NEP 2020 ALIGNED OBE CURRICULUM

PROGRAM: DIPLOMA IN ELECTRICAL ENGINEERING

by

Curriculum Development Cell,

Government Polytechnic, Nagpur

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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

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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.

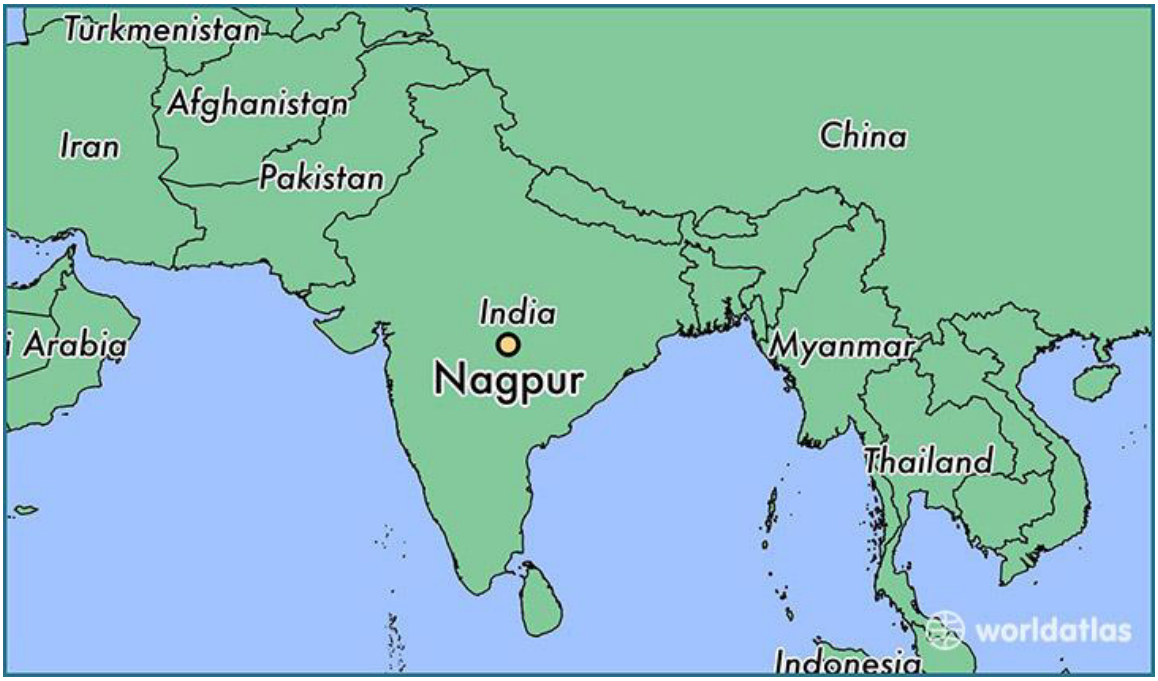

Figure 1.1. Location of Nagpur City

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.

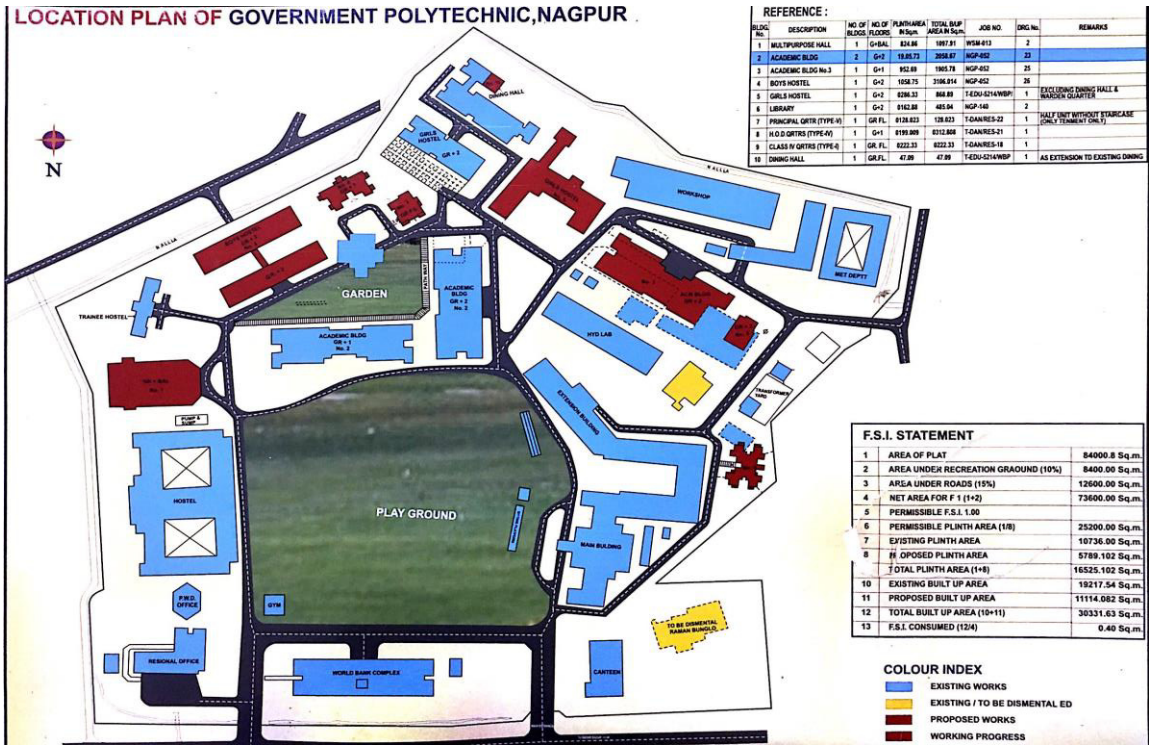

Figure 1.2. Government Polytechnic, Nagpur Campus

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.

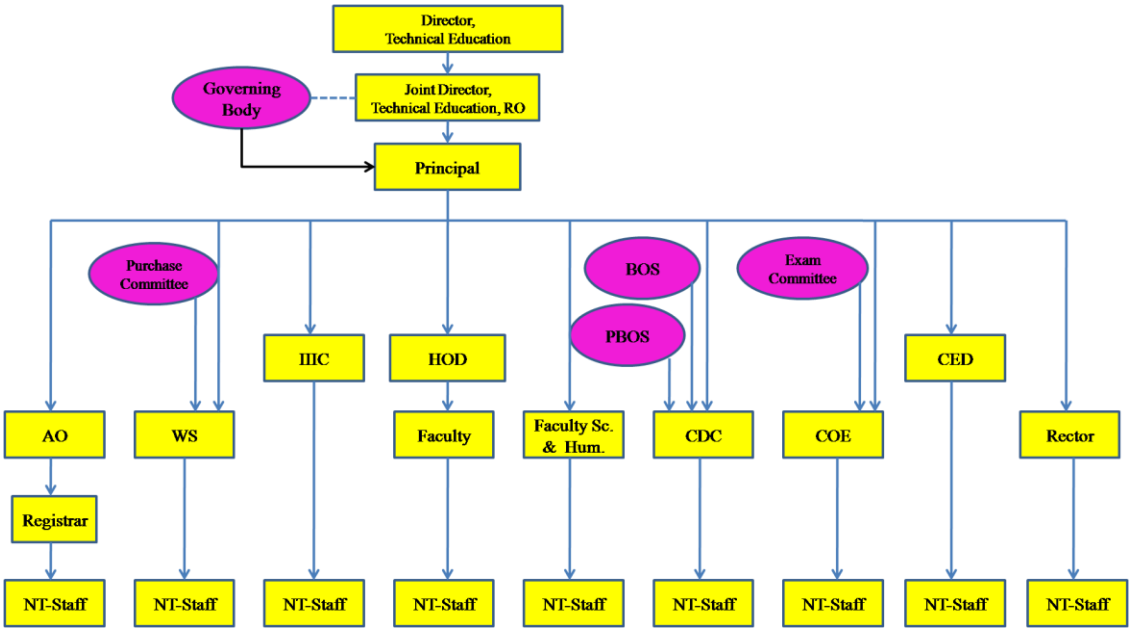

Figure 1.3. Organizational Structure of GPN

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.

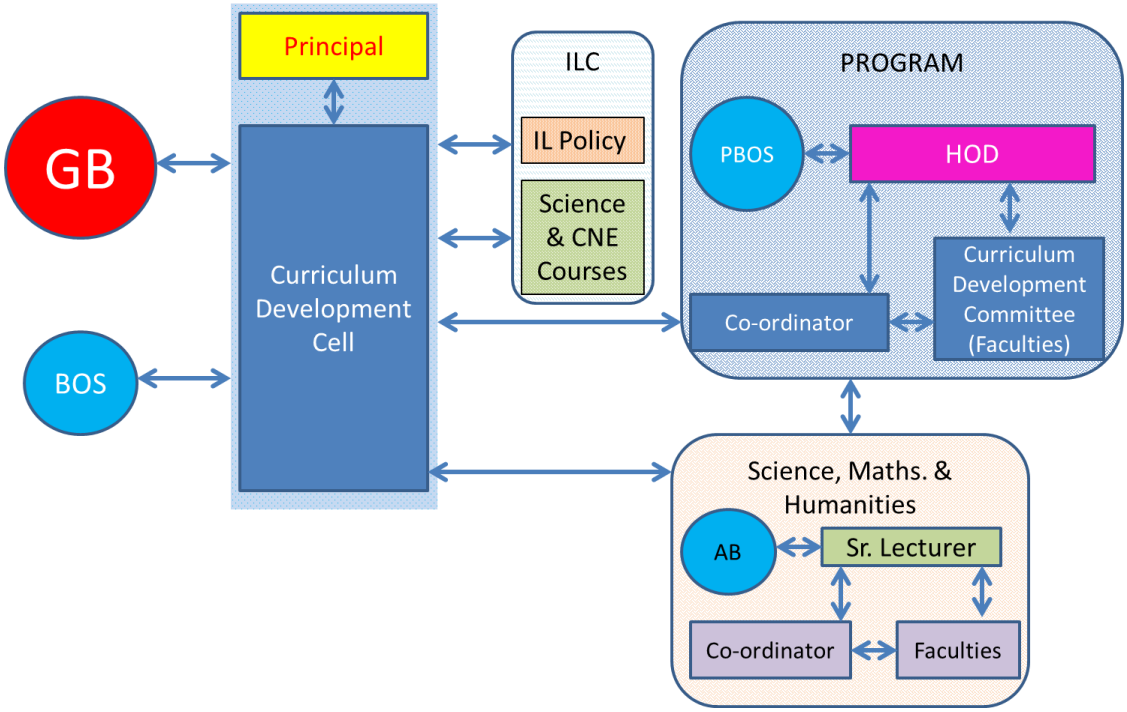

Figure 1.4. Curriculum Development System

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:

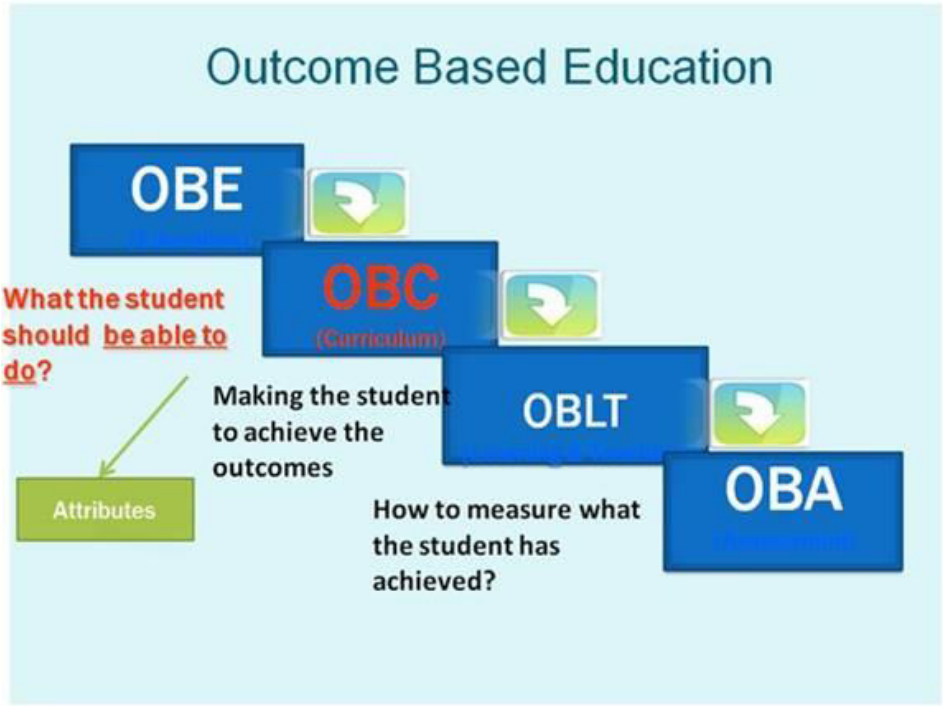


Figure 3.1. Outcome Based Education Framework

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:

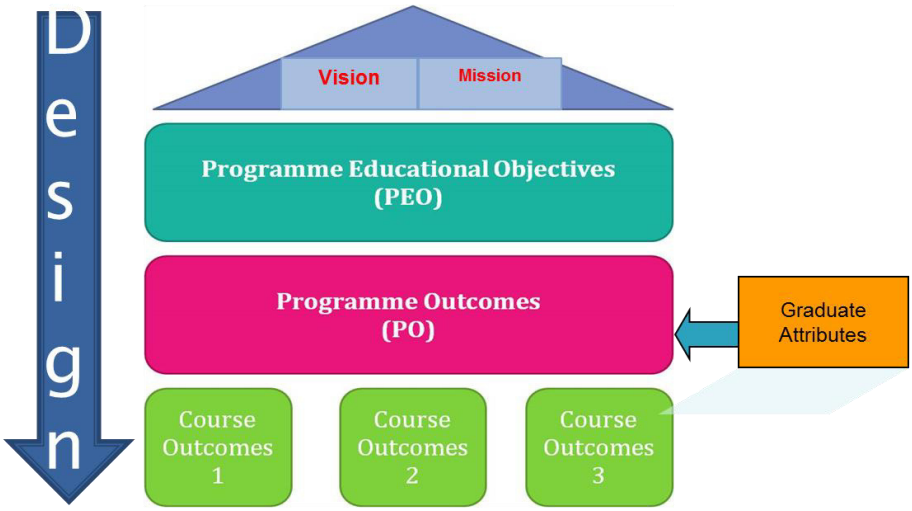


Figure 3.2. Key Constituents of OBE

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.

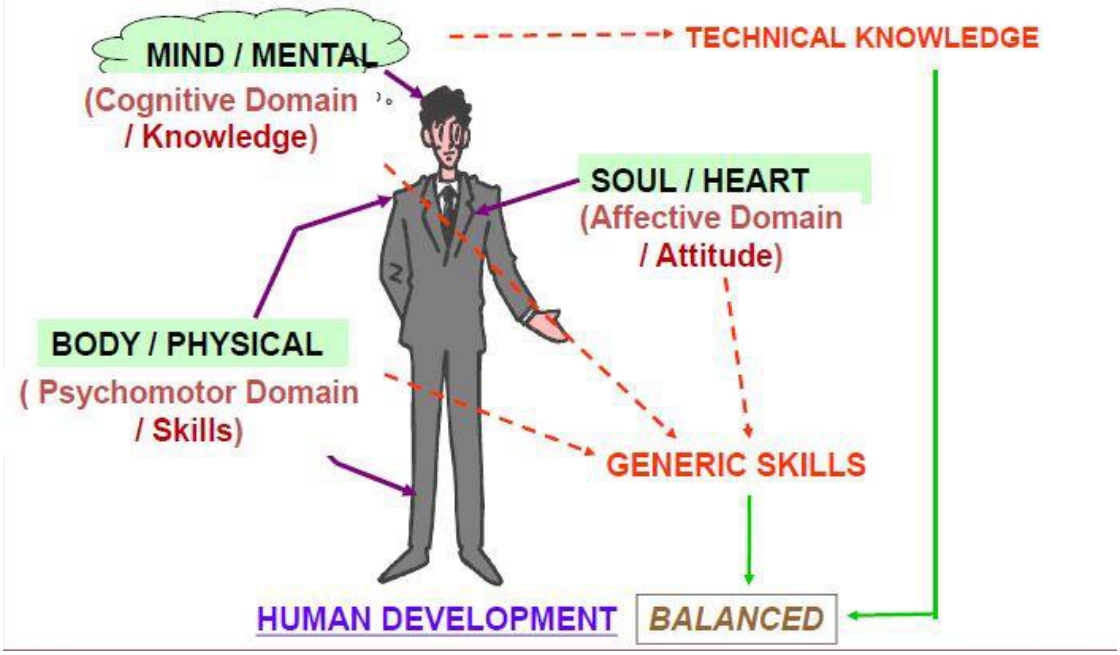


Figure 4.1. Human Being and Domains of Learning

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.

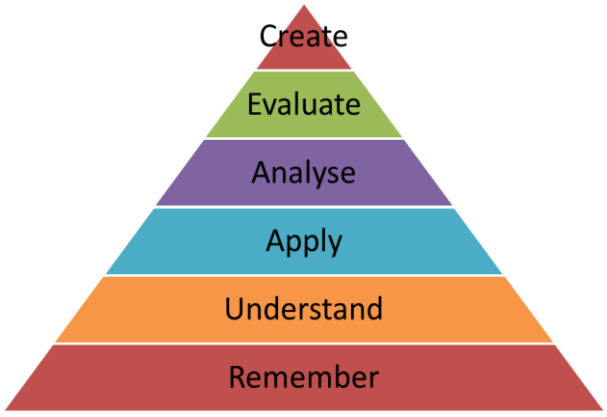


Figure 4.2. Revised cognitive hierarchy Levels

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.

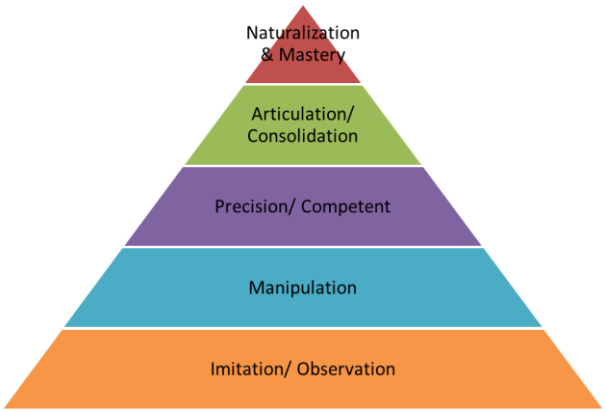


Figure 4.3. Psychomotor hierarchy Levels

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.

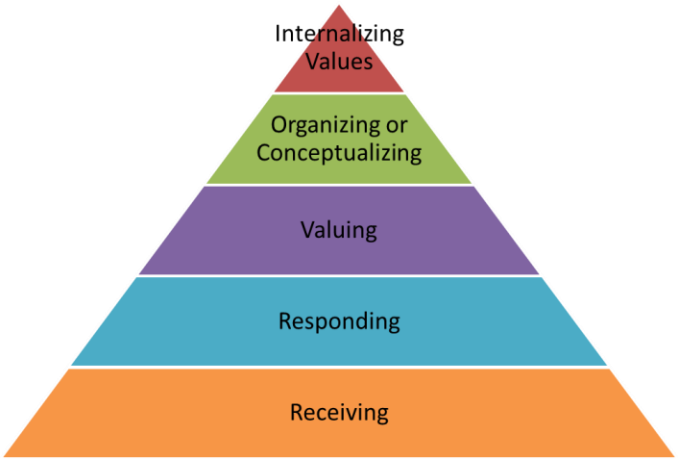


Figure 4.4. Affective Domain hierarchy Levels

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

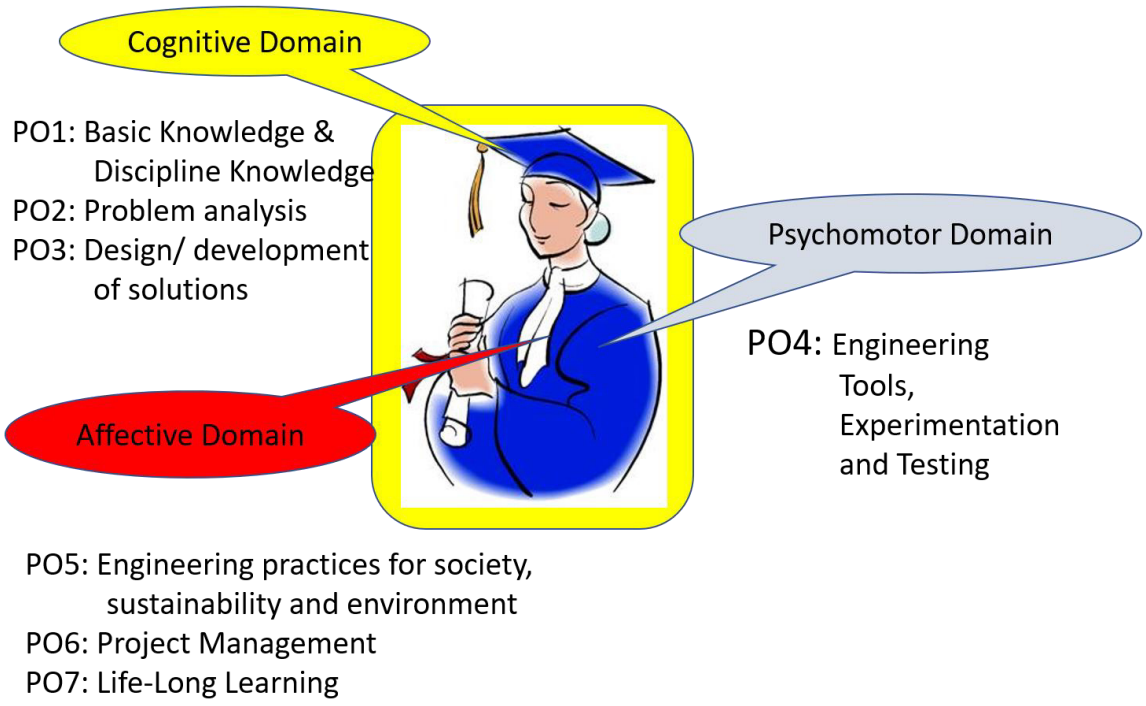


Figure 4.5. Program Outcomes and Domains of Learning

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 Electrical Engineering Program

5.2.1 Strengths (S):

1. Highly Experienced Faculty (69.3%): The department's experienced faculty is a significant strength, contributing to its academic excellence.
2. Modern Curriculum (55.1%): The alignment of the curriculum with industry needs is a notable advantage.
3. Excellent Hands-On Training (48.8%): The department's ability to provide practical training is highly appreciated.
4. Faculty Reputation (66.1%): Faculty plays a major role in enhancing the department's reputation.
5. Inclusive Learning Environment (52.8%): Inclusive and supportive faculty enhance the learning environment.

