):

XII Scheme of Self-Learning Summative Assessment (SA):

S.N.	Criteria	Max. Marks
1	Collection of data	20
2	Visit to Market Research	20
3	Survey report	10
4	Report writing/Viva-Voce	50
	TOTAL	100

XIII COs-POs/PSOs Mapping Matrix:

Course Outcomes	Program Outcomes							Program Specific	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	-	-	-	3	3	-	-	-
CO2	3	-	-	-	3	3	-	-	-
CO3	3	-	-	-	3	3	-	-	-
CO4	3	-	-	-	3	3	-	-	-
CO5	3	-	-	-	3	3	-	-	-
CO6	3	-	-	-	3	3	1	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	An Investigation of Entrepreneurial Inclination Among Engineering Students	C. P. Kapse, M. K. Das, Serial Publication, New Delhi	13: 978-8193342046
2	Entrepreneurship	Rajiv Roy, Oxford University Press, 2011	13: 978-0198072638
3	Entrepreneurship Development	Ulhas Chandra Das, Centre for Distance & Online Education Utkal University, Bhubaneswar.	-
4	Financial Management	I. M. Pandey, Vikas Publishing House Pvt. Ltd., 2004	10: 81-259-0638-X
5	Principles and Practice of Management	R. S. Gupta, B. D. Sharma, N. S. Bhalla, Kalyani Publishers, 2011	13: 978-81-272-7076-6

XV e-References:

1. https://ediindia.org/research-publication/faculty-publications/ assessed on 21st December 2024

XVI List of Major Equipment/Machineries with Specification:

1. NIL

XVII List of Industry Experts and Faculties who contributed for this curriculum:

S.N.	Name	Designation	Institute / Industry
1	Dr. C. P. Kapse	I/C HOD, Textile Manufacture	Government Polytechnic, Nagpur
2	Dr. S. G. Gaikwad	Selection Grade Lecturer, Textile Manufacture	Government Polytechnic, Nagpur
3	Prof L.S.Chakraborty	Lecturer, Textile Manufacture	Government Polytechnic, Nagpur
4	Prof Harshal Ramteke	HOD Textile Technology	SASMIRA, Mumbai
5	Mr Laxminarayan Kaushik	Director	LLP Professional, Nagpur
6	Dr Ganesh Kakad	HOD Textile Engineering	JDIT, Yavatmal
7	Prof S. S. Lawand	Selection Grade Lecturer, Textile Manufacture	Government Polytechnic, Nagpur

(Dr C. P. Kapse)
HOD & Chairman PBOS, TX

(Dr. G. V. Gotmare)
Member Sectretary PBOS, TX

Appendix II

Guidelines

Guidelines

for

Integrated Personality Development Courses (VE151H & VE152H)

1. For registration, use IPDC Campus course registration platform.
2. Use following links for registrations: (Use ipdc-campus-course-portal-user-manual for reference)
   i) IPDC Coordinators and Faculty Members Login Portal
   https://campus.ipdc.org/portal/Home/LoginForUsers/
   ii) IPDC Coordinator registration:
   https://campus.ipdc.org/portal/Home/coordinatorRegistration/
   iii) IPDC Faculty Members Registration
   https://campus.ipdc.org/portal/Home/facultyRegistration/
   iv) IPDC Students Registration
   https://campus.ipdc.org/portal/Home/studentRegistration/

3. IPDC Campus Course desktop application will be used to deliver lecture content to IPDC students into the physical classroom. Lecture content will have introductory films, lecture videos, student interactions, and workbook activities.
4. Role of IPDC Coordinators:
   i) Register yourself as an IPDC Coordinator, ask IPDC Administrator for approval.
   ii) Make sure that faculty members under your institution must register themselves.
   iii) Approve faculty members registered under you, by login portal via your profile.
5. Role of IPDC Faculty Members:
   i) Register yourself as an IPDC Faculty Member, ask your IPDC Coordinator for approval.
   ii) Make sure that your respective students must register themselves.
   iii) Enter the particular semester duration (only once) and approve students registered under you, by login portal via your profile.
   iv) Download desktop application from login portal via your profile login and install it to the computer system from which you want to conduct the multimedia lectures.
   v) Login to the desktop application by your profile, download the lectures and start conducting IPDC lectures.
6. Lectures will take place in the department classrooms and will be hosted by an integrated personality development course (IPDC) trained Faculty.
7. The Teaching resources will be provided by Swaminarayan Aksharpith on IPDC portal.
8. Each lecture has four components as shown below:
   i) **Introductory Film:** Each lecture begins with a short film that introduces the topic through modern production. The original content displays relatable scenarios and visuals that captivate the students' attention and stimulates their curiosity to learn more.