5.2.2 Weaknesses (W):

1. Laboratory Upgradation (45.7%): Immediate improvements are needed in laboratory facilities.
2. Student Engagement (42.6%): Student clubs and organizations require more engagement.
3. Non-Traditional Student Support (12.6%): Strategies for supporting non-traditional students need enhancement.
4. Interdisciplinary Initiatives (7.9%): More efforts are needed to engage in interdisciplinary projects.
5. Diversity in Course Offerings (17.3%): Curriculum relevance needs improvement.

5.2.3 Opportunities (O):

1. Emerging Technologies (59.1%): Opportunities lie in areas like electric vehicles and smart grids.
2. Community Engagement (88.2%): Opportunities exist to contribute to community development.
3. Sustainable Technologies (92.1%): The department can make significant contributions to sustainable technologies.
4. Industry Collaborations (50.4%): Effective engagement with local industries for collaborative projects.
5. Value-Added Courses (21.3%): Opportunities to improve value-added courses in the curriculum.

5.2.4 Threats (T):

1. Government Budget Cuts (39.4%): Potential reductions in funding pose a threat.
2. Rapid Technological Disruptions (19.7%): Adapting to technological changes is challenging.
3. Funding Uncertainty (70.9%): Uncertainty in funding sources is a significant concern.
4. Limited Elective Courses (5%): Providing a variety of elective courses is essential.
5. Inadequate Interdisciplinary Initiatives (7.9%): Expanding interdisciplinary projects is critical.

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 behaviors 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.

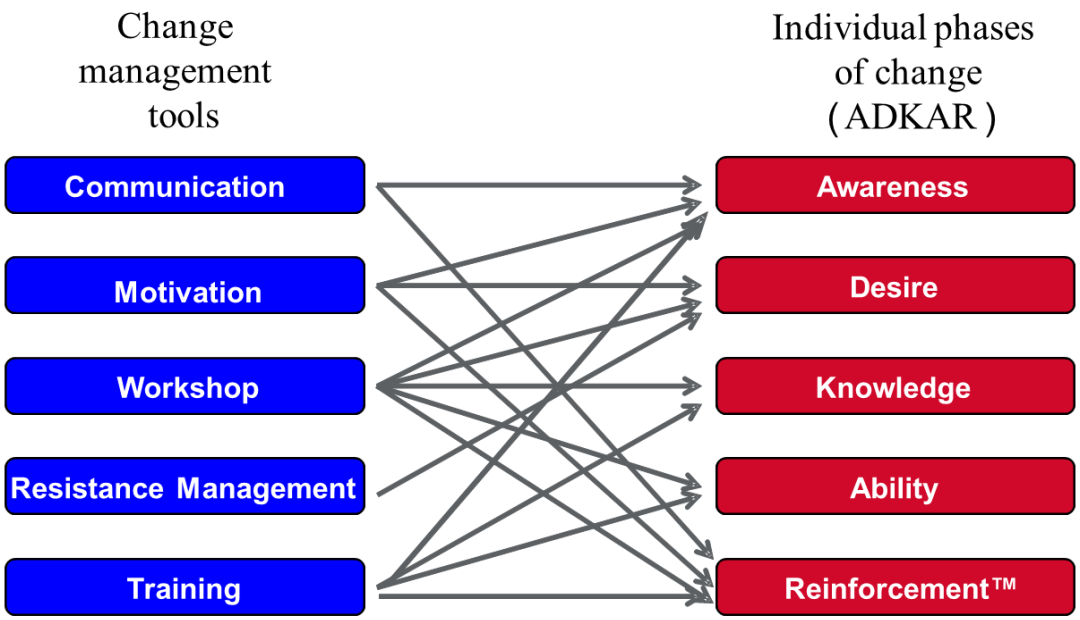


Figure 6.1. Mapping of change management tools with ADKAR

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

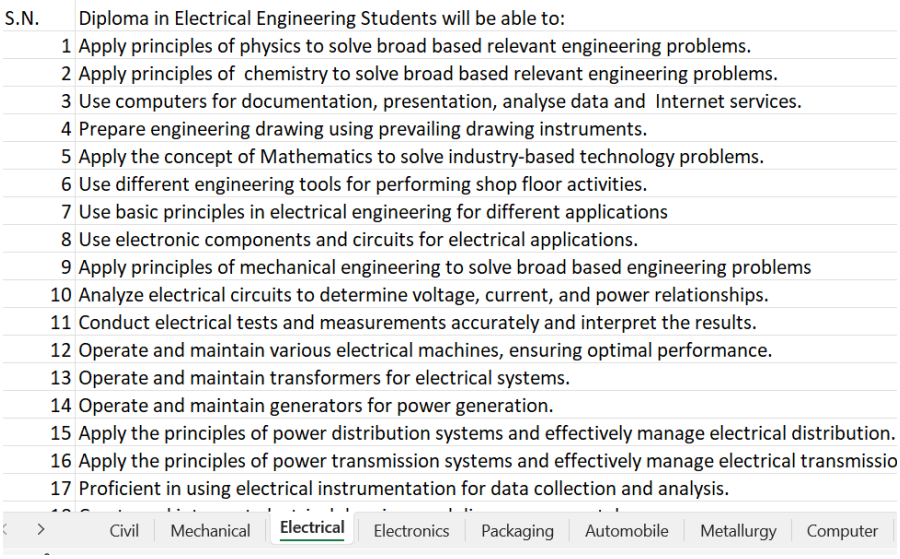
6.2.1 Identify the Competencies and Skills

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.

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.

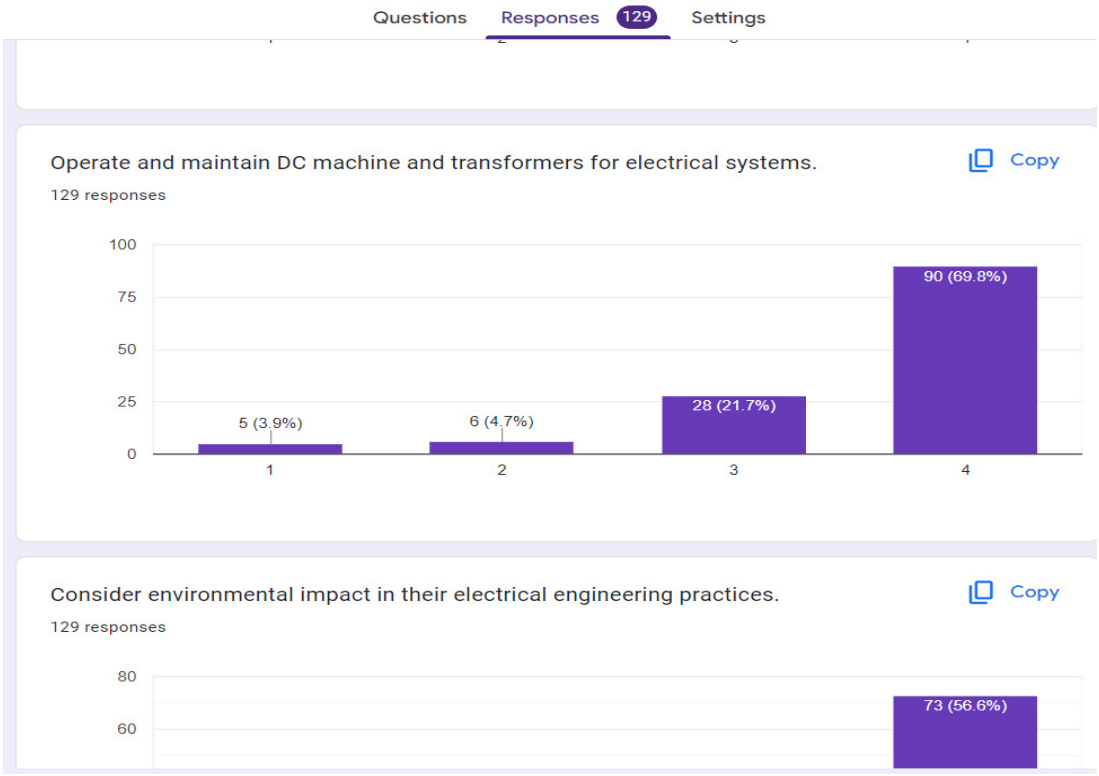


Figure 6.4. Feedback through Google Form

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	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)

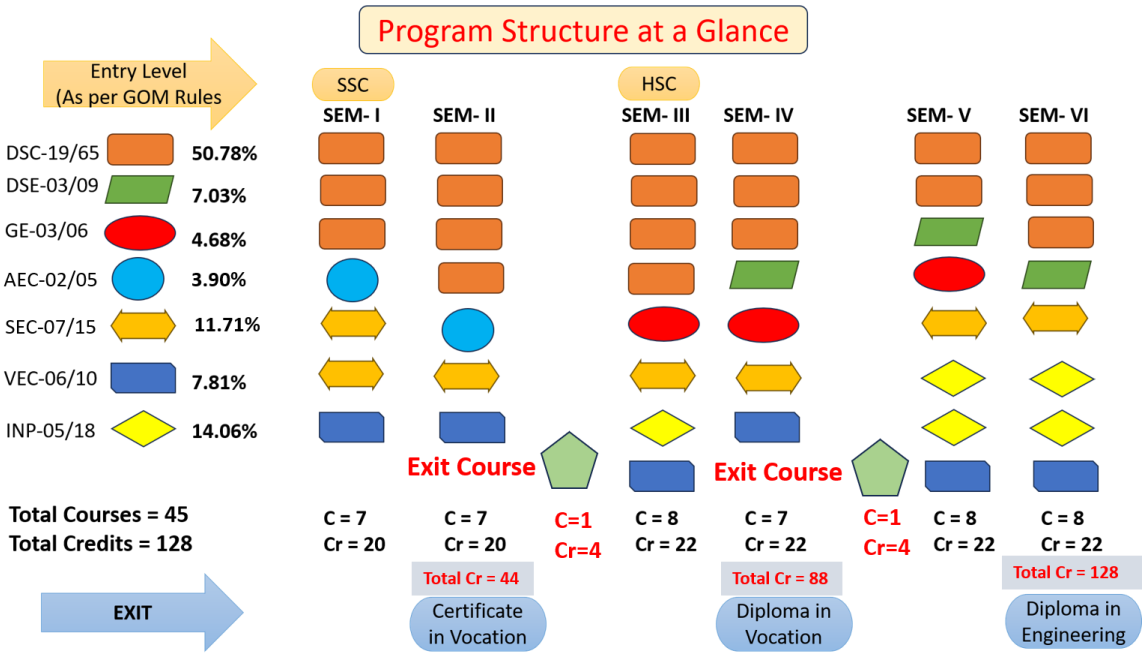


Figure 6.8. Basic Program Structure

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

Electrical 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.

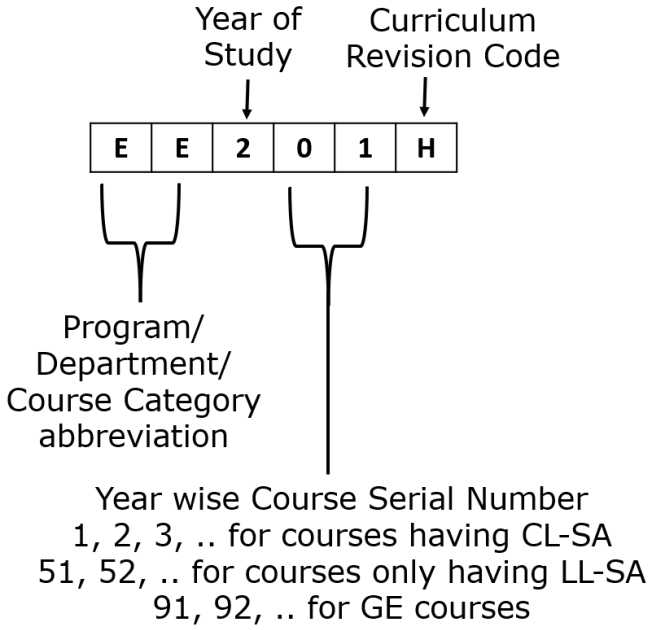


Figure 8.2. Course Code Details

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 **Electrical Engineering** 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 the Electrical Engineering Program:

"To develop skilled, ethical and self-motivated electrical professionals to meet global challenges."

9.4 Mission of Program

Mission of the Electrical Engineering Program:

M1: To develop the students to render services to Industry & Society

M2: To impart quality education to acquire soft skills & entrepreneurial qualities

M3: To maintain the relationship with renowned institutes of learning & alumni for overall development of students.

M4: To inculcate moral values & professional ethics.

9.5 Program Educational Objectives (PEOs)

The Program Educational Objectives of (PEOs) Electrical Engineering Program are:

PEO1: To provide solid fundamentals in science and humanity.

PEO2: To develop students to create ideas of latest technology and enhance entrepreneurial qualities.

PEO3: To develop professional excellence in students through lifelong learning.

PEO4: To induce behavioural skills & ethics for welfare of society.

PEO5: To relate socio-economic issues to solve the problems of real world.

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: Maintain Electrical Equipment

PSO2: Maintain Electrical Power Systems

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	Program Outcomes (POs)							PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
PEO1	✓							✓	
PEO2		✓	✓	✓			✓		✓
PEO3		✓	✓	✓			✓		✓
PEO4							✓	✓	
PEO5					✓	✓		✓	

9.9 Industry Identified Competencies in Search Conference

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	95	26	3	5	129	3.635659	2

	drawings and use software in electrical engineering.							
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
5	Use computers for documentation, presentation, analyze data and Internet services.	93	24	7	5	129	3.589147	5
6	Operate and maintain DC machine and transformers for electrical systems.	90	28	6	5	129	3.573643	6
7	Maintain electrical switchgears and protection systems to safeguard equipment and personnel.	88	29	9	3	129	3.565891	7
8	Optimize energy usage and promote energy efficiency in electrical systems.	87	30	8	4	129	3.550388	8
9	Use basic principles in electrical engineering for different applications.	89	25	12	3	129	3.550388	9
10	Exhibit leadership qualities and Manage time efficiently to meet project deadlines and goals.	84	35	6	4	129	3.542636	10
11	Implement renewable energy systems.	84	34	8	3	129	3.542636	11
12	Demonstrate a commitment to lifelong learning and professional development.	85	29	12	3	129	3.51938	12
13	Use electrical and electronics measuring instruments for electrical applications.	86	30	6	7	129	3.511628	13
14	Use electrical instrumentation for data collection and analysis.	83	32	11	3	129	3.511628	14
15	Apply industrial automation techniques for improved efficiency.	82	34	10	3	129	3.511628	15
16	Test the Performance of Power Electronic Devices and Circuits.	81	34	11	3	129	3.496124	16
17	Use workshop tools and machineries for engineering	80	36	7	6	129	3.472868	17

	applications							
18	Adhere to industry-standard wiring and installation practices.	76	39	12	2	129	3.465116	18
19	Plan, execute, and manage electrical projects effectively.	78	38	8	5	129	3.465116	19
20	Apply the principles of power transmission, distribution systems, and maintain electrical substations.	78	39	5	7	129	3.457364	20
21	Select and operate electrical equipment for utilities and electric traction systems.	73	44	9	3	129	3.449612	21
22	Manage budgets and control costs in electrical projects and maintenance activities.	76	38	12	3	129	3.449612	22
23	Prioritize safety in electrical engineering practices and adhere to established safety protocols.	74	40	12	3	129	3.434109	23
24	Apply the principles of power transmission, distribution systems, and maintain electrical substations	76	38	9	6	129	3.426357	24
25	Prepare electrical estimates of electrical installations.	76	37	10	6	129	3.418605	25
26	Demonstrate expertise in motor control and optimization.	73	39	13	4	129	3.403101	26
27	Demonstrate proficiency in programming and utilizing microcontrollers and PLCs for automation.	75	38	9	7	129	3.403101	27
28	Consider environmental impact in their electrical engineering practices.	73	39	11	6	129	3.387597	28
29	Apply problem solving skills to solve AC and DC circuits.	76	35	10	8	129	3.387597	29
30	Operate and maintain generators for power generation.	75	32	17	5	129	3.372093	30
31	Collaborate effectively within multidisciplinary teams.	66	47	11	5	129	3.348837	31
32	Implement renewable energy systems.	69	39	14	7	129	3.317829	32
33	Use electrical, electronic tools and meters for various applications.	66	42	15	6	129	3.302326	33
34	Select suitable Illumination	60	49	16	4	129	3.27907	34

	level & luminaries for special lighting applications.							
35	Formulate English language into meaningful structures and assess the given information.	61	44	20	4	129	3.255814	35
36	Apply industrial automation techniques for improved efficiency.	64	40	19	6	129	3.255814	36
37	Analyze the functioning of electronics control in industrial system.	58	51	14	6	129	3.248062	37
38	Prepare Engineering Drawing using prevailing standards and equipment,	64	34	24	7	129	3.20155	38
39	Use different engineering tools for performing shop floor activities.	53	52	19	5	129	3.186047	39
40	Analyze key issues about environment and create public awareness about those environmental issues.	59	40	23	7	129	3.170543	40
41	Apply concept of engineering graphics to draw electrical engineering drawings.	53	45	23	8	129	3.108527	41
42	Apply the concept of Mathematics to solve industry-based technology problems.	49	46	23	11	129	3.031008	42
43	Apply principles of physics to solve broad based relevant engineering problems.	43	54	22	10	129	3.007752	43
44	Use Electronic Components and Devices for engineering applications	41	52	27	9	129	2.968992	44
45	Apply principles of mechanical engineering to solve broad based engineering problems.	45	43	32	9	129	2.96124	45
46	Apply the principles of engineering mechanics to solve engineering problems.	40	47	29	13	129	2.883721	46
47	Outline structure of Indian Constitution.	31	39	35	24	129	2.596899	47
48	Apply principles of chemistry to solve broad based relevant engineering problems.	24	40	46	19	129	2.534884	48

Technical Skills Required for Diploma in Electrical Engineering

S.N.	Technical Skills (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	Conduct electrical tests using instruments such as multimeters, and other testing equipment to evaluate the performance of electrical system.	4	8	33	84	129	3.527132	1
2	Conduct safety audits and inspections to ensure compliance with electrical safety standards.	6	13	25	85	129	3.465116	2
3	Diagnose and troubleshoot electrical faults and problems in electrical equipment and domestic appliances.	6	9	40	74	129	3.410853	3
4	Wire and install electrical components, switches, outlets, and lighting fixtures.	4	14	41	70	129	3.372093	4
5	Install and maintain solar panels, wind turbines, and other renewable energy systems.	4	18	34	73	129	3.364341	5
6	Create and interpret electrical schematics and drawings using CAD software.	6	19	29	75	129	3.341085	6
7	Install and maintain EV charging stations and systems.	8	17	28	76	129	3.333333	7
8	Build and wire electrical panels and control cabinets.	6	22	30	71	129	3.286822	8
9	Calibrate and maintain electrical instrumentation devices for measurement and control.	5	20	41	63	129	3.255814	9
10	Develop digital control systems for motors, power converters and battery stems using MATLAB and Simulink	6	27	35	61	129	3.170543	10

11	Repair and modify electronic devices and PCBs.	13	22	38	56	129	3.062016	11
12	Assemble and solder electronic components onto circuit boards.	13	24	41	51	129	3.007752	12

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	Course Category DSC/DSE/ SEC/AEC/ VEC/INP etc.	Semester of the course
1	Communicate technical information clearly and effectively.	1	Business Communication	AEC	II
2	Create and interpret electrical drawings and use software in electrical engineering.	2	Electrical Software and CAD	SEC	V
3	Prioritize safety in electrical engineering practices and adhere to established safety protocols.	3	Testing and Maintenance of Electrical Machines	DSC	V
4	Identify, select, and use appropriate electrical materials and components.	4	Electrical Wiring	SEC	III
5	Use computers for documentation, presentation, analyze data and Internet	5	Basics of Computer	SEC	I

	services.				
6	Operate and maintain DC machine and transformers for electrical systems.	6	DC machines & Transformer	DSC	IV
7	Maintain electrical switchgears and protection systems to safeguard equipment and personnel.	7	Switchgear and Protection	DSC	VI
8	Optimize energy usage and promote energy efficiency in electrical systems.	8	Energy Conservation and Audit	DSE	V
9	Use basic principles in electrical engineering for different applications.	9	Fundamentals of Electrical Engineering	DSC	II
10	Exhibit leadership qualities and Manage time efficiently to meet project deadlines and goals.	10	Entrepreneurship and Start up	INP	VI
11	Implement renewable energy systems.	11	Renewable Energy Technologies	DSE	IV
12	Demonstrate a commitment to lifelong learning and professional development.	12	Advanced Personality Development	VEC	II
13	Use electrical and electronics measuring instruments for electrical applications.	13	Electrical and Electronics Measurements	DSC	III
14	Use electrical instrumentation for data collection and analysis.	14	Instrumentation	DSC	IV
15	Apply industrial automation techniques for improved efficiency.	15	PLC SCADA	DSE	VI
16	Test the Performance of Power Electronic Devices and Circuits.	16	Industrial Electronics	DSC	V
17	Use workshop tools and machineries for engineering applications	17	Workshop Practice	SEC	I

18	Adhere to industry-standard wiring and installation practices.	18	Electrical Wiring	SEC	III
19	Plan, execute, and manage electrical projects effectively.	19	Capstone Project	SEC	VI
20	Apply the principles of power transmission, distribution systems, and maintain electrical substations.	20	Electrical Power Transmission and Distribution	DSC	IV
21	Select and operate electrical equipment for utilities and electric traction systems.	21	Electrical Utilization & Traction	DSC	VI
22	Manage budgets and control costs in electrical projects and maintenance activities. *(Merging of this competency with competency no. 19)*	22	Capstone Project	SEC	VI
23	Prioritize safety in electrical engineering practices and adhere to established safety protocols.	23	Testing and Maintenance of Electrical Machines	DSC	V
24	Apply the principles of power transmission, distribution systems, and maintain electrical substations	24	Electrical Power Transmission and Distribution	DSC	IV
25	Prepare electrical estimates of electrical installations.	25	Electrical Estimating & Contracting	DSC	VI
26	Demonstrate expertise in motor control and optimization.	26	AC machines	DSC	IV
27	Demonstrate proficiency in programming and utilizing microcontrollers and PLCs for automation.	27	PLC & SCADA	DSE	VI
28	Consider environmental impact in their electrical engineering practices.	28	Electric Power Generation	DSC	III

29	Apply problem solving skills to solve AC and DC circuits.	29	Electrical Circuits and Network	DSC	III
30	Operate and maintain generators for power generation.	30	Electrical Power Generation	DSC	III
31	Collaborate effectively within multidisciplinary teams.	31	Entrepreneurship and Start up	INP	VI
32	Implement renewable energy systems.	32	Renewable Energy Technologies	DSE	IV
33	Use electrical, electronic tools and meters for various applications.	33	Basic Electrical & Electronics Workshop	DSC	II
34	Select suitable Illumination level & luminaries for special lighting applications.	34	Illumination Engineering	DSE	V
35	Formulate English language into meaningful structures and assess the given information.	35	Communication Skills	AEC	I
36	Apply industrial automation techniques for improved efficiency.	36	Microprocessor, PLC SCADA	DSE	VI
37	Analyze the functioning of electronics control in industrial system.	37	Industrial Electronics	DSC	V
38	Prepare Engineering Drawing using prevailing standards and equipment,	38	Engineering Graphics	DSC	I
39	Use different engineering tools for performing shop floor activities.	39	Basic Electrical & Electronics Workshop	SEC	II
40	Analyze key issues about environment and create public awareness about those environmental issues.	40	Environmental Science	VAC	III
41	Apply concept of engineering graphics to draw electrical engineering drawings.	41	Engineering Graphics	DSC	I

42	Apply the concept of Mathematics to solve industry-based technology problems.	42	Basic Mathematics, Applied Mathematics	DSC	I, II
43	Apply principles of physics to solve broad based relevant engineering problems.	43	Applied Physics	DSC	I
44	Use Electronic Components and Devices for engineering applications	44	Basic Electronics	DSC	II
45	Apply principles of mechanical engineering to solve broad based engineering problems. *(Merging of the competency with competency no. 30)*	45	Electrical Power Generation	DSC	III
46	Apply the principles of engineering mechanics to solve engineering problems.	46	Competency deleted as per PBOS recommendation	-	-
47	Outline structure of Indian Constitution.	47	Indian Constitution	VAC	V
48	Apply principles of chemistry to solve broad based relevant engineering problems.	48	Applied Chemistry	DSC	II
49	Diagnose and troubleshoot electrical faults and problems in electrical equipment and domestic appliances.	3-Skill	Repairs of Electrical Machines & Appliances	SEC	IV
50	Install and maintain EV charging stations and systems.	7-Skill	Electric Vehicle Technologies	DSE	IV
51	Apply theory, engage in diverse learning, develop soft skills, document, and present internship experiences.	As per NEP 2020 requirement	Internship (Basic)	INP	III
52	Bridge theoretical	As per NEP	Internship	INP	V, VI

	knowledge with practical experience in a professional environment	2020 requirement			
53	Exhibit a comprehensive grasp of Indian knowledge systems, applying their principles across various domains of technology and philosophy	As per NEP 2020 requirement	Indian Knowledge System	VEC	VI
54	Practice Yog and Meditation in daily life.	As per NEP 2020 requirement	Yog and Meditation	VEC	IV
55	Demonstrate leadership, effective communication, project management, and resilience in professional and personal environments.	As per NEP 2020 requirement	Integrated Personality Development	VEC	I
56	Demonstrate resilience, teamwork, integrity, and financial literacy in professional and personal settings.	As per NEP 2020 requirement	Advance Personality Development	VEC	II

9.11 Program Structure

The program structure of the Electrical Engineering program is developed as described previously and is given in appendix.

APPENDIX A Curriculum

Appendix I
Curriculum

Program Structure

Government Polytechnic, Nagpur

Diploma in Electrical Engineering

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	ME153H	Engineering Graphics (Electrical)	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	WS152H	Workshop Practice (Electrical)	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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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	MH103H	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	EE101H	Fundamentals of Electrical Engineering	DSC	3	-	2	1	6	(90)	3	70	30	25	25	25		175
4	EC102H	Basic Electronics	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	EE151H	Electrical & Electronics Workshop	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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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	EE201H	Electrical Power Generation	DSC	3	-	2	1	6	(90)	3	70	30	25	25	25		175
2	EE202H	Electrical Circuit & Network	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
3	EE203H	Electrical & Electronics Measurement	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
4	EE204H	DC Machines & Transformers	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
5	EE251H	Electrical Wiring	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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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	EC291H	Analog and Digital Electronics
4	IT291H	Applied Multimedia Techniques
5	MT291H	Foundry Technology
6	TX291H	General Textile Technology
7	AE291H	Basics of Automobile
8	PK291H	Basics of Packaging Technology
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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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	EE205H	Electrical Power Transmission & Distribution	DSC	3	-	2	1	6	(90)	3	70	30	25	25	25		175
2	EE206H	AC Machines	DSC	4	-	4	2	10	(150)	5	70	30	25 +	25	25		175
3	EE207H	Instrumentation	DSC	4	-	2	2	8	(120)	4	70	30	25 +	25	25		175
4	EEXXXH	Discipline Specific Elective	DSE	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
5	EE252H	Repairs of Electrical Machines & Appliances	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	EE208H	Renewable Energy Technologies
2	EE209H	Electric Vehicle Technologies

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:
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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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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	EC292H	Principles of Communication Engineering
4	IT292H	Web Designing
5	MT292H	Testing of Materials
6	TX292H	Dyeing and Printing
7	AE292H	Two-Wheeler Technology
8	PK292H	Folding Carton & Corrugated Box Manufacturing
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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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	EE301H	Industrial Electronics	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
2	EE302H	Testing & Maintenance of Electrical Machines	DSC	3	-	4	1	8	(120)	4	70	30	25 +	25	25		175
3	EEXXXH	Discipline Specific Elective	DSE	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
4	EE351H	Electrical Software & CAD	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	EE303H	Energy Conservation & Audit
2	EE304H	Illumination Engineering

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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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	EC391H	Microcontroller and Applications
4	IT391H	Cyber Security and Privacy
5	MT391H	Heat Treatment
6	TX391H	Garment and fashion Technology
7	AE391H	Four-Wheeler Technology
8	PK391H	Injection & Extrusion Blow Molding in Packaging
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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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	EE305H	Switchgear & Protection	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
2	EE306H	Electrical Utilization & Traction	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
3	EE307H	Electrical Estimating & Contracting	DSC	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
4	EEXXXH	Discipline Specific Elective	DSE	3	-	2	1	6	(90)	3	70	30	25 +	25	25		175
5	EE352H	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	EE308H	Microcontroller
2	EE309H	PLC & SCADA

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

(Mr. P.T. Khobaragade)
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/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 and	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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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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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 EE
Course Category	:	DSC
Course Code	:	ME153H
Course Title	:	Engineering Graphics (Electrical)

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 a electrical engineering componets.

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.	
:: Engineering 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	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.	
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
UNIT VI: Free Hand Sketches	6a	Draw freehand sketches of given geometrical shapes.	6.1	Freehand sketches of line, circle and various geometrical shapes.	CO6
	6b	Draw freehand sketches of given electrical accesories.	6.2	Freehand sketches of electrical accesories like switches, holders, and sockets	
	6c	Draw freehand sketches of given electrical machine part.	6.3	Freehand sketches of electrical machine parts like rotor, stator, bearing, shaft and pulley.	

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 Engineering Curves - Involute of pentagon, and circle (Practical Sketch book)	2#	CO2
II	7	Draw Engineering Curves - Archimedian spial, and helix (Practical Sketch book)	2#	CO2
II	8	Draw given Conic Sections Engineering Curves (Sheet No. 2)	2#	CO2
II	9	Draw Engineering Curves - Cycloidal Curves 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 lines, circles and given geometrical shapes. . (Practical Sketch book)	2#	CO6
VI	28	Draw Free Hand Sketches of electrical accesories. (Practical Sketch book)	2#	CO6
VI	29	Draw Free Hand Sketches of electrical machine parts like rotor and stator. (Practical Sketch book)	2#	CO6
VI	30	Draw Free Hand Sketches of electrical machine parts like bearing, shaft and pulley. (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	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):

-----NA-----

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=PLIhUrsYr8yHxVky7bfr nbRcdXcHjT_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
7	Dr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

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

(Dr. G. V. Gotmare)
Member Sectretary 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/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 EE
Course Category	:	SEC
Course Code	:	WS152H
Course Title	:	Workshop Practice (Electrical)

I Rationale:

The knowledge of this course is essential for electrical technicians to perform electrical maintenance work in industry. This course provides a simulated industrial environment and enables students to perform a variety of operations in various shops using relevant hand tools, equipment, tools, and machinery. In this course students will develop practical skill in fitting, welding and sheet metal shops.

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: **Use** firefighting equipment and other safety related accessories.

CO2: **Use** fitting tools and machineries for performing fitting operations.

CO3: **Prepare** utility jobs involving sheet metal operations.

CO4: **Prepare** utility jobs involving welding 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: Safety	1	Follow safety precautions while working on shop floor.	2#	CO1
	2	Identify fire extinguishers according to their uses.	2	CO1
	3	Perform mock drill for extinguishing fire using proper fire extinguisher.	2#	CO1
	4	Identify and draw standard safety symbol.	2	CO1
ng Shop	5	Follow safety precautions and housekeeping practice while working on fitting shop.	2	CO2
	6	Identify hand tools, machine Tools and equipment used in Fitting Shop.	2#	CO2
	7	Observe demonstration of various hand tools used in fitting shop.	2#	CO2
	8	Draw the sketches; write specifications, details, applications, and safety rules related to fitting tools.	2#	CO2
	9	Individual Job 1: Prepare job involving marking, punching, filing sawing and drilling operations as per given drawing. Perform Filing operation as per drawing.	2#	CO2
	10	Individual Job 1: (Contd.) Perform Marking and punching operation as per drawing.	2#	CO2

Unit II: Fittin	11	Individual Job 1: (Contd.) Perform sawing and drilling operation as per drawing.	2#	CO2
	12	Individual Job 2: Prepare job involving marking, punching, drilling, and tapping operations as per given drawing. Perform filing operation as per drawing.	2#	CO2
	13	Individual Job 2: (Contd.) Perform marking and punching operation as per drawing.	2#	CO2
	14	Individual Job 2: (Contd.) Perform drilling and tapping operation as per drawing.	2#	CO2
	15	Individual Job 3: Prepare individual job involving marking, and external threading operations as per given drawing. Perform Marking operation as per drawing.	2#	CO2
	16	Individual Job 3: (Contd.) Perform external threading operation as per drawing.	2#	CO2
Unit IV: Sheet Metal Shop	17	Follow safety precautions and housekeeping practice while working on sheet metal shop.	2#	CO3
	18	Identify hand tools, machine Tools and equipment used in sheet metal Shop.	2	CO3
	19	Observe demonstration of various hand tools used in sheet metal shop.	2#	CO3
	20	Draw the sketches; write specifications, details, applications, and safety rules related to fitting tools.	2	CO3
	21	Utility Job 1: Prepare job involving Sheet Metal Shop operations as per given drawing. (Job to be prepared by group of min. 4 students depending on volume of work) Perform cutting and bending operations as per given drawing.	2#	CO3
	22	Utility Job 1: (Contd.) Perform edging and edge curling operation as per given drawing.	2#	CO3
	23	Utility Job 1: (Contd.) Perform lancing and soldering operation as per given drawing.	2#	CO3
	24	Utility Job 1: (Contd.) Perform riveting operation as per given drawing.	2#	CO3
	25	Utility Job 1: (Contd.) Perform finishing/ assembly as per given drawing.	2#	CO3

Unit VI: Welding Shop	26	Observe demonstration of various tools and arc welding machine used in welding shop.	2#	CO4
	27	Utility Job 2: Prepare utility job (like base plate of electrical machine/Angle iron frame for fixing main switches) involving welding Shop operations as per given drawing. (Job to be prepared by group of min. 4 students depending on volume of work) Perform measuring and marking operation as per drawing.	2#	CO4
	28	Utility Job 2: (Contd.) Perform cutting and edge preparation operation as per drawing.	2#	CO4
	29	Utility Job 2: (Contd.) Perform arc welding operation as per drawing.	2#	CO4
	30	Utility Job 2: (Contd.) Perform finishing operation as per drawing.	2#	CO4

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	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	2	3	-	-
CO4	3	-	-	3	-	2	3	-	-
CO5	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-

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. Fire extinguishers (all classes)
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. Vernier height Gauge 450 mm
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. Sheet Bending Machine
7. 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)
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(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/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

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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/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 EE/EC/MK
Course Category	:	DSC
Course Code	:	MH103H
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 various function.

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

CO3: **Apply** the concept of limit to solve the examples of derivatives by using first principle.

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

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

CO6: **Express** the complex number in Polar and Exponential form.

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, Domain and Co-Domain of the given	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, and Inverse Trigonometric (LIATE)	
	1d	Check whether the given function is odd or even function.	1.4	Even and odd Function, Parametric, Composite Implicit, Explicit Functions.	
UNIT II: Limits	2a	Evaluate limit of the given functionby 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,	
	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 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	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 givendifferential 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 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: Complex Number	6a	Find modulus, amplitude, and Express complex number, in the polar form, and exponential form.	6.1	Definitions, Equality of two complex number, Power of imaginary number, Algebra of Complex number (Addition, Subtraction,Multiplication, Division and Conjugate of two complex number). Representation of a complex number in plane (ARGAND'S Diagram), Modulus and amplitude of a complex, Polar form of a complex number.	CO6
	6b	Find the root of the given complex number.	6.2	Exponential function of a complex variables, Power of complex number-De Moivre's Theorems. The roots of complex number.	
	6c	Prove the Trignometric Identities, of circular and hyperbolic function by using Euler's theorem.	6.3	Euler's Theorm, circular function of complex number, Hyperbolic function relation between Hyperbolic and circular function.	

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, composite and, 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 Bernoull'si differential equation.	2#	CO6
VI	14	Find modulus, amplitude and express the given complex number in the polar form. Find the roots of complex number.	2#	CO6
VI	15	Convert the complex number into exponential form, hyperbolic form. By using De'Moivres's theorems, Euler's Theorems prove the Trigonometric Identities.	2#	CO6

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 function by using Laws of Derivatives.
5. Prepare the list 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 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. Find modulus, amplitude and express the given complex number in the polar form.Find the roots of complex number.
13. Convert the given complex number into exponential form, hyperbolic form. By using De'Moivre's theorem, Euler's theorem, prove the trignometric identities.

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	04	00	6
			O	00	00	04	4
2	Limits	8	C	00	04	04	8
			O	02	00	00	2
3	Derivetive	14	C	02	06	06	14
			O	00	04	08	12
4	Integrations	14	C	04	04	04	12
			O	02	04	00	6
5	Differential Equation	5	C	04	00	08	12
			O	00	02	04	6
6	Complex Number	14	C	00	06	12	18
			O	02	02	06	10
Total		60	C	12	24	34	70
			O	6	12	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	6R2	5U2	6U2	5	7
2	1U4	2U4	3U4	1A4	2A4			3	5
3	4R4	4U4	4U4	3A4	3A4			3	5
4	5R4	5A4	5A4	5A4	4A4			3	5
5	6U6	3A6	6A6					2	3
6	3U6	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

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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).	

UI	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 and	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:

1. https://wwws.ancient-origins.net/history-famous-people/indian-sage-acharya-kanad-001399 , IKS Philosophy of atom by Acharya Kanad. assessed on 10th August 2023
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

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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 EE
Course Category	:	DSC
Course Code	:	EE101H
Course Title	:	Fundamentals of Electrical Engineering

I Rationale:

Electrical engineering students should know the facts, concepts, principles and procedures in electrical engineering. This course describes the basic facts, concepts & principles for the understanding of basic elementary knowledge related to electrical area. It is very useful course for understanding the higher-level knowledge in the field of electrical engineering.

II Industry Identified Competency:

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

Use basic principles in electrical engineering for different applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** basic laws in an electric circuit.

CO2: **Solve** DC electrical circuits using basic laws.

CO3: **Use** capacitor in an electric circuit for different conditions.

CO4: **Apply** laws of magnetism and electromagnetism for an electric circuit.

CO5: **Select** conducting and magnetic materials for perticular applications.

CO6: **Select** insulating materials for perticular 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: Fundamentals of Electricity	1a	Differentiate between given Electrical terms.	1.1	Atomic structure of an atom and concept of free electron, Concept of electric charge, current, voltage drop, EMF, potential difference, Direction of current and their SI units, Different effects of electric current.	CO1
	1b	Calculate various term from a given data.	1.2	Resistance, unit of resistance, Law of resistance (Factors affecting resistance), Effect of temperature on resistance, temperature coefficient of resistance, Ohms law.	
	1c	Calculate work, power and energy for a given circuit.	1.3	Work, power, energy and their SI units, Joule's law, Relation between H.P and watts, Kwh and Kcal, cost of electrical energy.	
	1d	Identify given BIS symbols.	1.4	BIS symbols as per IS:2032 are related to circuit elements, variable resistors, rotating machines, transformers, electrical meters, and miscellaneous apparatus.	