ii) **Lecture Video:** Students watch a lecture video presented by a dynamic speaker. The lecture reinforces the significance and necessity of fundamental principles and skills. The experience of the speaker, eloquence of presentation, and use of interactive visuals collectively create a profound impact on each student's mind and heart.

iii) **Student Interaction:** Student interaction sessions promote stimulating discussion and conversation and help create safe spaces for the healthy exchange of ideas. Thus, each session provides a forum in which students can openly express their emotions and thoughts.

iv) **Workbook Activities:** Workbooks assist students to begin implementing the values taught in the lecture into their personal lives. Reliable research, priceless experience, practical scenarios, and reflective questions are innovatively depicted, motivating students to contemplate and think creatively.

9. The assessments should include continuous assessment of 25 marks as mentioned in curriculum and based on the internal examination based on the question-bank with answers from each subject of IPDC provided by IPDC team.

Guidelines

for

Basic Internship Course (IN251H)

Duration of Summer Internship after Second Semester: **1st June to 30th June.**

Duration of Internship in Second Semester for DSY Student: **Part-time within Sem.**

Introduction:

The Basic Internship course provides diploma students in engineering with a four-week summer vacation internship opportunity after the second semester. The internship encompasses various inter/intra-institutional activities aimed at skill development, innovation, and professional growth. Students engage in practical experiences within institutional settings and are evaluated based on their daily activities documented in a diary.

As mentioned in program structure of third semester of NEP aligned 2023 Curriculum "Basic Internship" full time four week (120 Notional Hours) is mandatory for first year admitted students in the year 2023 and part-time (120 Notional Hours) during third semester for direct second year admitted students.

Internship activities:

During Internship students are required to be involved in:

1. Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; (In case of Government Polytechnic, Nagpur by Continuing Education Department (CED).
2. Contribution at incubation/ innovation /entrepreneurship cell of the institute.
3. Participation conferences/ workshops/ competitions etc.
4. Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop.
5. Working for consultancy/ research project within the institutes and Participation in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.
6. In case student want to pursue their family business, and don't want to undergo internship, a declaration by a parent may be submitted directly to the Head of the Department.

Documentation:

1. The Head of the Department should prepare a list of students indicating their consent for participation in the internship, along with the details of the internship location.
2. Every student is required to prepare a daily diary containing documentary proofs of the activities done by him during internship.

3. The report writing, preparation of presentation and the evaluation of these activities will be done by faculty mentor during third semester.
4. Students should use daily diary prepared by curriculum development cell.

Guidelines

for

Internship Course (IN351H and IN352H)

Duration of summer Internship after Fourth Semester: **1st June to 15th August.**

Introduction:
As mentioned in program structure of fourth and sixth semester of NEP aligned 2023 Curriculum a full time twelve week (360 Notional Hours) is mandatory for the students.
The internship course is a critical component of the diploma program, providing students with hands-on experience in a real-world industry setting. The internship takes place after the fourth semester during summer vacation and involves working in a small, medium, or large-scale industry related to the student's field of study. The course is designed to bridge the gap between academic learning and industrial application, allowing students to apply theoretical knowledge in a practical environment.
For ease, assessment of this course is divided into two semesters, seminar assessment in fifth semester (IN351H- Internship (Seminar)) and report writing (IN352H- Internship (Report Writing)) in sixth semester.

Internship activities:
During the summer vacations, after the 4th Semester, students are required to undergo internship with industry/ NGO"s/ Government organizations/ Micro/ Small/ Medium enterprises to make ready for the industry.

Documentation:

1. The Head of the Department should issue the letter to the industry in prescribed format framed by TPO.
2. The Head of the Department should prepare a list of students indicating their consent for participation in the internship, along with the details of the internship location.
3. Every student is required to prepare a daily diary containing documentary proofs of the activities done by him during internship.
4. The report writing, preparation of presentation and the evaluation of these activities will be done by faculty mentor during fifth and sixth semester as mentioned in curriculum.
5. Students should use daily diary prepared by curriculum development cell.

Guidelines

for

Generic Elective Courses

Introduction:

As third semester curriculum and program structure of NEP aligned 2023 curriculum were approved in 46th Board of studies meeting held on 20th June 2024. However, it is suggested by Hon. Chairman of BOS that the allotment of generic electives course should be as per "Inter-Se-Merit" of students rather than "first cum first serve" basis.