	1e	Illustrate given term of power system.	1.5	Concept of generation, transmission and distribution of electrical power, line diagram of AC power flow in supply systems, voltage levels at various stages in power system.	
UNIT II: DC Circuits	2a	Calculate equivalent resistance of the given series circuit.	2.1	Concept of DC voltage & current, Resistance in series, properties of series circuit, voltage distribution in series circuit, equivalent resistance of series circuit, Applications of series circuits.	
	2b	Differentiate between series and parallel circuits.	2.2	Resistance in parallel, properties of parallel circuit, current distribution in parallel circuit, equivalent resistance of parallel circuit, Applications of parallel circuits.	CO2
	2c	Calculate the equivalent resistance of the given series and parallel circuit.	2.3	Series-parallel combination, Equivalent resistance of series-parallel combination. Application of ohm's law for simple DC circuits.	
	2d	Convert the given type of source into another type.	2.4	Types of DC Electric Current source, Ideal voltage source, Practical Voltage Source, Ideal current source, Practical current Source, Source transformation.	
: Electrostatics	3a	Illustrate given term of electrostatics.	3.1	Coulomb's law of Electrostatics, Absolute and relative permittivity, Concept of electric field, electric flux, electric intensity, electric flux density, electric potential, potential gradient, dielectric strength.Capacitance, dielectric constant, and capacitance of parallel plate capacitor	CO3

UNIT III:	3b	Calculate the equivalent capacitance of the given series parallel capacitive circuit.	3.2	Capacitance in series and parallel, and source of capacitance in electrical systems. Charging & discharging of capacitor, Dielectric loss.	
	3c	Select the type of capacitor for given application.	3.3	Types of capacitors: Ceramic capacitor, Electrolytic capacitor and paper capacitor and their application.	
UNIT IV: Magnetism and Electromagnetism	4a	Distinguish between given terms related to the magnetic circuit.	4.1	Laws of magnetic force, magnetic field, Absolute and relative permeability of a medium, concept of lines of force, Magnetic flux and magnetic flux density and field intensity. Relation between B and H.	CO4
	4b	Calculate given parameter of magnetic circuit from given data.	4.2	Concept of MMF, Reluctance, Magnetic circuits, Comparison between electric and magnetic circuits, concept of leakage flux and leakage coefficient, calculation of ampere-turns for simple series magnetic circuit, B-H curve, hysteresis loop & hysteresis loss, Steinmetz hysteresis law.	
	4c	Select the proper rule for a given application.	4.3	Magnetic effect of electric current, Dot & cross conventions, Right hand thumb rule, Interaction between magnetic fields, force on current carrying conductors, Fleming's lefthand rule.	
	4d	Calculate given parameter of electromagnetic circuit from given data.	4.4	Faraday's Laws of electromagnetic induction. Direction of induced EMF and current, Lenz's Law, Fleming's right-hand rule, Induced EMF, dynamically induced EMF, statically induced EMF, self-inductance (L), Mutual Inductance, co-efficient of coupling.	

	4e	Identify the behaviour of inductor in given type of supply.	4.5	Inductances in series and parallel rise and decay of current in an inductive circuit, Energy stored in a magnetic field, Behaviour of inductor on AC & DC, lifting power of magnet, Eddy current loss, Steinmetz formula for eddy current loss.	
UNIT V: Conducting and Electromagnetic Materials	5a	Classify given type of conducting material with their properties.	5.1	Properties of Conducting Materials: Electrical, Mechanical and Thermal Properties of Conducting Materials.	CO5
	5b	Choose a different conducting material as per the requirement.	5.2	Conducting Materials and their applications: Copper, aluminum, Tungsten, brass, bronze, mercury, silver, lead, nickel, and tin.	
	5c	Select the given type of magnetic material for particular applications.	5.3	Types of Magnetic Materials: Ferromagnetic, paramagnetic and diamagnetic materials, their comparison.	
	5d	Select magnetic materials as per the given application.	5.4	Properties and application of magnetic material: CRGO silicon steel, HRGO silicon steel, typical hysteresis loop of different ferromagnetic materials (hard steel, wrought iron and alloyed steel), loss of magnetism.	
laterials	6a	Classify the given types of insulating material with their properties.	6.1	Classification of Insulating Materials: Solid, Liquid, Gases, Properties of Insulating Materials: Classification of Properties of Insulating Materials: Electrical Properties, Thermal Properties, Chemical Properties, Physical / Mechanical Properties	

UNIT VI: Insulating M	6b	Select an insulating material for a given application.	6.2	Insulation Classes as per IS: 1271-2012: Limiting Temperature in degree Celsius, Materials, and Uses.	CO6
	6c	Differentiate between Dielectrics and Insulators.	6.3	Main Reasons for Insulation Failure, Dielectric Failure of insulating materials (Gaseous, liquid and Solid state), Difference between Dielectrics and Insulators.	
	6d	Select insulating materialfor a given applications	6.4	Properties of Insulating materials and their application in electric machines	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Follow electrical safety and Identify electrical measuring instruments.	2#	CO1
I	2	Identify electrical, sources, ICDP/ICTP, switches, loads, wires.	2#	CO1
I	3	Connect voltmeter, ammeter, and wattmeter in electrical circuit.	2#	CO1
I	4	Find unknown resistance in an electric circuit using Ohms law.	2#	CO1
II	5	Find temperature coefficient of materials.	2	CO2
II	6	Calculate unknown resistance of DC series circuit.	2#	CO2
II	7	Calculate unknown resistance of DC parallel circuit.	2#	CO2
II	8	Calculate equivalent resistance of series parallel circuit.	2#	CO2
III	9	Determine the time constant (RC) by plotting the discharging curves of a capacitor(C) through resistor (R)	2	CO3
III	10	Measure capacitance of capacitor and calculate equivalent capacitance in series circuit.	2#	CO3
III	11	Measure capacitance of capacitor and calculate equivalent capacitance in parallel circuit.	2#	CO3
IV	12	Plot the B-H loop of a Ferro-magnetic core material.	2#	CO5
V	13	Identify different conducting materials using resistive test.	2#	CO5
VI	14	Identify different resinous materials using a burning test.	2#	CO5
VI	15	Collect and classify insulating materials based on class of insulators.	2	CO6

Note: 1) # Compulsory. 2)Use virtual labs where ever possible.

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

1. Collect various types of resistors available in market test it and prepare report.
2. Prepare practical kit for verification of series circuit.
3. Collect various types of capacitors available in market test it and prepare report.
4. Prepare microproject on series parallel electric circuit.
5. Prepare practical kit for verification of perallel circuit.
6. Prepare microproject based electromagnetism.
7. Collect various types of conducting material and prepare report.
8. Collect various types of insulating material and prepare report.
9. Prepare any models related to curriculum topic in the form of mini-projects.
10. Prepare a practical kit for verification of ohms law.
11. Prepare a model for explaning faradays law of electromagnetic induction.
12. Prepare a model of electric bell explaining effect of electromagnetisum.
13. Solve numericals based on Equivalent Resistance of Series and Parallel connection of Resistances in given D.C. Circuits.
14. Solve numericals based on Equivalent Capacitance in given D.C. Circuits.
15. Solve numerical based on calculation of various parameters of given magnetic circuit

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	8	C	02	04	10	16
			O	00	04	06	10
2	DC Circuits	6	C	02	04	06	12
			O	00	00	08	8
3	Electrostatics	5	C	02	04	04	10
			O	00	04	00	4
4		8	C	02	04	06	12
			O	00	00	06	6
5	Conducting and Electromagnetic Materials	4	C	02	04	06	12
			O	02	04	00	6
6	Insulating Materials	5	C	00	04	04	8
			O	02	04	00	6
Total		36	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	5R2	6R2	5	7
2	1U4	1A4	2U4	4U4	2A4			3	5
3	3U4	3A4	4U4	3U4	1U4			3	5
4	5U4	6U4	6A4	6U4	5U4			3	5
5	1A6	2A6	4A6					2	3
6	4A6	5A6	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	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/skill	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	-	-	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	Experiments in Basic Electrical Engineering	S.K. Bhattacharya and K.M. Rastogi., New Age International Publisher,	13: 9788122410426
5	A Textbook on laboratory courses in Electrical	S.G. Tarnekar and P.K. Kharbanda, S.Chand & Company Ltd., Third, 1990	13: 978-8121901048
6	Electrical Engineering Materials	N. Alagappan,NT Kumar, TataMcGrawHill Publishing Company Ltd. 1988	13: 978-0-07-460420-5

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2. http://nptel.ac.in/courses/108108076/1 , accessed on 21st June , 2021
3. http://www.electrical4u.com , accessed on 21st June , 2021
4. https://en.wikipedia.org/wiki/Capacitor accessed on 21st June , 2021
5. https://en.wikipedia.org/wiki/Magnetic_circuit , accessed on 21st June , 2021
6. https://youtu.be/M-QfX2fvpp4?si=xpZDAiX3-_7xrn , accessed on 21st June , 2021
7. https://www.youtube.com/watch?v=M-QfX2fvpp4 , accessed on 21st June , 2021
8. https://www.youtube.com/watch?v=62lmfPki868 , accessed on 21st June , 2021
9. https://www.youtube.com/watch?v=bBKYZFtcWHc , accessed on 21st June , 2021
10. http://www.electrical4u.com , accessed on 21st June , 2021

XVI List of Major Equipment/Machineries with Specification:

1. Ammeter MI 0-5-10A
2. Voltmeter MI 0-150-300 V
3. Wattmeter 0-3000 W
4. Various types of capacitor
5. Rheostat assorted sizes
6. Variable Inductor
7. Single phase auto transformer 0-240 Volts, 16A
8. Digital Multi-meter

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. G.V. Gotmare	I/C HoD, Electrical Engineering	Government Polytechnic, Nagpur
3	Mrs.A.A.Alegaonkar	Sr. Engineer	Powergrid Corporation of India Ltd, Nagpur
4	Mrs.A.P.Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
5	Mrs. N. J. Suryawanshi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
6	Mrs.P.M.Sonwane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
7	Miss P. S. Rithe	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
8	Mr. A. P. Dasarwar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
9	Mr. B. D. Wadhai	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

(Dr. G. V. Gotmare)
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(Dr. G. V. Gotmare)
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 EE
Course Category	:	DSC
Course Code	:	EC102H
Course Title	:	Basic Electronics

I Rationale:

Electrical Engineering students should require the knowledge of semiconductor electronic components while maintaining various electrical systems. This course describes the construction, characteristics, operating principle and applications of some basic electronic components and circuits. It is very useful course to apply the knowledge to solve broad electronics engineering application problems in electrical engineering field.

II Industry Identified Competency:

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

Use electronic components and devices for different applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Test** various types of diodes.

CO2: **Build** rectifier and filter circuits.

CO3: **Use** transistor as amplifier and switch.

CO4: **Assemble** given voltage regulator circuit.

CO5: **Realize** boolean expression using gates.

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: Semiconductor Theory and Semiconductor Diodes	1a	Compare given types of semiconductor materials.	1.1	Semiconductor theory: Definition of semiconductor, Intrinsic Semiconductor and Extrinsic Semiconductor with examples; Commonly used semiconductors: Germanium, Silicon; Types of extrinsic semiconductors: P-type and N-type, Pentavalent Impurities, Trivalent Impurities, majority and minority carriers, crystalline structure and conduction in P-type and N-type semiconductor	CO1
	1b	Plot V-I characteristics of PN junction diode	1.2	Formation of PN junction, Depletion region, PN junction diode-Symbol, Terminal identification, Forward and reverse biasing, V-I characteristics	
	1c	Select a diode as per application	1.3	Special purpose Diodes–Zener diode, LED, Photodiode (only Symbol, working and applications)	

UNIT II: Rectifiers and Filter Circuits	2a	Compare given types of rectifiers on the basis of given points.	2.1	Rectifiers: Definition and types of rectifiers, Circuit diagram, working, output waveforms, advantages, disadvantages, specifications of half wave rectifiers (HWR), Center tapped full wave rectifier and Bridge rectifier; Definitions of peak inverse voltage, ripple factor, rectification efficiency; Comparison of half wave rectifiers HWR), Center tapped fullwave rectifier and Bridge rectifier	CO2
	2b	Compare the output waveforms of rectifier circuit with filter and without filter.	2.2	Filters: Necessity and types of filters; Circuit diagram, working, output waveforms, advantages, disadvantages of CLC filter	
UNIT III: Bipolar Junction Transistor	3a	Illustrate the operating principle of given type of Transistor	3.1	Definition of Transistor, NPN and PNP BJT: symbols, constructions, operating principle	CO3
	3b	Plot input and output characteristics of given transistor configuration.	3.2	Operating Regions of BJT; Circuit diagram of CB, CE and CC transistor configuration; Input and output characteristic of CE transistor configuration	
	3c	Justify the use of transistor for given application.	3.3	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	
ators	4a	Justify the need of given block of regulated power.	4.1	Block diagram, working and Merits of Regulated power supply	

UNIT IV: Voltage Regul	4b	Plot the load and line regulation of given voltage regulator	4.2	Necessity and types of voltage regulation, Definition of load and line regulation	CO4
	4c	Select the voltage regulator IC for or Zener diode for given output voltage.	4.3	Zener diode as voltage Regulator and its merits and demerits, IC Voltage Regulator: 78XX, 79XX, LM723	
	4d	Interpret the function of given block of SMPS	4.4	Concept of switched mode power supply (SMPS)	
UNIT V: Digital Electronics	5a	Convert a given decimal number to binary and binary to decimal.	5.1	Number system– Types, Decimal to Binary conversion, Binary to Decimal Conversion	CO5
	5b	Realize a given Boolean expression using gates.	5.2	Logic Gates – Logic symbol and truth table of –AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR; Realization of Boolean Expression using Basic Gates	
	5c	Realize a given combinational circuit	5.3	Combinational Circuits – Half Adder, Full Adder	
	5d	Illustrate working of given flip flops.	5.4	Sequential Circuits– Symbol, Truth table and Working of JK Flip-flop, D flip flop and T flip flop.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Plot V-I characteristics of P-N junction diode and find the value of cut-in voltage.	2#	CO1
I	2	Test various diodes using multimeter.	2#	CO1
II	3	Build the half wave rectifier circuit on breadboard and draw input and output waveforms.	2#	CO2
II	4	Build the Bridge rectifier circuit on breadboard and draw input and output waveforms.	2	CO2
II	5	Build the Bridge rectifier circuit with CLC filter on breadboard and draw input and output waveforms.	2#	CO2
III	6	Build a circuit on breadboard to demonstrate use of transistor as a switch and measure the voltage across the transistor when it is ON and when it is OFF.	2#	CO3
III	7	Plot the input and output characteristics of BJT in CE mode.	2#	CO3
IV	8	Design a voltage regulator circuit using zener diode for given output voltage.	2#	CO4
IV	9	Design a voltage regulator circuit using regulator IC for given output voltage.	2#	CO4
IV	10	Build regulated power supply for given output voltage.	2#	CO4
IV	11	Connect input to SMPS and measure output.	2	CO4
V	12	Verify the truth table of AND, OR and NOT gates.	2#	CO5
V	13	Verify the NAND and NOR gates as universal logic gates.	2#	CO5
V	14	Design and verify of the truth tables of Half adder circuits.	2#	CO5
V	15	Design and verify of the truth tables of Full adder circuits.	2	CO5
V	16	Verify the truth table of a J-K flip-flop.	2#	CO5

Note: # Compulsory

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

1. Develop a fire alarm circuit using photodiode.
2. Develop a LED flashing circuit.
3. Develop a circuit and plot V-I characteristics of Varactor diode/ Tunnel diode.
4. Develop a fier alarm circuit using PIN diode.
5. Develop a regulated power supply on breadboard using zener diode for given output voltage.
6. Develop a circuit of transistor as a switch to ON/OFF LED.
7. Develop a circuit of single stage common emitter transistor amplifier.
8. Develop a circuit of single stage common base transistor amplifier.
9. Develop a regulated power supply on breadboard using 78XX regulator IC for given output voltage.
10. Develop a regulated power supply on breadboard using 79XX regulator IC for given output voltage.
11. Develop a regulated power supply on breadboard using LM723 regulator IC for given output voltage.
12. Develop combinational circuit (Encoder/ Decoder/ Substractor/ Multiplexer/ Demultiplexer) using logic gates.
13. Develop combinational Code Converter using logic gates.
14. Develop a sequential circuits-Counter using flip flops.
15. Develop a sequential circuits- Register using flip flops.

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	Semiconductor Theory and Semiconductor Diodes	12	C	4	4	6	14
			O	2	4	0	6
2	Rectifiers and Filter Circuits	9	C	2	8	6	16
			O	4	0	6	10
3	Bipolar Junction Transistor	8	C	2	4	4	10
			O	0	4	4	8
4	Voltage Regulators	7	C	2	8	6	16
			O	2	4	0	6
5	Digital Electronics	9	C	4	4	6	14
			O	0	4	6	10
Total		45	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	1R2	1R2	2R2	3R2	4R2	1R2	4R2	5	7
2	5R4	1U4	3U4	1U4	3U4			3	5
3	2U4	2U4	3A4	2R4	3A4			3	5
4	4U4	4U4	5U4	4U4	5U4			3	5
5	1A6	2A6	2A6					2	3
6	5A6	4A6	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. writing procedure, etc.	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	Work done	10
2	Report writing	10
3	Viva-voce	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	-	-	2	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	2	-	-
CO4	3	-	-	2	-	-	2	-	-
CO5	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: 9788121927833
4	Basic Electronics	Grob, Tata McGraw Hill, 12th edition	10: 0073510859
5	Electronics Devices and Circuits	S Salivahanan, Tata McGraw Hill, 2nd edition 2011	10: 0074633864, 13: 9780074633861
6	Digital Principles and Application	Malvino, Albert Paul; Leach, Donald P., Mcgraw-Hill, 1986	10: 0070398836 13: 9780070398832
7	Modern Digital Electronics	R.P.Jain, McGraw Hill Education (India) Private Limited, 2009	10: 0070669112 13: 9780070669116

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2. http://vlabs.iitkgp.ernet.in/be/ accessed on 05th Oct 2023
3. https://www.learnelectronicsonline.com/ accessed on 05th Oct 2023
4. http://www.instructables.com/id/Basic-Electronics accessed on 05th Oct 2023
5. https://learnabout-electronics.org/ accessed on 05th Oct 2023
6. https://www.datasheetcafe.com/ accessed on 05th Oct 2023
7. www.electrical4u.com/digital-electronics assessed on 05th Oct 2023
8. https://www.electrical4u.com/electrical-engineering-articles/digital-electronics/ assessed on 05th Oct 2023

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- 0-5V, 0-15 V, 0-30 V, 0-100 V
3. Digital Multi-meter
4. Cathode ray oscilloscope- 0 to 30MHz
5. Function Generator–0-5MHz.
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. R. V. Yenkar	HoD, Electronics & Telecom. Engg.	Government Polytechnic, Nagpur
2	Dr. M. N. Bawane	Lecturer, Electronics & Telecom. Engg.	Government Polytechnic, Nagpur
3	Prof. N. V. Chide	Lecturer, Electronics & Telecom. Engg.	Government Polytechnic, Nagpur
4	Dr. V. J. Dongre	HoD, Electronics & Telecom. Engg.	Government Polytechnic, Arvi
5	Mr. Sandip V. Darwhekar	Director	Beta Computronics Pvt. Ltd., Nagpur
6	Mrs. Gazala Ali	HoD, Electronics & Telecom. Engg.	Anjuman Polytechnic, Nagpur

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Near Mangalwari Bazar, Sadar, Nagpur-440001

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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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,
4	Mr. Ravindra Suryawanshi	Lecturer in English	NIT Polytechnic, Nagpur
5	Mr. Nitin Pathak	Lecturer in English	Kamptee Polytechnic, Nagpur

(Mr. P. T. Khobragade)
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GOVERNMENT POLYTECHNIC, NAGPUR
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Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	SEC
Course Code	:	EE151H
Course Title	:	Electrical and Electronics Workshop

I Rationale:

Basic Electrical and Electronics workshop course mainly focuses on the introduction of various tools, meters and circuits into the electrical and electronics filed. It also focus on the measurement of various parameters using different tools and their connection into the circuit. This course will help the student to acquire skill and attitude to perform the function of supervisor in industry.

II Industry Identified Competency:

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

Use electrical, electronic tools and meters for various applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Follow** safety precautions when undertaking electrical and electronic work.

CO2: **Select** and use various electrical workshop tools as per the application.

CO3: **Select** and use various meters for measurement of electrical quantities.

CO4: **Identify** the various electronics components and tests its functionality.

CO5: **Performs** circuit building activities of various electronics components.

CO6: **Prepare** a micro project.

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:

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 electrical safety signs and symbols for a given situation.	2#	CO1
I	2	Use personal protective equipment (PPE) for a electrical safety.	2#	CO1
I	3	Identify various types of fire extinguishers.	2#	CO1
I	4	Perform mock drill session of fire fighting extinguishers.	2	CO1
I	5	Perform different methods of Artificial respiration on dummy.	2	CO1
II	6	Identify various electrical workshop tools.	2#	CO2
II	7	Use following electrical workshop tools- Spanner and wrenches, combination plier, electrician's screwdriver, side cutting plier, insulation remover, hammer, spanners etc.	2#	CO2
II	8	Use following electrical workshop tools - Portable drill machine, Hand drill machine, Electriciean knife, cutter machine, Punch etc.	2#	CO2
II	9	Test single-phase and three-phase supply using tester and test lamp.	2#	CO2
II	10	Perform various tests using series test-board.	2#	CO2
III	11	Use digital multimeter for measurement of various electrical quantities.	2#	CO3
III	12	Use digital multimeter for finding faults in electrical circuits	2	CO3
III	13	Use tong tester for measurement of various electrical quantities	2#	CO3
III	14	Use megger for continuity test, short circuit test and insulation test.	2#	CO3
III	15	Connect analog voltmeter, ammeter, and wattmeter in an electric circuit for measurement of electrical quantities.	2#	CO3
III	16	Connect digital meters in an electric circuit for measurement of electrical quantities.	2#	CO3
III	17	Use power analyzer for measurement of various electrical quantities.	2#	CO3
IV	18	Identify the various electronic components by sight.	2#	CO4
IV	19	Use reference materials to identify resistors, capacitors, diodes, and transistors.	2#	CO4

IV	20	Identify the values of electronics components such as resistor and capacitor	2#	CO4
IV	21	Use a multimeter to test the functionality of resistors, capacitors, and diodes.	2#	CO4
IV	22	Practice proper wire stripping techniques using a wire stripper tool.	2	CO4
IV	23	Crimp the connectors into the wires for secure connections.	2#	CO4
V	24	Test the working of Diode and Transistor.	2	CO5
V	25	Build voltage divider and current divider circuits using resistors, and measure output voltages and currents.	2#	CO5
V	26	Build a simple regulated DC power supply using rectifiers, filters, and voltage regulators	2#	CO5
V	27	Connect and disconnect components on a breadboard without damaging them.	2#	CO5
V	28	Practice proper soldering techniques on a soldering board.	2#	CO5
V	29	Perform soldering and desoldering of simple components like resistors and LEDs.	2	CO5
VI	30	Prepare any one micro project from the Followings a. Design and prepare electrical circuit of one bulb with switch and fuse in circuit. b. Design and build any electronics circuit using soldering technique.	6#	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):

-----NA-----

XI Scheme of Laboratory Formative Assessment (FA):

S.N.	Criteria	Max. Marks
1	Drawing circuit diagram, selection of equipment☐	5
2	Performance	30
3	Calculation, Result, Drawing Graphs (if any)	10
4	Viva Voce	5
	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	1	-	-	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	2	-	3	-	-	-	-	-
CO5	3	-	2	-	-	-	-	-	-
CO6	3	2	2	3	-	1	1	1	-

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	S.L.Uppal, G.C.Garg, Khanna publications, Sixth Edition, 2009	13: 978-81-7409-240-3
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: 978-16-3920-381-9

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1. http://nptel.ac.in/courses/108108076/1 , accessed on 21st June , 2021
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4. http://nptel.ac.in/courses/108108076/1 , accessed on 21st June , 2021
5. https://library.automationdirect.com/basic-electrical-theory/ , accessed on 21st June , 2021
6. https://www.di.univr.it/documenti/OccorrenzaIns/matdid/matdid441904.pdf ,

XVI List of Major Equipment/Machineries with Specification:

1. Ammeter MI 1A, 2A, 5A, 10A, 20A
2. Voltmeter MI 0-200V, 0-500V
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. Power Analyzer 0 - 500V Variable, Class 0.5S
8. Megger 0 - 500V dc, 0 - 1000V dc
9. Regulated Power Supply
10. Soldering gun 0 - 200 Watt, temperature range 0 - 70 Deg C

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. B. D. Wadhai	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

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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/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

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

(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

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 EE
Course Category	:	DSC
Course Code	:	EE201H
Course Title	:	Electrical Power Generation

I Rationale:

Electrical power plays significant role in the development of industries & agriculture. With growing demand of electric power it has become important to generate power more efficiently. This course deals with generation of electrical power using Thermal , Hydro, Nuclear , diesel, gas as well as solar & wind energy . These types of power plants need highly skilled technicians who are capable of operating various control equipment to supply uninterrupted power to grid.

II Industry Identified Competency:

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

Operate & maintain generators for power generation.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** the layout , component details of thermal power station & draw block diagram.

CO2: **Classify** hydro- Electric Power Station based on head of water.

CO3: **Analyze** the environmental impact of nuclear, diesel & gas power plant.

CO4: **Analyze** performance parameters of various power plants.

CO5: **Maintain** the optimised working of solar power plant.

CO6: **Maintain** the optimised working of wind power plant.

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
: Thermal Power Station	1a	Justify the function of given system in Thermal power station.	1.1	Importance of electrical energy. Generation of electric energy. Types of coal and their calorific values, Electric energy Sources conventional & renewable, Advantages & disadvantages of thermal power station, Site selection for thermal power plant, line & Block diagram of the system showing the process of energy conversion. Functions of equipment used in the systems such as: Coal handling plant , Ash handling plant , Boiler - Classification of boiler based on methods of firing, Economizer, Air pre –heater, Super-heater, ID /FD fans, Condensers, Cooling towers & Cooling systems. Flow diagrams - water-steam path, hydrogen path, coal-ash path & Flue-gas path.	CO1

UNIT I:	1b	Classify the given types of turbine.	1.2	Steam turbine- working principle, type & specification, Alternator : Special features of turbo alternator, specification , Cooling of turbo alternator. Electrostatic precipitator : definition, working principle, Application, use.	
	1c	Justify the given environmental impact of thermal power plant.	1.3	Location of Thermal power plants in Maharashtra and their capacities, Causes of pollution in thermal power plant, environmental impact of thermal power plant.	
UNIT II: Hydro Electric Power Station	2a	Justify the function of given system in Hydro Electric Power Station with diagram.	2.1	Introduction, Advantages and disadvantages of hydroelectric plants. Site selection for hydroelectric plant, line and block diagram of the system showing the process of energy conversion.	CO2
	2b	Classify given types of turbine.	2.2	Classification of hydroelectric power stations: High, medium & low head, Types based on generation capacity. Functions of catchment area, dam, spillways, surge tank, reservoir, penstocks and tailrace. Micro hydro Power system- its description & diagram	
	2c	Compare given types of turbine used in hydro plant based on given points.	2.3	Classification of turbine based on head of water: Pelton turbine, Francis turbine, Kaplan turbine . Working principle & constructional feature of each type of turbines.	
	2d	Justify the use of pumped storage plants for supplying peak load	2.4	Pumped storage plants for supplying peak load-description, advantages, location of hydro power plants in Maharashtra and their capacities	

UNIT III: Other Power Plants	3a	Classify radiations on the basis of given points for nuclear power station.	3.1	Nuclear Power Plant: Introduction, Line and block diagram of the system showing the process of energy conversion, Nuclear fission, chain reaction, site selection for nuclear plant, Types of radiations, effects of radiation on humans. Nuclear power plants in India and their capacities.	CO3
	3b	Compare given type of diesel engine on the basis of given points.	3.2	Diesel Power Plant: line and block diagram of the system showing the process of energy conversion, Types of diesel engine & its construction & working principle, environmental impact of diesel power plant	
	3c	Select types of fuels for given gas turbine	3.3	as Power Plant: Block diagram of gas power plant, fuels, important properties while selecting the fuel for gas turbine, Advantages and disadvantages of gas power plant, environmental impact of gas power plant.	
	4a	Compare given power stations on the basis of given points	4.1	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: Performance of Power Station	4b	Calculate given factors based on given data of power station	4.2	Definitions - connected load, maximum demand, average load, installed capacity, load factor, diversity factor, demand factor, plant capacity factor, plant utilization factor, Calculate connected load, maximum demand, average load, installed capacity, load factor, diversity factor, demand factor, plant capacity factor, plant utilization factor.	CO4
	4c	Analyze given load curve of power plant	4.3	Load curve and load duration curve, their importance . Concept of generating units. Choice of number and rating of units for a given load curve and operational schedule, calculate no. of unit generated from given load curve, concept of base load & peak load stations	
T V: Solar Power Plant	5a	Justify the function of given terms related to solar radiation.	5.1	Terms related to solar radiation : irradiation, insolation, beam radiation, diffuse radiation, Solar constant, solar radiation at a given location, annual radiation in solar radiation, optimal tilt for solar equipment, monthly averaged global radiation at optimal tilt.	CO5
	5b	Justify the function of given system in Solar Photovoltaic (PV) power plant.	5.2	Solar Cell- Principle of Electricity Generation, Types of Solar Cells and their Conversion efficiency, Solar Photovoltaic (PV) power plant: Layout, construction working.	

UNI	5c	Compare given Solar PV Cell on the basis of given points.	5.3	Solar PV Module, Ratings of PV Module, Types Solar PV Module- Monocrystalline, Polycrystalline, PERC, Thin-Film. Connection of Solar PV modules in series, Connection of Solar PV modules in parallel. Troubleshooting of PV module & maintain schedule of solar power plant.	
UNIT VI: Wind Power Plant	6a	Compare wind power plants on the basis of given points.	6.1	Wind map of India: Wind power density in watts per square meter, Classification of wind power plant: Vertical axis, Horizontal Axis. Layout of Horizontal axis large wind power plant, Layout of vertical axis large wind power plant.	CO6
	6b	Justify the function of given system in wind power plant	6.2	Block diagram of WPP, Components of WPP, Site selection criteria of WPP, Problems associated with grid connection. Salient features of electric generators used in large wind power plants. Maintenance schedule of wind power plant.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the parts of the coal fired thermal power plant after watching a video programme.	2#	CO1
I	2	Prepare a report on visit of thermal power plant.	2	CO1
II	3	Identify the parts of large hydro power plant after watching a video programme	2#	CO2
II	4	Identify the parts of micro hydro power plant after watching a video programme.	2	CO2
II	5	Identify various parts of Pelton turbine & Operate it.	2#	CO2
II	6	Identify various parts of Francis turbine & Operate it .	2#	CO2
III	7	Identify various parts of 2 stroke diesel engine & Operate it.	2#	CO3
III	8	Identify the parts of a small diesel generator power plant after watching a video programme.	2#	CO3
III	9	Identify various parts of 4 stroke diesel engine & Operate it.	2	CO3
III	10	Troubleshoot small diesel generating system.	2#	CO3
III	11	Identify the parts of the nuclear fired thermal power plant after watching a video programme.	2#	CO3
III	12	Identify the parts of Gas power plant after watching a video programme.	2#	CO3
IV	13	Analyze the load curve of power plants.	2#	CO4
V	14	Troubleshoot & maintain Solar PV power system.	2#	CO5
VI	15	Identify the parts of large wind power plant & its maintenance schedule after watching a video programme.	2#	CO6

Note: # Compulsory. Use A3 drawing sheet for drawing.

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

1. Prepare microproject based on Coal handling plant.
2. Prepare microproject based on ash handling plant.
3. Prepare microproject based on cooling towers & cooling system in Thermal Power Station.
4. Prepare microproject based on pumped storage plant for supplying peak load.
5. Prepare microproject based on electrostatic precipitator.
6. Prepare microproject based on types of turbine based on head of water.
7. Prepare microproject based on chain reaction, nuclear fission.
8. Prepare microproject based on two stroke diesel engine.
9. Prepare microproject based on four stroke diesel engine.
10. Prepare microproject based on peak load station.
11. Prepare microproject based on Thermal power plant.
12. Prepare microproject based on gas power power plant.
13. Prepare microproject based on diesel power plant.
14. Prepare microproject based on Hydroelectric power station.
15. Prepare given assignment on performance of power station.

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	Thermal Power Station	10	C	06	00	10	16
			O	00	04	00	4
2	Hydro Electric Power Station	10	C	02	00	10	12
			O	04	04	00	8
3	Other Power Plants	10	C	02	04	10	16
			O	02	00	04	6
4	Performance of Power Station	5	C	02	04	06	12
			O	00	00	04	4
5	Solar Power Plant	5	C	00	08	00	8
			O	02	00	06	8
6	Wind Power Plant	5	C	02	04	00	6
			O	00	04	06	10
Total		45	C	14	20	36	70
			O	8	12	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	3R2	5R2	5	7
2	1R4	1U4	4U4	2R4	2U4			3	5
3	3U4	2A4	1A4	3A4	3A4			3	5
4	5U4	5U4	6U4	6U4	4A4			3	5
5	1A6	2A6	5A6					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	Drawing line & block diagram of power plant, other diagrams	5
2	Report writing	10
3	Result	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/Skill	10
3	Report writing	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	-	-	-	2	2	3	-	-
CO2	3	-	-	2	-	-	3	-	-
CO3	3	-	-	2	2	2	3	-	-
CO4	3	1	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	2
CO6	3	-	-	-	-	-	-	-	2

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Generation Of Electrical Energy	B.R.Gupta, Eurasia Publishing House (Pvt.) Ltd, Third Edition, 1996.	10: 935253381X, 13: 978-9352533817
2	Principles Of Power System	V.K. Mehta, S.Chand & Co.Ltd, Reprint, 1996.	10: 81-219-0594-X
3	A Text Book on Power System Engineering	A. Chakrabarti P. V. Gupta M. I.Soni , U.S. Bhatnagar, Dhanpat Rai Publishing Company (P) Ltd., 2008	10: 8177000209, 13: 978-8177000207
4	Power Plant Engineering	K.K.Ramalingam, Sciech Publications (India) Pvt. Ltd, Reprint, 2010	81-8732-877-0
5	Elements of Electrical Power Station Design	M.V. Deshpande, Prentice Hall India Learning Private Limited, 2009	10:812033647X, 13: 978-8120336476
6	Power Plant Engineering	G.R. Nagpal, S.C. Sharma, Khanna Publishers-Delhi, 2012	10: 8174093095, 13: 978- 8174093097
7	Renewable Energy Sources and Emerging Technologies	D. P. Kothari, K.C. Singal, Rakesh Ranjan,PHI Learning Pvt. Ltd., 2nd Edition, 2015	13: 978-81-203-4470-9

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1. https://youtu.be/-xebh8wU8gY?si=LQRq9RUPYDq4_4de , accessed on 29th April 2024
2. https://www.youtube.com/watch?v=bCEiOnuODac, accessed on 29th April 2024
3. http://www.electrical4u.com/electrical-power-transformer-definition-and-types-of- , accessed on 29th April 2024
4. http://nptel.ac.in/courses/108108076/16, accessed on 29th April 2024
5. https://youtu.be/AMXxXoHtM-o, accessed on 29th April 2024
6. https://youtu.be/usnnKAOvNnM, accessed on 29th April 2024

XVI List of Major Equipment/Machineries with Specification:

1. 1 to 3 kW microhydro power plant with relevant auxillaries.
2. Francis turbine.
3. Pelton wheel turbine.
4. Solar PV module / Rooftop solar system.
5. Vertical axis wind turbine-1kw.
6. 2 stroke diesel engine.
7. 4 stroke diesel engine.
8. Small diesel generating system.

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 Engineering, Nagpur
3	Mrs. Divya Pirpode	Sr. Engineer	Powergrid Corporation of India Ltd, Nagpur
4	Shri.M.N.Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
5	Dr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
6	Ms. P. M. Sonawane	Lecturer In Electrical Engineering	Government Polytechnic, Nagpur

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Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSC
Course Code	:	EE202H
Course Title	:	Electrical Circuit And Network

I Rationale:

This course 'Electrical circuit and Networks' is essential for Diploma in Electrical Engineering students as it lays the foundation for understanding and analyzing various electrical systems encountered in the field. It equips students with the knowledge of circuit theory, network analysis techniques, and AC Circuit principles necessary for designing, troubleshooting, and optimizing electrical circuits. Through practical application and theoritical study, students develop critical skills required for successful careers in electrical engineering and related industries.

II Industry Identified Competency:

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

Apply problem solving skills to solve AC and DC Circuits.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Analyze** simple electrical DC circuits using basic circuit laws and techniques.

CO2: **Apply** basic concepts of AC to interpret response of circuit elements on application of sine wave AC.

CO3: **Apply** concept of single phase AC to interpret response of series AC circuit.

CO4: **Apply** concept of single phase AC to interpret response of parallel AC circuit.

CO5: **Analyze** Three phase AC circuits using phasors techniques and calculate various AC circuit parameters

CO6: **Analyze** complex electrical DC networks using various theorems.

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: D.C Circuit & Network Reduction	1a	Classify given electrcial quantites and Convert given source into other type of source.	1.1	Defination- circuit, linear and non linear circuit, Bilateral and unilateral circuit, Electrical network, Node, Branch, Loop, mesh. Concept of voltage source and current source, Ideal and Practical voltage source and its VI Characteristics, Ideal and Practical current source and its VI Characteristics.	CO1
	1b	Calculate equivalent resistance of a given network by applying Star/Delta conversion technique.	1.2	Star Delta and Delta Star transformation of resistances. DC network reduction using star Delta and source conversion techniques.	
	1c	Calculate branch current of given network using KCL and KVL.	1.3	Kirchoff's current and voltage law and their sign convention. Steps for solving application of KCL and KVL.	

UNIT II: Basic Concepts of AC	2a	Calculate various AC quantities based on given data.	2.1	Defination of various terms like cycle, time period, frequency, amplitude, sinusoidal voltages, current equations and their different forms, phase difference, lagging and leading phase relation. Alternating quantities values-Peak values, Average values, RMS values, Form factor & Peak factor.	CO2
	2b	Convert given phasors into various forms.	2.2	Addition and subtraction of two alternating quantities. Significance of operator j. Rectangular form, Polar form, Triganometric form, Conversion from one form to another form.	
	2c	Perform mathamatical operations of given phasors.	2.3	Addition, subtraction, division, and multiplication of phasor, complex conjugate.	
	2d	Draw phasor diagram for given AC circuits.	2.4	AC applied to pure R, L, C only, waveforms, equations and phasor diagram. Concept of reactances, impedance and power factor.	
UNIT III: Single Phase AC Series Circuits	3a	Calculate various parameters from given data for R-L series circuit.	3.1	R-L series circuit - Phasor diagram and waveforms, power factor. Impedance triangle, power traingle, current & voltage equation.	CO3
	3b	Calculate various parameters from given data for R-C series circuit.	3.2	R-C series circuit- Phasor diagram, waveforms, Impedance triangle, power traingle, power factor, current and voltage equation.	
	3c	Calculate various parameters from given data for R-L-C series circuit.	3.3	R-L-C series circuit- Phasor diagram for three conditions and waveforms, Impedance triangle, power traingle, power factor, current and voltage equation.	

	3d	Calculate resonant frequency and quality factor(Q factor) of given series circuit.	3.4	Series Resonance- Definition, condition, resonant frequency, characteristics of series resonance, Quality factor (Q factor), series R-L-C resonant circuit, Application of series resonant circuit.	
UNIT IV: Single Phase AC Prallel Circuit	4a	Calculate R-L-C parallel circuit parameters by given method.	4.1	R-L, R-C, R-L-C Parallel combination of AC circuits. Impedance method of solving R-L-C parallel Circuits, phasor diagram.	CO4
	4b	Find Resonant frequency and Quality factor (Q factor) based on given data	4.2	Resonance in R-L-C parallel circuit. Condition for resonance, characteristics of parallel resonance, Quality factor (Q factor), Application of parallel Resonant Circuit.	
UNIT V: Three Phase AC Circuits.	5a	Interpret the relationship of three phase AC Quantites.	5.1	Comparison of three-phase AC over single phase AC system. Generation of three phase AC, Sinusoidal waveform, sinusoidal equation of AC quantities, phase sequence, Phase relationship.	CO5
	5b	Calculate the various parameters for given three phase star connection system.	5.2	Star connected system-Phasor diagram, relationship between Line and phase values of voltage and current, three phase power.	
	5c	Calculate the various parameters for given three phase delta connection system.	5.3	Delta connected system-Phasor diagram, relationship between line and phase values of voltage and current, three phase power.	
nd Theorems	6a	Apply Mesh current analysis to solve the given network.	6.1	Mesh current analysis. Steps to be followed for applying a mesh current analysis to solve DC Circuits.	

UNIT VI: DC Network Analysis ar	6b	Apply Node voltage analysis to solve the given network.	6.2	Node voltage analysis. Steps to be followed for applying node voltage analysis. solve DC Circuits using node analysis method.	CO6
	6c	Apply given Theorem to solve the given circuit.	6.3	Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, condition for maximum power transfer theorem steps for solving DC circuit and application of above theorem.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Measure branch current of DC circuit using Kirchhoff's Current law.	2#	CO1
I	2	Measure branch current of DC circuit using Kirchhoff's Voltage law.	2#	CO1
II	3	Trace the response of sinusoidal voltage and current when AC applied to pure R, L, C on CRO.	2#	CO2
II	4	Trace the response of sinusoidal voltage and current when AC applied to R-L, R-C Circuit on CRO .	2	CO2
III	5	Determine current, active power & power factor in R-L series circuit. Draw phasor diagram.	2#	CO3
III	6	Determine current, active power & power factor R-C series circuit. Draw phasor diagram.	2#	CO3
III	7	Determine current, active power & power factor R-L-C series circuit. Draw phasor diagram.	2#	CO3
III	8	Create resonance in given R-L-C Series circuit Using variable inductor and capacitor.	2#	CO3
IV	9	Determine current, active power & power factor in R-L-C parallel circuit with series connection of R & L in parallel with C. Draw phasor diagram.	2#	CO4
V	10	Measure the line and phase values of voltage and current of three-phase star connected balanced load and verify relation between line and phase values.	2#	CO5
V	11	Measure the line and phase values of voltage and current of three-phase delta connected balanced load and verify relation between line and phase values.	2#	CO5
VI	12	Determine branch currents of a DC circuit containing two sources by superposition theorem.	2#	CO6
VI	13	Determine the current through load resistance of DC circuit by Thevenin's theorem.	2#	CO6
VI	14	Determine the current through load resistance of DC circuit by Nortan's theorem.	2	CO6
VI	15	Determine load resistance for maximum power transfer in DC circuit using maximum power transfer theorem.	2	CO6

Note: # Compulsory, Use virtual laboratory whereever possible

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

1. Fabricate experimental kit for KCL. Measure differnt electrical parameter.
2. Fabricate experimental kit for KVL. Measure different electrical parameter
3. Prepare series LED Lamp/Load (R-L) Circuit. Draw vector diagram. Calculate power factor of the circuit.
4. Prepare series LED Lamp/Load (R-C) Circuit. Draw vector diagram. Calculate power factor of the circuit.
5. Prepare Lamp/Load (R-L-C) Circuit. Draw vector diagram. Calculate power factor of the circuit.
6. Prepare three phase network of star connected balanced load at 440 volts and determine phase and line quantities, active and reactive power.
7. Prepare three phase network of delta connected balanced load at 440 volts and determine phase and line quantities,active and reactive power.
8. Prepare a micro project on source transformation
9. Prepare a micro project on star delta transformation
10. Prepare a micro project on mesh and nodal analysis.
11. Prepare a micro project on any one Network theorems.
12. Solve the various electric circuit problems using PSpice/Matlab software.