Decision as per Institute Level Committee Meeting held on 1st July, 2024.

i) Awareness workshop will be arranged by HOD of program related to Generic Elective Courses in offline or online mode for the students of III semester before registration.

ii) Sealing of Generic Elective seats is as per intake capacity of program plus 20% (for EWS/TFWS/DSY students).

iii) Quota of Generic Elective courses will be allotted by ILC. Refer annexure-I for program-wise quota for Generic Elective Course.

iv) Allot Generic Elective Course as per departmental "Inter-Se-Merit" by taking preferences for all Twelve programs other than own program. (For Computer Engineering, Information Technology and AIML for remaining Ten Programs)

v) Final registration of Generic Elective course of all students will be done by registration in-charge after allotting the GE course as per above procedure.

Timetable slots of Generic Elective Courses.

All program should keep reserved following slots for Generic Elective Course.

Day	Time	Remarks
Thursday	3.45 to 5.45 PM (last two periods)	Practical for first Batch
Friday	10.00 to 11.00 AM (First Period)	Theory Period- 1
Friday	3.45 to 5.45 PM (last two periods)	Practical for Second Batch
Saturday (working)	10.00 to 12.00 Noon (Second Period)	Theory Period- 2
Saturday (working)	1.00 PM to 5 PM	Practical for Third Batch

Use "Zero Period" between 9.00 AM to 10 AM for timetable to adjust department timetable, if required.

Annexure-I

Abstract of Generic Elective Quota

S.N.	Name of Program	Quota/Seats													
		CE	ME	EE	EC	IT	MT	TX	AE	PK	CO	MK	AIML	TX	Total
1	Civil Engineering	00	30	15	38	15	10	8	15	8	15	8	8	8	178
2	Mechanical Engineering	30	00	12	30	12	8	6	12	6	12	6	6	6	146
3	Electrical Engineering	15	12	-	15	6	4	3	6	3	6	3	3	3	79
4	Electronics & Telecommunication Engineering	38	30	15	-	15	10	8	15	8	15	8	8	8	178
5	Information Technology	15	12	6	15	-	4	3	6	3	-	3	-	3	70
6	Metallurgical Engineering	8	6	3	8	3	-	2	3	2	3	2	2	2	44
7	Textile Manufacture	8	6	3	8	3	1	-	3	1	3	1	1	1	39
8	Automobile Engineering	15	12	6	15	6	4	3	-	3	6	3	3	3	79
9	Packaging Technology	8	6	3	8	3	1	1	3	-	3	1	1	1	39
10	Computer Engineering	15	12	6	15	-	4	3	6	3	-	3	-	3	70
11	Mechatronics	8	6	3	8	3	1	1	3	1	3	-	1	1	39
12	Artificial Intelligence and Machine Learning	8	6	3	8	-	2	2	3	2	-	2	-	2	38
		168	138	75	168	66	49	40	75	40	66	40	33	41	

List of Generic Elective Courses (Multidisciplinary) for Civil Engineering Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Mechanical Engineering	120	30	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
2	Electrical Engineering	60	15	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
3	Electronics & Telecommunication Engineering	150	38	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
4	Information Technology	60	15	IT291H: Applied Multimedia Techniques	IT292H: Web Designing	IT391H: Cyber Security and Privacy
5	Metallurgical Engineering	36	10	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
6	Textile Manufacture	30	8	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
7	Automobile Engineering	60	15	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Packaging Technology	30	8	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Computer Engineering	60	15	CM291H: Open-Source Technologies	CM292H: Web Development	CM391H: Digital Marketing
10	Mechatronics	30	8	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
11	Artificial Intelligence and Machine Learning	30	8	AI291H: Python Programming	AI292H: Basics of Artificial Intelligence	AI391H: Machine Learning
12	Travel and Tourism	30	8	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**178**			

List of Generic Elective Courses (Multidisciplinary) for Mechanical Engineering Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	30	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Electrical Engineering	60	12	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
3	Electronics & Telecommunication Engineering	150	30	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
4	Information Technology	60	12	IT291H: Applied Multimedia Techniques	IT292H: Web Designing	IT391H: Cyber Security and Privacy
5	Metallurgical Engineering	36	8	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
6	Textile Manufacture	30	6	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
7	Automobile Engineering	60	12	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Packaging Technology	30	6	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Computer Engineering	60	12	CM291H: Open-Source Technologies	CM292H: Web Development	CM391H: Digital Marketing
10	Mechatronics	30	6	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
11	Artificial Intelligence and Machine Learning	30	6	AI291H: Python Programming	AI292H: Basics of Artificial Intelligence	AI391H: Machine Learning
12	Travel and Tourism	30	6	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**146**			