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	D.C Circuit & Network Reduction	9	C	02	02	10	14
			O	02	00	06	8
2	Basic Concepts of AC	8	C	04	08	00	12
			O	02	04	00	6
3	Single Phase AC Series Circuits	8	C	04	04	04	12
			O	00	04	04	8
4	Single Phase AC Prallel Circuit	6	C	02	02	06	10
			O	00	00	04	4
5	Three Phase AC Circuits.	8	C	02	04	06	12
			O	00	04	06	10
6	DC Network Analysis and Theorems	6	C	00	04	06	10
			O	00	04	00	4
Total		45	C	14	24	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	2U2	4R2	4U2	5R2	1R2	2R2	5	7
2	2U4	2R4	2U4	2U4	5U4			3	5
3	1A4	3R4	3U4	3U4	3A4			3	5
4	3A4	5U4	6U4	6U4	4A4			3	5
5	4A6	1A6	5A6					2	3
6	6A6	5A6	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	Drawing circuit diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)	5
4	Viva Voice	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	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	2	-	3	-	-	3	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	-	-	3	-	-	3	-	-
CO5	3	2	-	3	-	-	3	-	-
CO6	3	2	-	3	-	-	3	-	-

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	Experiments in Basic Electrical Engineering	S.K. Bhattacharya and K.M. Rastogi., New Age International Publisher, 2017	13: 978-81-224-1042-6
5	A Textbook on laboratory courses in Electrical engineering	S.G. Tarnekar and P.K. Kharbanda, S.Chand & Company Ltd., Third, 1990	13: 978-8121901048
6	Circuits and Network Analysis	A Sudhakar,Shyammohan S Palli, Tata McGraw-Hill Publishing Co.Ltd, Third Edition, 2007	10: 0-07-460394-9

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2. https://www.tutorialsduniya.com/notes/basic-circuit-theory-and-network-analysis-notes/ accessed on 21st May 2024
3. https://www.di.univr.it/documenti/OccorrenzaIns/matdid/matdid441904.pdf , accessed on 21st May 2024
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XVI List of Major Equipment/Machineries with Specification:

1. Digital Ammeter 0-5A-10A
2. Digital Voltmeter 0-150V-300 V
3. Digital Multi-meter 3 ½ digits,tongtester
4. Single-phase auto transformer 0-240 V, 15 A
5. Three-phase auto transformer, 0-440 V, 30 A
6. Variable resistor, Inductor, Capacitor
7. Regulated DC power supply 0-30V
8. Cathode rays oscilloscope
9. Trainer kits of various Theorems
10. Three-phase load load bank- Resistive, capacitive, inductive

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 Engineering, Nagpur
3	Mrs.Divya Piprode	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	Mrs. N.J.Suryawanshi	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSC
Course Code	:	EE203H
Course Title	:	Electrical and Electronics Measurement

I Rationale:

The Electrical Measurement course equips diploma holders with essential skills for roles as technicians in diverse industries, including power generation, transmission, and distribution. They undertake responsibilities ranging from production to maintenance and testing of electrical equipment. Throughout the course, students gain proficiency in measuring various electrical parameters and quantities essential for handling a wide array of electrical machinery and instruments. Upon completion, they are adept at utilizing diverse measuring instruments vital for electrical engineering applications.

II Industry Identified Competency:

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

Use electrical and electronics measuring instrument for electrical applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** electrical measuring instruments on the basis of various parameter.

CO2: **Calibrate** voltmeter and ammeter using standard meter and potentiometer.

CO3: **Use** of wattmeter and energy meter for measurement of power and electrical energy.

CO4: **Use** special meters to measure various parameters.

CO5: **Measure** resistance using various bridges.

CO6: **Use** electronic meter for measurement of various electrical quantities.

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: Fundamental of Measurement	1a	Classify given qualities of a measuring instruments.	1.1	Need of measurement & significance of measurement. Qualities of instrument-sensitivity, accuracy, precision, stability, reliability, standards & calibration, resolution. Types of errors in analog meter.	CO1
	1b	Classify given measuring instruments.	1.2	Classification of instruments:- Null and deflection type instruments, Absolute and secondary instruments, Analog and digital instruments.	
	1c	Classify different torque and their necessities.	1.3	Necessity of different torque in measuring instruments- Deflecting, controlling torque and damping torque.	
tage	2a	Identify given measuring instruments.	2.1	Construction & principle of following instruments-a) Permanent Magnet Moving Coil (PMMC) b) Moving Iron (MI)	

UNIT II: Measurement of Current and Volt	2b	Calculate range extension of ammeter & voltmeter-by shunt and series resistance of given data.	2.2	DC ammeter and voltmeter Range extension of ammeter & voltmeter-by shunt and series resistance, advantages and disadvantages of shunt and series resistor used for range extension. Calculate range extension of ammeter &voltmeter-by shunt and series resistance.	CO2
	2c	Calibrete given instrument.	2.3	Calibration of voltmeter and ammeter using standard meter and potentiometer.	
	2d	Select the instrument transformer for extension of ranges.	2.4	Instrument transformer. Principle of current transformer (CT) and potential transformer (PT), their use in extension of ranges, precautions to be taken while using CT.	
UNIT III: Measurement of Power	3a	Calculate Multiplying factor of wattmeter from given data.	3.1	Principle and construction of dynamometer type wattmeter single phase and Poly-phase wattmeter. Errors and their compensation. Calculation of Multiplying factor of Wattmeter. Significance of power factor in power measurement.	CO3
	3b	Calculate active and reactive power in three-phase given load by one wattmeter method and two-wattmeter method.	3.2	Measurement of Active and Reactive power, phasor diagram of three phase balance and unbalance load:- one and two wattmeter method. Two element wattmeter.	
ers	4a	Select meter for given application.	4.1	Construction and working principle of Single phase and three phase Power Factor meter, Electro- dynamometer type power factor meter	

UNIT IV: Special Met	4b	Select a meter for a given application.	4.2	Construction and working principle of Frequency meter, Weston and Ferro-dynamic type frequency meter. Construction & working principle of Weston type synchro scope.	CO4
	4c	Measure various parameter using appropriate meter	4.3	Construction and working principle of Rotating type phase sequence indicator. Construction and working principle of Clip-on-ammeter.	
UNIT V: Measurement Of Circuit Parameter	5a	Select proper methods for measurement of resistance for given application.	5.1	Measurement of Resistance: Classification as low, medium and high resistance. Methods used for measurement of each type of resistance. (i) Low resistance- potentiometer, kelvin double bridge method. (ii) Medium resistance- Wheat stone bridge. (iii) High resistance-Megger. Megger – Construction, working principle and its application.	CO5
	5b	Select proper methods for measurement of earth resistance.	5.2	Measurement of earth resistance by fall of potential method, earth resistance tester construction, working principle and measurement of earth resistance.	
	5c	Identify application of given AC bridges.	5.3	Introduction to A.C. bridges- Anderson bridge for measurement of inductance, Schering bridge for measurement of capacitance, Bridge balance equation only. Introduction and working principle of LCR meter.	
ic Meter	6a	Draw a block diagram of given device.	6.1	Need of electronic/Digital meters. Introduction of CRO, block diagram of CRO. Introduction of Function Generator, block diagram of Function Generator.	

UNIT VI: Measurement by Electron	6b	Classify the application of given meter.	6.2	Digital ammeter and voltmeter block diagram. Digital multi meter- Block diagram working principle and its application. Digital Energy meter- Block diagram, working principle and its application. Concept of Prepaid Energy meter. Construction and working principle of Digital tong tester.	CO6
	6c	Select suitable meter for given application.	6.3	Construction and working principle of Tri-vector meter. Construction and working principle of Digital insulation resistance tester.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify measuring instruments on the basis of symbols on dial, type, accuracy and scale.	2#	CO1
I	2	Identify error in given meter and illiminate it.	2	CO1
II	3	Extend the range of ammeter and voltmeter using shunt and series resistance.	2	CO2
II	4	Measure voltage and current using Potential and current transformer.	2#	CO2
II	5	Identify the components of PMMC and MI instruments using cut section models.	2#	CO2
II	6	Calibrate voltmeter and ammeter using standard meters.	2#	CO2
III	7	Measure active & reactive power in three-phase balanced load by single wattmeter method.	2#	CO3
III	8	Calibrate wattmeter using standard voltmeter, ammeter and power factor meter.	2	CO3
III	9	Measure active & reactive power in three-phase balanced load by two wattmeter method & observe the effect of power factor variation on wattmeter readings	2#	CO3
IV	10	Use phase sequence indicator to identify phase sequence.	2	CO4
V	11	Measure different parameters using LCR meter.	2	CO5
V	12	Measure medium resistance by wheatstone bridge	2#	CO5
V	13	Measure insulation resistance of AC/DC motor using megger.	2#	CO5
VI	14	Use tong tester to measure different electrical quantities	2#	CO6
VI	15	Use Tri-vector meter for measuring KW, KVAR and KVA of a power line.	2#	CO6
VI	16	Measure various electrical quantities using digital multi-meter.	2#	CO6
VI	17	Use digital earth tester for measurement of earth resistance.	2#	CO6

Note: # Compulsory, Use Virtual laboratory whereever possible.

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

1. Dismantle MI instrument and identify different parts and again assemble the same
2. Dismantle different types of wattmeter and identify current coil and presure coil and again assemble the same.
3. Collect data of power consumption of equipment installed in departmental laboratories.
4. Prepare a micro project on extension of range of ammeter by using shunt resistance .
5. Callibrate ammeter with standard meter.
6. Prepare a micro project on extension of range of Voltmeter using series resistance .
7. Callibrate voltmeter with standard meter.
8. Collect a data from energy meter of your home for 30 days and calculate energy consumed and compare it with energy bills.
9. Prepare any one micro project based on curriculum content.
10. Dismantle PMMC instrument and identify different parts and again assemble the same

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	Fundamental of Measurement	6	C	6	4	0	10
			O	2	4	0	6
2	Measurement of Current and Voltage	7	C	2	4	6	12
			O	4	0		4
3	Measurement of Power	7	C	2	4	4	10
			O		0	6	6
4	Special Meters	7	C	0	4	6	10
			O	2	4	0	6
5	Measurement Of Circuit Parameter	8	C	2	0	10	12
			O	0	4	4	8
6	Measurement by Electronic Meter	10	C	2	4	10	16
			O	0		10	10
Total		45	C	14	20	36	70
			O	8	12	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	5R2	6R2	1R2	4R2	5	2
2	1R4	1U4	2U4	1R4	2R4			3	2
3	3U4	4U4	3A4	6A4	4U4			3	2
4	5A6	6U6	6A6	5U4	5A4			3	2
5	2A6	4A6	3U6					2	1
6	5A6	6A6	6A6					2	1

*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/skill	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	-	-	3	-	-	2	-	-
CO2	3	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	2	-	-
CO4	3	-	-	3		-	2	-	-
CO5	3	-	-	3		-	-	-	-
CO6	3	-	-	3		-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author,Publisher, Editon and Year of Publication	ISBN Number
1	Electric & Electronic Measurement & instrumentation	A. K. Sawhney, Dhanpat Rai & Sons, 18 thEdition, 2007	13: 9788177000160
2	Electrical Measurements & Measuring instruments	N.V. Suryanarayna , S, Chand & Co. 1st Edition, 2001	10: 81-219-2011-6
3	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
4	Electrical Measurement & Measuring Instruments.	E. W.Golding, Pitman Publisher, 5 th Edition, 1968	13: 978-0273402022 10: 0273402021

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4. https://www.youtube.com/results?search_query=electro+dynamo+type+power+factor+meter+ accessed on 13 may 2024.
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7. https://www.youtube.com/watch?v=PBw21ioS7Jw accessed on 13 may 2024.
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9. https://www.youtube.com/watch?v=YXYZ_u5Bjfk accessed on 13 may 2024.
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XVI List of Major Equipment/Machineries with Specification:

1. Ammeter MI 0-5-10, Voltmeter MI 0-150-300 V (PMMC & MI)
2. Digital Multi-meter- 24V-250V AC/DC, Accuracy- 0.5% ± 1 digit.
3. Wattmeter 0-3000 W,Tong tester
4. Three-phase resistive, inductive, capacitive load , Wattmeter LPF, unity
5. Electronic Energy Meter. Accuracy Class 1.0 & Current Rating : 5-30Amp
6. CT 20/5A ,PT 460/115 V
7. Tri vector meter (upto 100A)3 phase 3 wire,110V
8. Digital Multi-meter, Digital insulation resistance tester.
9. LCR meter, Weastone bridge kit.

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 Engineering
3	Mrs. Divya Piprode	Sr.Engineer	Power grid Coporation of India Ltd, Nagpur
4	Shri M. N. Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
5	Dr G.V. Gotmare	I/C HoD,Electrical Engineering	Government Polytechnic, Nagpur
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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSC
Course Code	:	EE204H
Course Title	:	DC Machines & Transformers

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..

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.

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.

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: 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. Calculation of emf induced in the generator	

Ur	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 in DC generator. Efficiency of generator (No Numericals) and their applications.	
UNIT II: DC Motor	2a	Derive the given (voltage, power, torque) equation of DC motor.	2.1	Principleof operation of a DC motor, back EMF and its significance, Armature reaction Voltage equation of DC Motor, power equation and Torque equation, Armature torque and Shaft torque.	CO2
	2b	Draw the given characteristics for given type of D.C. motor.	2.2	Types of DC motor,electrical and mechanical Characteristics of DC motor.	
	2c	Select the suitable starter as per the given rating of motor for given applications.	2.3	Necessity of Starter, Types of starters- Two point, three point, four point starter, their construction and working.	
	2d	Select the suitable speed control method for given motor for given applications	2.4	Speed control of DC motor: Factors affecting Speed control of D.C. Motors, methods for speed control of series and shunt motors.	
	2e	Select the D.C motor on the basis of given applications	2.5	Reversal of direction of rotation of DC motor, Calculation of speed of given motor with given speed control parameters, applications of motor.	
	3a	Compare given type of single phase transformer on the basis of given points	3.1	Working Principle of transformer, Constructional parts and their functions, different material used in construction, classification of transformer on the basis of supply, construction, voltage levels.	

UNIT III: Single phase transformer	3b	Calculate Emf induced in transformer with given parameters.	3.2	EMF equation, Voltage ratio, current ratio, transformation ratio, turns ratio, rating of transformer (KVA), Losses, efficiency and voltage regulation of single-phase transformer.	CO3
	3c	Draw the phasor diagram of single phase transformer based on given points.	3.3	Concept of ideal transformer, ideal transformer on NO-load and ON-load, Practical transformer on No load and ON load, Phasor diagram of transformer ON load, Equivalent resistance and reactance reffered to primary side and secondary side, Approximate equivalent circuit diagram.	
	3d	Calculate equivalent circuit parameters, efficiency voltage regulation of transformer withthe help of given test.	3.4	Transformer testing: Direct loading test, Open Circuit and Short Circuit Test on single-phase transformer Calculate equivalent circuit parameters, losses, efficiency, Regulation of transformer using above test.	
	3e	Recommond suitable transformer for given applications.	3.5	Importance of All day efficiencyfor distribution transformer, Calculate all day efficiency, Applications of single phase transformers.	
l transformer	4a	Differentiate single phase auto transformer with conventional transformer on the basis of given points.	4.1	Single-Phase autotransformer: its construction, operation and applications. its Comparison with two winding transformer	
	4b	Select a suitable reactor for given application of welding transformer	4.2	Single phase Welding transformer: its construction, operation, V-I characteristics of welding transformer, types of reactors and applications.	

UNIT IV: Specia	4c	Select suitable isolation transformer for given applications.	4.3	Isolation Transformer: Construction, Working Principle, Types, Advantages,Disadvantages & its Applications, specifications of isolation transformer	CO4
	4d	Select suitable special transformer for given applications.	4.4	Concept of Audio frequency transformer, Pulse transformer, Furnace transformer,Cast resin Dry type transformer, its advantages , disadvantages and their applications.	
NIT V: Three phase transformer	5a	Compare given type of three phase transformer on the basis of given points	5.1	Construction of three phase transformer, Bank of three single phase transformer, its advantages. Types of three phase transformer: core and shell type, its merits and demerits.	CO5
	5b	Calculate transformation ratio,secondary line voltage, line current and output for given type of connections	5.2	Three phase transformer connection a. Star -star connection b. delta-delta connection c. delta -star connection d. star - delta connection e. V-V or open delta connection f. T-T or scott connections Calculate transformation ratio, secondary line voltage, line current and output for given type of connections	
	5c	Perform the polarity test on given transformer	5.3	Polarity marking Test: Dot convention Additive and subtractive polarity, procedure of polarity test.	

UI	5d	Identify the given type of vector group with their connections and wiring diagram.	5.4	Three-phase autotransformer, Working principle, construction, operation and its applications, concept of power transformer and distribution transformer. Specifications of three-phase distribution transformers and power transformer, Vector groups, its advantages, symbol designation of different vector groups.	
UNIT VI: Parallel operation of transformers	6a	Suggest the conditions to be satisfied for parallel operation of given transformer	6.1	Necessity of parallel operation.Conditions to be fulfilled for parallel operation of single phase and three phase transformers.	CO6
	6b	Calculate load sharing of given transformers in parallel for given conditions.	6.2	Load sharing between two single-phase transformers and two three-phase transformers in parallel (a) ideal case (b) equal voltage ratios, Calculation of load sharing of two single-phase transformers in parallel. Calculation of load sharing of two three-phase transformers in parallel.	

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
II	4	Perform load test on DC cumulatively compound generator. and Plot internal and external characteristics of DC compound generator.	2#	CO2
II	5	Start DC shunt motor with three point starter and reverse the direction of rotation of motor	2#	CO2
II	6	Start DC series motor by using 2 point starter and reverse the direction of rotation of motor.	2	CO2
II	7	Control the Speed of D.C. shunt motor using field control and armature control methods.	2#	CO2
II	8	Perform load test on D. C. shunt motor and plot Speed-torque characteristics	2#	CO2
III	9	Find transformation ratio, the voltage regulation and efficiency of single-phase transformer by direct loading method.	2#	CO3
III	10	Perform open circuit test and short circuit (S.C.) test on single-phase transformer and determine of equivalent circuit parameters, regulation and efficiency.	2#	CO3
IV	11	Perform load characteristics on welding transformer and Plot V-I Characteristics of Welding Transformer	2#	CO4
IV	12	Perform impedance matching test on Audio frequency transformer	2	CO4
V	13	Identify different parts of Three phase Distribution Transformer. Perform polarity test on it.	2	CO5
V	14	Perform open circuit (O.C) and short Circuit (S.C.) test on three-phase transformer & determine equivalent circuit parameters.	2#	CO5
VI	15	Perform Parallel operation of single-phase transformer and record their load sharing.	2#	CO6

Note: # Compulsory, Use Virtual laboratory whereever possible.

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.
3. Prepare a microproject on small dc motorand prepare report.
4. Prepare a report on comparison of dc motors with their characteristics .
5. Draw Constructional diagram of single phase transformer showing different Parts andand write their functions along with materials used for the different parts.prepare report.
6. Prepare a simple model of1KVA / 0.5KVA single phase transformerand prepare report.
7. Draw Constructional diagram of three phase transformer showing different Parts and prepare a chart showing functions, Different materials used for different parts of three phase transformer and prepare report.
8. Collect photographs with detail specifications of power transformer with different manufactureres and prepare report.
9. Collect photographs with detail specifications of distribution transformer with different manufactureres and prepare report.
10. Prepare a report on Three phase transformers connections as per IS:2026 (part IV)-1977, Three phase to two phase conversion (Scott Connection).
11. Collect photograph and prepare report on Furnace transformer.
12. Collect photograph and prepare report on isolation and welding transformer
13. Collect photograph and prepare report on Cast resin Dry type transformer
14. Perform Distribution TransformerTesting as per IS 1180: 2014 and prepare 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	DC Generator	5	C	02	04	00	06
			O	00	00	06	06
2	DC 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

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

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	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

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	-	-

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	10: 9788121921916
3	Electrical Technology Vol.II AC & DC Machines	B.L.Theraja, S. Chand & Company Ltd., Third, 1990	10: 812-192-4375 13: 978-8121924375
4	Basic Electrical Engineering	V.N.Mittle, Arvind Mittal, The Mc Graw Hill Education Pvt.Ltd, Reprint, 2011	13:78-0-07-0593572
5	Experiments in Basic Electrical Engineering	S.K.Bhattacharya and K.M.Rastogi., New Age International Publisher, Reprint, 2009	13: 978-81-224-1042-6
6	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

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2. https://www.youtube.com/watch?v=-xebh8wU8gY accessed on 29th April 2024
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5. https://www.youtube.com/watch?v=bCEiOnuODac, accessed on 29th April 2024
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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
5. Single phase transformer, 50 Hz, 2 KVA, 230/115 V
6. Three phase transformer , 50 Hz, 3 KVA, 440/230 V
7. Welding transformer 250A, three-phase, 440 V

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	G.H.Raisoni College of Engineering, Nagpur
3	Mrs. Divya Piprode	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	Mrs. A. A. Alegaonkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	SEC
Course Code	:	EE251H
Course Title	:	Electrical Wiring

I Rationale:

Electrical Diploma Engineers are required to work as supervisor in small and large scale industries. They should be equipped with the skills of wiring related to electrical engineering field as well as they should be enable to construct and test various electrical circuits using appropriate electrical tools, wires, protective devices and wiring accessories as per IS standards. This course aims to equip learners with essential skills and knowledge in electrical wiring. By focusing on wiring tools, equipment, testing procedures, and safety practices, students develop competence in real-world installations. Emphasis on hands-on experience and adherence to safety standards fosters responsible and informed practice among future electrical technicians, ensuring they are well-prepared for the demands of the field.

II Industry Identified Competency:

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

Adhere to industry-standard wiring and installation practices.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Use** various wiring tools and electrical accessories.

CO2: **Perform** testing procedure to verify the functionality of MCB's, RCB's and ELCB's.

CO3: **Execute** wiring task for different scenarios including PVC conduit wiring, casing and capping system.

CO4: **Install** and test various electrical devices such as ceiling Fans, Exhaust Fans and Induction motors ensuring proper functioning.

CO5: **Conduct** Various Wiring Installation test.

CO6: **Prepare** Micro-Project based on electrical wiring installation.

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	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 accessories such as Switches, Sockets, Plugs, Distribution Board, MCB's, RCB's, ELCB's, Holder, Wire and Cable.	2#	CO1
I	3	Identify different safety accessories such as Hand gloves, Helmet, Shoes, Goggle, Rubber mats and various types of fire extinguishers	2#	CO1
II	4	Test the working of MCB for overload and short circuit.	2#	CO2
II	5	Test the working of RCB and ELCB.	2	CO2
III	6	Prepare different insulating wire joint.	2#	CO3
III	7	Prepare different bare conductor joint.	2#	CO3
III	8	Prepare two/three core cable joint.	2#	CO3
III	9	Perform crimping tool operation for connecting lugs to cables.	2#	CO3
III	10	Prepare switch board containing various electrical accessories and test it.	2#	CO3
III	11	Prepare series parallel test board and test it.	2#	CO3

III	12	Prepare switch board contains 6 A and 16 A sockets and switches and test it.	2#	CO3
III	13	Prepare one lamp and one tube light wiring on wiring board in PVC conduit wiring system and test it.	2#	CO3
III	14	Prepare staircase wiring on wiring board using PVC conduit wiring system and test it.	2#	CO3
III	15	Prepare Go-down wiring on wiring board using PVC casing capping system and test it.	2#	CO3
III	16	Prepare call bell circuit on wiring board using PVC casing capping system and test it.	2#	CO3
IV	17	Install ceiling fan / Exhaust Fan and test it.	2#	CO4
IV	18	Wire up distribution board containing two pole isolator and MCBs.	2#	CO4
IV	19	Wire up single-phase energy meter, cut-out, main-switch and distribution board.	2#	CO4
IV	20	Wire up three-phase energy meter, cut-outs, and main-switch.	2	CO4
IV	21	Install a single-phase induction motor and connect it to supply with main-switch and starter.	2	CO4
IV	22	Install a three-phase induction motor and connect it to supply with main-switch and starter.	2#	CO4
V	23	Perform Polarity and earth continuity test on electrical installation.	2#	CO5
V	24	Test wiring installation using megger.	2#	CO5
V	25	Perform plate earthing of domestic installation.	2#	CO5
V	26	Perform pipe earthing of domestic installation.	2	CO5
V	27	Test earth resistance of existing earth electrode using earth tester.	2#	CO5
VI	28	Prepare any one micro-project based on electrical wiring installation.	6#	CO6

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	Drawing circuit diagram, selection of equipment	10
2	Performance	20
3	Calculation, Result, Drawing Graphs (if any)	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	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	-	-	3	-	-	3	-	-
CO5	3	-	-	3	-	-	3	-	-
CO6	3	-	-	3	-	1	3	1	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Electrical Engineering Drawing	Bhattacharya S. K. International, New Delhi	13: 978-81-224-0855-3
2	The Complete Guide to Wiring	Cool Springs Press Minneapolis, Minnesota	13: 978-1-59186-612-1
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: 978-16-3920-381-9
4	A Text Book on Laboratory Courses in Electrical Engineering	Tarnekar S.G., Kharbanda P.K., Bodkhe S.B., Naik S.D. & Dahigaonkar D.J. 2009	13: 978-81-2190-104-8

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2. https://www.hellermanntyton.com/in/competences/cable-jointing-relicon assessed on 21st May 2024
3. https://www.thespruce.com/electrical-wiring-1152909 assessed on 21st May 2024
4. https://erieit.edu/learn-basics-of-home-electrical-wiring/ assessed on 21st May 2024
5. https://www.youtube.com/watch?v=by8pcYmCIcU assessed on 21st May 2024

XVI List of Major Equipment/Machineries with Specification:

1. Electrical Wiring Tool kit
2. Pillar type Drilling Machine 13 mm
3. Double Ended Grinder 150 mm
4. Portable Drilling Machine
5. Digital Insulation Resistance Tester
6. Megger
7. Crimping Tool

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	Head of Department, Academic Expert	G.H.Raisoni College of Engineering, Nagpur
3	Mr. M. N. Gawande	Lecturer in Electrical Engg, MSBTE Expert	Government Polytechnic, Gondia
4	Mrs. Divya Piprode	Sr. Engineer, Industry Expert	PGCIL Nagpur
5	Dr. G. V. Gotmare	I/C HOD, Electrical Engineering	Government Polytechnic, Nagpur
6	Mr. B. D. Wadhai	Lecturer in Electrical Engineering, Course Expert	Government Polytechnic, Nagpur

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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)
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/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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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 Combustion 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

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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)
Member Sectretary PBOS, ME

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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/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

(Dr. G. V. Gotmare)
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.
7. http://nptel.ac.in/courses/108108076/1 , accessed on 25th May 2024.
8. http://www.electrical4u.com , accessed on 25th May 2024.
9. https://www.youtube.com/watch?v=A9KSGAnjo2U, accessed on 25th May 2024.

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:

S.N.	Name	Designation	Institute / Industry
1	Dr. R. V. Yenkar	HOD, Electronics & Telecomm. Engg.	Government Polytechnic, Nagpur
2	Dr. V. H. Mankar	HOD, Electronics & Telecomm. Engg.	Government Polytechnic, Nagpur
3	Mrs. R.R.Vairagade	Lecturer, Electronics & Telecomm. Engg	Government Polytechnic, Nagpur
4	Mrs. J.A.Raut	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

(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:

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1	Dr. A. R.Mahajan	HOD, Information Technology	Government Polytechnic, Nagpur
2	Mr. Dipak Dhote	Operations Manager	IT- Network, NAgpur
3	Dr. Rakesh Kadu	Assistant Professor, Information Technology	Ramdeobaba College of Engineering and Technology, Nagpur
4	Mrs. V. A. Raje	System Analyst	MSBTE, RO, Nagpur
5	Mrs. I. L. Sangolkar	Lecturer, Information Technology	Government Polytechnic, Nagpur
6	Mr.L.D.Vilhekar	Lecturer, Information Technology	Government Polytechnic, Nagpur

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GOVERNMENT POLYTECHNIC, NAGPUR
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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	CO2
	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	

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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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:

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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

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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	:	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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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
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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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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

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3. http://www.carbibles.com/transmission_bible_pg3.html, assessed on 30th May 2024
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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.	CO4

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=qAGCl0-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:

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 Secretary 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/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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1. /https://www.latex-project.org/#google_vignette, accessed on 20th May , 2024
2. https://www.maths.tcd.ie/~dwilkins/LaTeXPrimer, accessed on 20th May , 2024
3. https://web.mit.edu/rsi/www/pdfs/new-latex.pdf, accessed on 20th May , 2024
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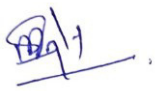
5. https://texdoc.org/serve/beamer/0 assesed on 20th May , 2024
6. http://https://www.synfig.org/, accessed on 21st May , 2024
7. http://https://synfig.gumroad.com/l/synfig, accessed on 20th May , 2024
8. https://www.canva.com, 20th May , 2024
9. https://https://blog.hubspot.com/marketing/how-to-use-canva, accessed on 21st May , 2024

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



(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/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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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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2. https://docs.python.org/3/tutorial/ accessed on 20th Feb. 2024
3. https://www.tutorialspoint.com/python/index.htm accessed on 28th Jan. 2024
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
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5	Mr. A. G. Barsagade	Lecturer in Information Technology	Government Polytechnic, Nagpur
6	Mr. R. L. Meshram	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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1. https://tourism.gov.in/schemes-and-guidelines/guidelines/national-strategy-and-roadmap-development-rural-tourism-india assessed on 17th May 2024
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
2	Mr. Rajesh P. Pund	Lecturer, Travel and Tourism	Government Polytechnic, Nagpur
3	Dr. Aarti Meshram	I/C Principal	GIHMCT, Nagpur
4	Ms. Erika Kar	Director	Pegasus Institute, Nagpur
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

(Dr. P. P. Virkhare)
HOD & Chairman PBOS, TR

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

Semester IV

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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSC
Course Code	:	EE205H
Course Title	:	Electrical Power Transmission & Distribution

I Rationale:

Electrical power system plays a significant role in the development of Urban, Rural, Industries and Agriculture Sector. The electricity is generated in bulk at remote places and transmitted to long distances and then distributed in cities, villages and to industry. Technicians are required to operate and maintain the power transmission and distribution system so that electrical energy is continuously available to the consumers economically. After completion of this course student will able to supervise installation, operate and maintain equipments in substation as well as assist in-charge in planning and designing distribution system.

II Industry Identified Competency:

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

Apply the principles of power transmission, distribution systems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** suitable components for transmission and distribution lines.

CO2: **Analyse** effect of transmission line parameters on performance of different types of transmission lines.

CO3: **Identify** the components of EHV-AC and HVDC transmission system.

CO4: **Identify** components of distribution systems.

CO5: **Use** the concepts of load dispatch, SCADA & smart grid in power system.

CO6: **Identify** various components of transformer sub-station in power system.

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
its	1a	Classify given Line supports on the basis of given points.	1.1	Single line diagram with components of electric flow mentioning generation, transmission & distribution systems standard voltage levels. Introduction to main components of overhead lines. Line supports: Desirable characteristics, types of poles-wooden poles, steel tubular and rail poles, RCC poles, Steel towers for single circuit and double circuit.	

UNIT I: Transmission & Distribution Line Componen	1b	Compare given conductors on the basis of given parameters.	1.2	Conductors: desirable properties, types- copper, all-aluminum conductor (AAC), aluminum conductors steel reinforced (ACSR), cadmium copper, galvanized steel, composite conductors. Conductor spacing and clearances: Spacing between conductors, conductor clearances, span length, sag. Numericals based on calculation of sag for equal height supports.	CO1
	1c	Calculate potential distribution over a string of suspention insulators and string efficiency for given insulator string based on given data.	1.3	Line insulators: Desirable properties of insulator materials, selection of material, types of insulators (For transmission and distribution lines), application. Potential distribution over a string of suspension insulators, string efficiecy. Methods of improving string efficiency. Calculation of string efficiency for string of three suspension insulator.	
	1d	Analyse the corona loss effect in transmission line.	1.4	Corona effect, factors affecting corona, advantages and disadvantages, methods of reducing corona loss, bundled conductors.	
eters & its performance	2a	Analyse the effect of transmission line parameters.	2.1	Line parameters: Concept of R, L & C of line . Skin effect and Proximity Effect, Transposition of conductors and its necessity, Calculation of inductance and capacitance of single phase and single circuit three phase transmission lines.	

UNIT II: Transmission Line Param	2b	Calculate voltage regulation and efficiency of given short transmission lines.	2.2	Classification of transmission linnes, short transmission lines equivalent representation and phasor diagram, calculation of voltage regulation and efficiency.	CO2
	2c	Analyse medium transmission lines.	2.3	Medium transmission lines- Nominal-Pi and nominal-T circuit representation, analysis and phasor diagram.	
	2d	Analyse long transmission lines.	2.4	Long transmission lines- Equivalent circuit representation, Ferranti effect.	
UNIT III: EHV-AC and HVDC	3a	Draw configuration of EHV-AC transmission link.	3.1	EHV-AC transmission system - Necessity, applications, configuration of EHV-AC transmission link.	CO3
	3b	Draw configuration of Bi-polar HVDC transmission link.	3.2	HVDC transmission system- Necessity, applications, types and their schematic diagram. configuration of Bi-polar HVDC transmission link.	
	3c	Compare EHVAC and HVDC transmission on the basis of given points.	3.3	EHV-AC Vs HVDC transmission system- Comparative technical and economicaladvantages and limitations.	
	3d	Classify FACTS controller.	3.4	Flexible AC Transmission line: Features, types of FACTS controller.	
l Voltage control.	4a	Identify components of distribution system.	4.1	Introduction, feeders, distributor and service lines. Construction of overhead distribution lines, earth wire, guarding.	
	4b	Classify different types of primary and secondary distribution system.	4.2	Primary distribution systems & Secondary distribution systems. Types of different distribution schemes: Radial, ring mains and grid- layout, advantages, limitations & applications.	

UNIT IV: Distribution Systems and	4c	Calculate various parameters in single phase distributors on given data.	4.3	Voltage drop in single phase & three phase distributors, sending end & receiving end voltage, distributor fed at one end and fed at both ends,calculate voltage drop, current in saingle phase distributors, design Consideration for feeder and distributor.	CO4
	4d	Compare given methods of voltage control on the basis of given points.	4.4	Voltage control – Importance, permissible voltage variation. Methods of voltage control-excitation control and automatic voltage regulation of alternators, ON load and OFF load tap changing transforme,shunt compensation.	
UNIT V: Interconnected Power System & Load Dispatch	5a	Classify the interconnected power system.	5.1	Interconnected power system: Introduction, role, merits and limitations.Types : National interconnection, regional interconnection, state interconnection.	CO5
	5b	Justify the role of load dispatch center & necessity of load shedding.	5.2	Load Dispatch : Introduction, Types of Load Dispatch Center, Function of Load Dispatch Centre and its objectives. Load shedding: Concept, causes of load shedding, meaning of Power outage vs load shedding.	
	5c	Justify the function of given components of SCADA system.	5.3	SCADA system: Introduction, components of SCADA system, Features of SCADA system.	
	5d	Compare traditional grid and a smart grid on the basis of given points.	5.4	Smart grids: Definition, components, features & applications. The importance of smart grid. Difference between the traditional grid and a smart grid.	

UNIT VI: Sub-Stations	6a	Identify the components of transformer sub-station.	6.1	Classification of sub-stations according to service and loaction, sub-station components & their functions-Transformer, Bus-bar, Circuit breaker, Isolators, Earth switch, CT, PT, Reactor, Lighting arrester, Relays, auxilary equipments and system.	CO6
	6b	Draw single line diagram of given transformer sub-station.	6.2	Typical single Line Diagram of 11KV/0.415 KV pole mounted distribution sub-station, 33/11 KV indoor and outdoor Sub-Station, 132 or 220 or 400KV/33 KV outdoor sub-station.symbols and functions of their components.	
	6c	Justify the need for PLCC system in power system.	6.3	Power line carrier communication (PLCC) system-Block diagram & applications, applications of fiber optics in electrical power system.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify different types of transmission and distribution line supports and draw free hand sketch.	2#	CO1
I	2	Identify different types of overhead line insulators and draw free hand sketch.	2#	CO1
I	3	Identify different types of transmission line conductors and draw free hand sketch.	2#	CO1
I	4	Prepare a report to analyze the effect of Wind and Ice loading on transmission line.	2	CO1
II	5	Prepare a report to analyze the effect of transmission line parameters after watching the video.	2#	CO2
II	6	Prepare a report on different types of transmission system available in India.	2	CO2
III	7	Identify the different components of Extra High Voltage (EHVAC) Transmission lines using visit/Animations/ Video Programme.	2#	CO3
III	8	Identify different components of HVDC transmission system by watching video/visit and draw block diagram.	2#	CO3
III	9	Interpret the given layout drawing of HVDC terminal substation and identify the type of its configuration	2#	CO3
IV	10	Identify the types of service connection at your home and draw free hand sketch on drawing sheet.	2#	CO4
IV	11	Identify the different types of distribution system available in India and prepare a report after watching video.	2#	CO4
V	12	Prepare a visit report of load dispatch cente by observing all activities.	2	CO5
V	13	Identify and draw various symbols and indicators used on control panels of load dispatch center.	2#	CO5
V	14	Prepare a report on smart grid development in India.	2	CO5
VI	15	Identify different components of 400kV or 220kV or 132 kV transformer sub-station by watching video or visit and draw single line diagram.☐	2#	CO6
VI	16	Identify different lightning arresters used in various AC sub-stations by watching video/visit.	2	CO6
VI	17	Prepare a report by actually visiting to 11KV/400 V distribution substation and draw single line diagram.	2#	CO6

Note: # Compulsory. Use A3 drawing sheet for drawing.

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

1. Prepare a micro project based on conductor material used for transmission line.
2. Prepare a micro project based on conductor material used for distribution line.
3. Collect information and prepare a report on 400KV transmission Substation.
4. Prepare a micro project based on line supports for transmission line.
5. Prepare a micro project based on EHVAC transmission line.
6. Prepare a comparative report for HVAC and HVDC Transmission line on the basis of their Strength, Limitations, Capital cost
7. Prepare a micro project based on HVDC transmission line.
8. Prepare a micro project based on equipment's used in distribution sub-station.
9. Prepare a micro project based on parts of distribution system (feeders, distributors & service lines).
10. Prepare a micro project based on ring mains type of distribution scheme.
11. Prepare a micro project based on National grid.
12. Prepare a micro project based on role of load dispatch center for load shedding.
13. Prepare a micro project based on smart grid technology.
14. Prepare a micro project based on renewable energy sources in smart grids.
15. Draw single line diagram of 400KV sub-station using CAD.