List of Generic Elective Courses (Multidisciplinary) for Electrical Engineering Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	15	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	12	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electronics & Telecommunication Engineering	150	15	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
4	Information Technology	60	6	IT291H: Applied Multimedia Techniques	IT292H: Web Designing	IT391H: Cyber Security and Privacy
5	Metallurgical Engineering	36	4	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
6	Textile Manufacture	30	3	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
7	Automobile Engineering	60	6	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Packaging Technology	30	3	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Computer Engineering	60	6	CM291H: Open-Source Technologies	CM292H: Web Development	CM391H: Digital Marketing
10	Mechatronics	30	3	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
11	Artificial Intelligence and Machine Learning	30	3	AI291H: Python Programming	AI292H: Basics of Artificial Intelligence	AI391H: Machine Learning
12	Travel and Tourism	30	3	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**79**			

List of Generic Elective Courses (Multidisciplinary) for Electronics & Telecommunication Engineering Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	38	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	30	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electrical Engineering	60	15	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
4	Information Technology	60	15	IT291H: Applied Multimedia Techniques	IT292H: Web Designing	IT391H: Cyber Security and Privacy
5	Metallurgical Engineering	36	10	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
6	Textile Manufacture	30	8	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
7	Automobile Engineering	60	15	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Packaging Technology	30	8	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Computer Engineering	60	15	CM291H: Open-Source Technologies	CM292H: Web Development	CM391H: Digital Marketing
10	Mechatronics	30	8	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
11	Artificial Intelligence and Machine Learning	30	8	AI291H: Python Programming	AI292H: Basics of Artificial Intelligence	AI391H: Machine Learning
12	Travel and Tourism	30	8	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**178**			

List of Generic Elective Courses (Multidisciplinary) for Information Technology Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	15	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	12	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electrical Engineering	60	6	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
4	Electronics & Telecommunication Engineering	150	15	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
5	Metallurgical Engineering	36	4	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
6	Textile Manufacture	30	3	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
7	Automobile Engineering	60	6	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Packaging Technology	30	3	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Mechatronics	30	3	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
10	Travel and Tourism	30	3	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**70**			

List of Generic Elective Courses (Multidisciplinary) for Computer Engineering Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	15	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	12	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electrical Engineering	60	6	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
4	Electronics & Telecommunication Engineering	150	15	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
5	Metallurgical Engineering	36	4	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
6	Textile Manufacture	30	3	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
7	Automobile Engineering	60	6	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Packaging Technology	30	3	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Mechatronics	30	3	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
10	Travel and Tourism	30	3	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**70**			

List of Generic Elective Courses (Multidisciplinary) for AIML Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	8	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	6	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electrical Engineering	60	3	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
4	Electronics & Telecommunication Engineering	150	8	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
5	Metallurgical Engineering	36	2	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
6	Textile Manufacture	30	2	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
7	Automobile Engineering	60	3	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Packaging Technology	30	2	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Mechatronics	30	2	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
10	Travel and Tourism	30	2	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**38**			

List of Generic Elective Courses (Multidisciplinary) for Automobile Engineering Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	15	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	12	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electrical Engineering	60	6	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
4	Electronics & Telecommunication Engineering	150	15	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
5	Information Technology	60	6	IT291H: Applied Multimedia Techniques	IT292H: Web Designing	IT391H: Cyber Security and Privacy
6	Metallurgical Engineering	36	4	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
7	Textile Manufacture	30	3	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
8	Packaging Technology	30	3	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Computer Engineering	60	6	CM291H: Open-Source Technologies	CM292H: Web Development	CM391H: Digital Marketing
10	Mechatronics	30	3	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
11	Artificial Intelligence and Machine Learning	30	3	AI291H: Python Programming	AI292H: Basics of Artificial Intelligence	AI391H: Machine Learning
12	Travel and Tourism	30	3	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**79**			

List of Generic Elective Courses (Multidisciplinary) for Metallurgical Engineering Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	8	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	6	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electrical Engineering	60	3	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
4	Electronics & Telecommunication Engineering	150	8	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
5	Information Technology	60	3	IT291H: Applied Multimedia Techniques	IT292H: Web Designing	IT391H: Cyber Security and Privacy
6	Textile Manufacture	30	2	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
7	Automobile Engineering	60	3	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Packaging Technology	30	2	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Computer Engineering	60	3	CM291H: Open-Source Technologies	CM292H: Web Development	CM391H: Digital Marketing
10	Mechatronics	30	2	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
11	Artificial Intelligence and Machine Learning	30	2	AI291H: Python Programming	AI292H: Basics of Artificial Intelligence	AI391H: Machine Learning
12	Travel and Tourism	30	2	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**44**			

List of Generic Elective Courses (Multidisciplinary) for Textile Manufacture Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	8	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	6	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electrical Engineering	60	3	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
4	Electronics & Telecommunication Engineering	150	8	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
5	Information Technology	60	3	IT291H: Applied Multimedia Techniques	IT292H: Web Designing	IT391H: Cyber Security and Privacy
6	Metallurgical Engineering	36	1	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
7	Automobile Engineering	60	3	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Packaging Technology	30	1	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
9	Computer Engineering	60	3	CM291H: Open-Source Technologies	CM292H: Web Development	CM391H: Digital Marketing
10	Mechatronics	30	1	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
11	Artificial Intelligence and Machine Learning	30	1	AI291H: Python Programming	AI292H: Basics of Artificial Intelligence	AI391H: Machine Learning
12	Travel and Tourism	30	1	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**39**			

List of Generic Elective Courses (Multidisciplinary) for Packaging Technology Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	8	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	6	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electrical Engineering	60	3	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
4	Electronics & Telecommunication Engineering	150	8	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
5	Information Technology	60	3	IT291H: Applied Multimedia Techniques	IT292H: Web Designing	IT391H: Cyber Security and Privacy
6	Metallurgical Engineering	36	1	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
7	Automobile Engineering	60	3	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Textile Manufacture	30	1	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
9	Computer Engineering	60	3	CM291H: Open-Source Technologies	CM292H: Web Development	CM391H: Digital Marketing
10	Mechatronics	30	1	MK291H: Basic Mechatronics	MK292H: Computer Aided Design	MK391H: Automotive Mechatronics
11	Artificial Intelligence and Machine Learning	30	1	AI291H: Python Programming	AI292H: Basics of Artificial Intelligence	AI391H: Machine Learning
12	Travel and Tourism	30	1	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**39**			

List of Generic Elective Courses (Multidisciplinary) for Mechatronics Program Students and Quota for Registration

SN	Name of Program	Intake	Quota/Seats	Third Semester	Fourth Semester	Fifth Semester
1	Civil Engineering	150	8	CE291H: Civil Engineering Practice	CE292H: Basic Surveying	CE391H: Building Services
2	Mechanical Engineering	120	6	ME291H: Elements of Mechanical Engineering	ME292H: Workshop Technology	ME391H: Heat Engine Technology
3	Electrical Engineering	60	3	EE291H: Electrical Generation, Transmission and Distribution	EE292H: Electrical Machines	EE391H: Electrical Wiring and Estimation
4	Electronics & Telecommunication Engineering	150	8	EC291H: Analog and Digital Electronics	EC292H: Principles of Communication Engineering	EC391H: Microcontroller and Applications
5	Information Technology	60	3	IT291H: Applied Multimedia Techniques	IT292H: Web Designing	IT391H: Cyber Security and Privacy
6	Metallurgical Engineering	36	1	MT291H: Foundry Technology	MT292H: Testing of Materials	MT391H: Heat Treatment
7	Automobile Engineering	60	3	AE291H: Basics of Automobile	AE292H: Two-Wheeler Technology	AE391H: Four-Wheeler Technology
8	Textile Manufacture	30	1	TX291H: General Textile Technology	TX292H: Dyeing and Printing	TX391H: Garment and fashion Technology
9	Computer Engineering	60	3	CM291H: Open-Source Technologies	CM292H: Web Development	CM391H: Digital Marketing
10	Packaging Technology	30	1	PK291H: Basics of Packaging Technology	PK292H: Folding Carton & Corrugated Box Manufacturing	PK391H: Injection & Extrusion Blow Molding in Packaging
11	Artificial Intelligence and Machine Learning	30	1	AI291H: Python Programming	AI292H: Basics of Artificial Intelligence	AI391H: Machine Learning
12	Travel and Tourism	30	1	TR291H- Agro & Rural Tourism	TR292H- Wildlife Tourist Guide/ Naturalist	TR391H- Tourism Resources of India
		Total	**39**			