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	Transmission & Distribution Line Components	8	C	2	4	6	12
			O	2	4	0	6
2	Transmission Line Parameters & its performance	8	C	2	4	6	12
			O	4	0	4	8
3	EHV-AC and HVDC	6	C	2	4	4	10
			O	0	0	6	6
4	Distribution Systems and Voltage control.	9	C	4	4	6	14
			O	0	4	4	8
5	Interconnected Power System & Load Dispatch	6	C	2	4	4	10
			O	0	0	6	6
6	Sub-Stations	8	C	2	4	6	12
			O	2	4	0	6
Total		45	C	14	24	32	70
			O	8	12	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	5R2	6R2	1R2	6R2		
2	1U4	2U4	3A4	2A4	1U4				
3	4R4	4U4	3U4	2R4	4U4				
4	5U4	5A4	6U4	6U4	4A4				
5	1A6	2A6	3A6						
6	4A6	6A6	5A6						

*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 sheets	5
2	Performance	10
3	Report writing	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/ Drawing Sheet	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	-	-	-	-	-	2	-	-
CO2	3	1	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	2	-	-
CO4	3	1	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	1	2	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Course in Electrical Power	J.B.Gupta, S.K.Kataria & Sons, Pvt. Ltd., 1990.	13: 978-9350143742
2	Transmission and Distribution of Electrical Power	K. B. Raina, K.C. Singal and Y.K. Anand, Tata McGraw- Hill Publication Ltd., 1985.	10: 8122403638
3	Principles of Power System	V. K. Mehta, S.Chand & Co Pvt. Ltd., 2000.	10: 81-219-0594-X
4	Electrical Power System	C. L. Wadhawa, New Age International, 2005.	13: 978-81-224-2839-1
5	A Text book on Power System Engineering	A. Chakrabarti ,M.L.Soni, P. V. Gupta, Dhanpat Rai& Co. (P) Ltd., 2000.	10: 81-7700-020-9

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2. http://www.electrical4u.com , accessed on 22nd August, 2024
3. https://library.automationdirect.com/basic-electrical-theory/ , accessed on 22nd August, 2024
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5. https://sites.google.com/site/profswapnilambade assesed on 22nd August, 2024
6. http://nptel.ac.in/courses/108108076/1 , accessed on 22nd August, 2024
7. http://www.electrical4u.com , accessed on 22nd August, 2024
8. https://library.automationdirect.com/basic-electrical-theory/ , accessed on 22nd August, 2024
9. https://www.di.univr.it/documenti/OccorrenzaIns/matdid/matdid441904.pdf , accessed on 22nd August, 2024
10. http://www.electrical4u.com , accessed on 22nd August, 2024

XVI List of Major Equipment/Machineries with Specification:

1. Various types of conductors
2. Various types of Insulators
3. Video Programme/Animation/Demonstration Model of different Supporting structures
4. Video Programme/Animation/Demonstration Model/Chart Demonstration of Electric Power system
5. Video Programme/Animation/Demonstration Model of Transmission/Distribution Substation.
6. Video Programme/Animation/Demonstration Model of Load dispatch center
7. Video Programme/Animation/Demonstration Model of Smart Grid
8. MATLAB/AUTOCAD Software

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
2	Dr. P. M.Daigavane	HOD, Electrical Engineering	G. H. Raisoni college of Engineering, Nagpur
3	Mrs. Divya Pirpode	Sr. Engineer	Powergrid Corporation of India Ltd, Nagpur
4	Shri. M. N. Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
5	Shri. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

(Mr. M. C. Musale)
HOD & Chairman PBOS, EE

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

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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 EE
Course Category	:	DSC
Course Code	:	EE206H
Course Title	:	AC Machines

I Rationale:

This course deals with basics of AC machines. Students will learn to This course on "Electrical AC Machines" provides diploma students in Electrical Engineering with comprehensive knowledge of AC machines, including single-phase and three-phase AC motors, alternators, synchronous motors, modern machines. The course combines theoretical learning with practical laboratory work to ensure a solid understanding of the subject. Knowledge of AC machines and FHP motors enhances students' employability by equipping them with specialized skills sought after by employers in various industries. The field of AC machines and motors is constantly evolving with advancements in technology and regulations. Teaching students about these technologies encourages a mind-set of continuous learning and adaptation to stay updated with industry trends and innovations.

II Industry Identified Competency:

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

Demonstrate expertise in motor control and optimization.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Calculate** the given parameters of three phase induction motor

CO2: **Select** the suitable starter and speed control method for given three phase induction motor.

CO3: **Test** the performance of single phase induction motor under given conditions.

CO4: **Test** the performance of three phase alternator.

CO5: **Test** the performance of three phase synchronous motor.

CO6: **Use** special purpose electrical machines for industrial applications.

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: Three Phase Induction Motors	1a	Identify parts of three phase induction motor	1.1	Squirrel cage induction motor and slip ring induction motor: constructional details.	CO1
	1b	Calculate given parameters of three phase induction motor on given data	1.2	Concept of rotating magnetic field: production of rotating magnetic field, laws related to operation of induction motor, synchronous speed, Rotor behaviour and relations: standstill and running conditions, speed, slip, frequency of induced emf/currents, power factor.	
	1c	Evaluate the performance of three phase induction motor under given conditions.	1.3	Slip measurement methods: tachometer, stroboscope, galvanometer, Torques: starting, full load and maximum torque & their ratios, Torque-slip (T-S) characteristics, Squirrel cage induction motor: losses and power stages, Calculation of Slip, speed, maximum torque, starting torque.	

UNIT II: Starting and speed control of three phase induction motors	2a	Select given type of starter for specified application.	2.1	Necessity of starters for three phase induction motors, Primary resistance starter, DOL, autotransformer starter, star delta starter, rotor resistance starter, soft starter: constructional details and working.	CO2
	2b	Select a suitable speed control method of induction motor for given application.	2.2	Speed control methods: stator voltage control, pole changing, rotor resistance, variable frequency drives (VFD), description, effect on Torque-speed characteristics.	
UNIT III: Single Phase Induction Motor	3a	Classify the given single phase induction motor.	3.1	Double field revolving theory, principle of making these motors self-start. Classification of single phase induction motors.	CO3
	3b	Select a suitable single phase induction motor for given application.	3.2	Classification: capacitor start-induction run, capacitor start-capacitor run, universal motor, construction, working, speed torque characteristics, speed reversal, applications, Self-starting techniques: phase splitting, shaded pole, reluctance.	
or	4a	Identify parts of given type of alternator.	4.1	Construction of Three Phase Alternator a) Armature: stationary and Rotating, their advantages and disadvantages b) Rotor: Salient Pole and Cylindrical rotor and their comparison.	
	4b	Calculate given parameters on given data.	4.2	Derivation of EMF Equation of an Alternator, Chording factor, Distribution Factor and their effect on EMF generation, calculate emf induced in alternator.	

UNIT IV: Three Phase Alternato	4c	Evaluate performance of an alternator at given load and power factor.	4.3	Alternator loading: Factors affecting the terminal voltage of alternator; Armature resistance and Leakage reactance, Armature reaction at various power factors and synchronous impedance, vector diagrams of loaded alternator.	CO4
	4d	Calculate the voltage regulation of an alternator using given method of voltage regulation based on given data.	4.4	Voltage Regulation of Three Phase Alternator: Synchronous Impedance Method, Direct Loading method, Calculate voltage regulation of alternator with synchronous impedance method.	
	4e	Identify the effects of given input parameters on the load sharing of alternators connected in parallel.	4.5	Necessity of parallel operation of an alternator, Conditions of parallel operation and its load sharing. Grid Integration and advanced Synchronization, Effect of excitation and Steam input on load sharing of an alternator.	
NIT V: Synchronous Motor	5a	Implement given starting methods of synchronous motor.	5.1	Principle of working, significance of load angle. Methods of starting of Synchronous Motor. Torques: Starting torque, running torque, pull in torque, pull out torque.	CO5
	5b	Judge the effect of the excitation variation for the given loading conditions.	5.2	Synchronous motor on load with constant excitation, effect of excitation at constant load	
	5c	Justify effect of given parameters on the given curves of a synchronous motor.	5.3	V-Curves and Inverted V-Curves. Losses and efficiency of synchronous motor, Hunting / Phase swinging: its causes, effects and remedies.	

U	5d	Suggest suitable synchronous motors for given applications	5.4	Applications of synchronous motor for power factor correction, constant-speed, constant-load drives and voltage regulation, Emerging Technologies and Applications.	
UNIT VI: Special FHP Motors	6a	Select a special purpose motor for given application.	6.1	Universal motor, synchronous reluctance motor, permanent magnet synchronous motors (PMSM), stepper motors: Construction, working, characteristics, and applications	CO6
	6b	Calculate various parameters of stepper motor based on given data.	6.2	Stepper motor types: Permanent Magnet stepper motor, construction, working and application, Calculate step angle, resolution, stator teeth and rotor teeth of Permanent magnet stepper motor.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify different parts of three phase squirrel cage induction motor.	2#	CO1
I	2	Identify different parts of three phase slip ring induction motor.	2#	CO1
I	3	Perform Direct load test on three phase squirrel cage induction motor.	2#	CO1
I	4	Perform No load and blocked roter test on three phase squirrel cage induction motor.	2#	CO1
I	5	Draw the circle diagram based on No load and block rotor test of sqirrel cage induction motor.	2#	CO1
II	6	Start the three phase squirrel cage induction motor using DOL starter and reverse its direction.	2#	CO2
II	7	Start the three phase squirrel cage induction motor using autotransformer starter.	2#	CO2
II	8	Start the three phase squirrel cage induction motor using manual star delta starter and set overload relay	2#	CO2
II	9	Control The speed of three phase squirrel cage induction motor by stator voltage control method.	2#	CO2
II	10	Control The speed of three phase squirrel cage induction motor by V/f control method.	2#	CO2
II	11	Control The speed of three phase squirrel cage induction motor by pole changing method.	2	CO2
II	12	Control The speed of three phase slip ring induction motor by rotor resistance control method.	2#	CO3
III	13	Identify different windings and components of capacitor start capacitor run single phase induction motor.	2#	CO3
III	14	Start and reverse the direction of rotation of single phase induction motor.	2#	CO3
III	15	Perform direct load test on single phase induction motor.	2	CO3
IV	16	Identify differnt windings and parts of three phase alternator.	2#	CO4

IV	17	Perform the direct loading test on the given three phase alternator and determine the regulation.	2#	CO4
IV	18	Perform Open circuit and short circuit tests on three phase alternator (Part 1)	2#	CO4
IV	19	Perform Open circuit and short circuit tests on three phase alternator (Part 2)	2#	CO4
IV	20	Determine the voltage regulation of three phase alternator by synchronous impedance method.	2#	CO4
IV	21	Synchronize given three phase Alternator with an Infinite Bus.	2	CO4
V	22	Start the three phase synchronous motor and run it in forward and reverse direction.	2#	CO5
V	23	Perform load test on three phase synchrounous motor and calculate its effeciency under different loading conditions.	2#	CO5
V	24	Analyze the relationship between field current and armature current under different loading conditions by ploting V and inverted V curves (Part 1)	2#	CO5
V	25	Analyze the relationship between field current and armature current under different loading conditions by ploting V and inverted V curves (Part 2)	2#	CO5
VI	26	Identify the parts of Stepper motor.	2#	CO6
VI	27	Interface the stepper motor to 8051 micorcontroller and change the direction of rotation.	2#	CO6
VI	28	Rotate the stepper motor to a specific angle using step counting.	2	CO6
VI	29	Carryout speed reversal of BLDC motor	2	CO6
VI	30	Carryout speed control of BLDC motor	2	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Collect the information of top ten single phase induction motor manufacturing companies and prepare report on it
2. Collect the information of top ten three phase induction motor manufacturing companies and prepare report on it
3. Prepare a report on market survey of single phase and three phase induction motor
4. Prepare a report on market survey of three phase alternator
5. Prepare a report on market survey of synchronous motor
6. Explore the construction and operation of a brushless DC motor and prepare a report.
7. Test the parallel operation of two alternators and analyze load sharing and prepare a report.
8. Investigate the construction and starting methods of a synchronous motor.
9. Implement an IoT-based monitoring system for an electric machine and write a report.
10. Prepare any micro-project based on curriculum content.

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	Three Phase Induction Motors	14	C	2	8	6	16
			O	2	4	4	10
2	Starting and speed control of threephase induction motors	7	C	0	4	6	10
			O	2	4	0	6
3	Single Phase Induction Motor	9	C	2	4	4	10
			O	0	0	6	6
4	Three Phase Alternator	12	C	2	4	6	12
			O	0	4	4	8
5	Synchronous Motor	8	C	2	4	4	10
			O	0	0	6	6
6	Special FHP Motors	10	C	2	4	6	12
			O	0	4	0	4
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	2R1	5	2
2	1U4	1U4	2U4	1U4	2U4			3	2
3	3U4	4U4	5U4	4U4	4A4			3	2
4	6U4	3A4	5A4	1A4	4U4			3	2
5	1A6	2A6	3A6					2	1
6	4A6	6A6	5A6					2	1

*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	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

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	-	-
CO2	3	-	-	3	-	2	2	-	-
CO3	3	-	-	3	-	2	-	-	-
CO4	3	-	-	3	-	2	2	-	-
CO5	3	-	-	3	-	2	-	-	-
CO6	3	-	-	3	-	-	-	-	-

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: 978-0-07-066921-5, 10: 0-07-066921-X
2	Principle of Electrical Machines	V K Mehta, Rohit Mehta, S. Chand Publishing, 2nd Edition, 2002	13: 9788121921916
3	Electrical Technology Vol.II AC & DC Machines	B.L.Theraja, S. Chand & Company Ltd., Third, 1990	10: 8121924375, 13: 9788121924375
4	Basic Electrical Engineering	V.N.Mittle, Arvind Mittal, The McGraw Hill Education Pvt. Ltd, Reprint, 2011	13: 780070593572
5	Experiments in Basic Electrical Engineering	S.K.Bhattacharya and K.M.Rastogi, New Age International Publisher, Reprint, 2009	13: 9788122410426
6	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

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5. https://youtu.be/hjE-73Yyoas, accessed on 25th July 2024
6. https://youtu.be/f0vrTNmCTkc, accessed on 30th July 2024
7. https://www.youtube.com/watch?v=5t1S8qy9oVk ,accessed on 30th July 2024
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XVI List of Major Equipment/Machineries with Specification:

1. Induction motors 3 hp/ 5hp, 415 V, 50 Hz, 1440 RPM squirrel cage type
2. Induction motors 3 hp/ 5hp, 415 V, 50 Hz, 1440 RPM slip ring type.
3. Digital multimeter4 ½ digit with standard make for measurements
4. Electrical meters for measurment of current, voltage, power and frequency.
5. Load bank: Resistive, 3-phase, 5kW, 415V,Inductive, 3-phase, 2 to 5kVAR, 415V, capacitive, 3-phase, 2 to 5kVAR , 415V
6. Star- delta, auto transformers starters, Rotor resistance starter
7. Three phase alternator: 5kVA, 415 V, 50 Hz, 4 pole, 1500 RPM.
8. Three phase synchronous motor: 3hp, 415 V, 50 Hz, 1500 RPM.

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
2	Dr. P. M.Daigavane	HoD, Electrical Engineering	G.H.Raisoni College of Engineering, Nagpur
3	Mrs. Divya Piprode	Sr. Engineer	Powergrid Corporation of India, Nagpur
4	Mr. M.N. Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
5	Dr. G.V.Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
6	Mr. J. K. Pandit	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSC
Course Code	:	EE207H
Course Title	:	Instrumentation

I Rationale:

The course in Instrumentation equips diploma students in electrical engineering with essential knowledge and skills to grasp and apply instrumentation systems. Covering fundamentals of instrumentation, transducers, sensors, and techniques to measure non-electrical quantities, the curriculum emphasizes signal conditioning, data acquisition, and telemetry. This knowledge is vital for modern industries requiring precision and automation, preparing students to handle real-world challenges in monitoring, control, and communication systems effectively.

II Industry Identified Competency:

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

Use electrical instrumentation for data collection and analysis.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** different switches used in instrumentation system

CO2: **Use** various type of sensors and transducers

CO3: **Measure** non-electrical quantities using proper instruments

CO4: **Demonstrate** the data processing and signal conditioning System

CO5: **Use** data acquisition systems in various applications

CO6: **Operate** different recorders and digital instruments

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: Fundamentals of instrumentation	1a	Justify the function of given block of instrumentation system	1.1	Block diagram and functions of each block of Instrumentation system. Role of instrumentation system in Industry and its application.	CO1
	1b	Select the given switches used in the instrumentation system for particular application.	1.2	Symbolic representation, working and application of Toggle switch, Slide switch,Dual in-line package (DIP) switch, Rotary switch, Thumbwheel switch, Selector switch, Push button, Drum switch, Limit switch, Temperature switch, Pressure switch, Level switch, Flow switch.	
	1c	Select given Relays for particular symbolic representation application in instrumentation system.	1.3	Symbolic representation, working and applications of Electromechanical relay, Reed relay, Hermetically sealed relay, Solid state relays	

UNIT II: Transducer and Sensor	2a	Classify the given transducer on the basis of their application.	2.1	Classification of transducer - Active and passive, analog and Digital, Primary and secondary, Mechanical and Electrical Advantages of electric transducers. Required Characteristics of transducers. Factors affecting the choice of transducers.	CO2
	2b	Suggest given type transducer for paticular application.	2.2	Construction and principle of Electrical Transducer: Resistive transducers-Linear and Angular potentiometers, strain gauge, types, gauge factor. Inductive transducer- LVDT, RVDT, Piezoelectric transducer, photovoltaic cell.	
	2c	Select given types of sensor for particular application	2.3	Sensors: Definition and classification of sensor working principle of Thermal, Electric, Optical and Magnetic sensors.	
easurement of non-electrical quantity	3a	Select relevant temperature transducer for the given applications	3.1	Temperature measurement: Construction & Working of RTD Thermistor, Thermocouple Radiation pyrometer, technical Specifications and ranges.	CO3
	3b	Select relevant pressure transducer for the given applications	3.2	Pressure measurement : Construction and Working of bourdon tube, bellow, diaphragm, Combination of diaphragm and inductive transducer, bourdon tube and LVDT, bellow and LVDT, diaphragm capacitance and bridge Circuit,technical Specifications and ranges.	
	3c	Select relevant speed transducer for the given applications	3.3	Speed measurement: Construction and Working of photo- electric tachometer, toothed rotor tachometer generator, magnetic pickup and Stroboscope, technical Specifications and ranges.	

UNIT III: Me	3d	Suggest the transducer used for measurement of flow	3.4	Flow measurement: Construction and Working of Flow Measurement: Construction and Working of electromagnetic and Turbine flowmeter, technical Specifications and ranges.	
	3e	Prepare the specification of given liquid level transducer	3.5	Liquid level Measurement: Construction and Working of resistive, inductive, capacitive gamma rays and Ultrasonic methods, technical Specifications and ranges.	
UNIT IV: Signal Conditioning	4a	Evaluate the electrical characteristics and parameters of given OP-AMP with a block diagram.	4.1	Basic Concept of signal conditioning system. Draw basic block diagram of OP-AMP. Draw pin configuration of IC 741. Define Ideal OP-AMP and Electrical Characteristics of OP-AMP. Different Parameters of op-amp: Input offset voltage, Input offset current, Input bias current, Differential input resistance, CMMR, SVRR, voltage gain, output voltage, slew ate Gain bandwidth, output Short circuit current.	CO4
	4b	Justify the use of different applications of given op-amp	4.2	Use of op-amp as Inverting, Non- inverting mode, Adder, Subtractor, and Instrumentation amplifier with circuit diagram and its output equation	
	4c	Analyze the operation and applications of given circuits.	4.3	Filters: Types of RC filters and its frequency response with its function. Sample and hold circuits - operation and its application	
	5a	Justify the function of given block of of Data Acquisition System (DAS).	5.1	Block diagram and function of each block of Data Acquisition System (DAS)	

UNIT V: Data Acquisition System.	5b	Compare the salient features of the given Channel on given points.	5.2	Draw Single Channel and Multi-channel DAS- Block diagram only. Difference between Signal Channel and Multi-Channel DAS	CO5
	5c	Convert given Analog-to digital and digital-to analog method.	5.3	Analog to digital conversion: Construction and Working of successive ap-proximation method, ramp type method. Digital to Analog conversion: Construction and Working of binary weighted resistance method	
	5d	Compare DAS and Data logger on the basis of given points.	5.4	Data logger- Block diagram and working of Data Logger and PC based monitoring system.Comparison between DAS and Data logger.	
UNIT VI: Data Transmission,Telemetry and Display Devices	6a	Classify different methods of data Transmission	6.1	Concept and methods of data Transmission Of Electrical and electronic transmission	CO6
	6b	Justify the function of given block of of Telemetry system	6.2	Block diagram and function of each block of Telemetry Types of Telemetry System : construction and working of Electrical telemetering system-Voltage, current and fequency.	
	6c	Compare given types of Modulation System on given points.	6.3	Comparison between Amplitude Modulation, Frequency Modulation and Phase Modulation systems with its application.	
	6d	Justify the use of given Digital Display device	6.4	Digital display device: Operation and its application of seven segment display, dot matrix display and concept of 3½, 4½ digits.,nixi-tube, LED LCD and its application.	
	6e	Evaluate the architecture, functionality, and limitations of virtual instrumentation.	6.5	Concept of Virtual Instrumentation. General block diagram and architecture of a virtual instrument Advantages and Disadvantages of Virtual Instrumentation	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify different switches used in instrumentation system.	2#	CO1
I	2	Identify different relays used in instrumentation system.	2	CO1
II	3	Measure linear displacement by L.V.D.T.	2#	CO2
II	4	Measure angular displacement using RVDT.	2	CO2
II	5	Measure the strain with the help of strain gauge.	2#	CO2
III	6	Measure temperature by PT-100, thermistor, thermocouple along with simple resistance bridge .	2#	CO3
III	7	Measure pressure using pressure sensor kit.	2#	CO3
III	8	Measure angular speed using stroboscope.	2#	CO3
III	9	Measure the flow using flow meter.	2#	CO3
III	10	Measure the liquid level in a tank using an ultrasonic sensor.	2	CO3
IV	11	Use op-amp as inverter and non-inverting mode	2#	CO4
IV	12	Use op-amp as adder and subtractor.	2#	CO4
V	13	Convert digital data into analog data by using analog to digital converters.	2#	CO5
V	14	Convert analog data into digital data by digital to analog converter	2#	CO5
VI	15	Identify various digital display devices.	2#	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Prepare a report of various switches used in the instrumentation system for particular application
2. Prepare a report of symbolic representation for relays
3. Prepare a report of various types of Transducer on the basis of their application
4. Collect various types of sensor and prepare report
5. Prepare a report on temperature transducer
6. Prepare a report on flow transducer
7. Prepare a report on liquid level transducer
8. Collect various types of Op-amp and prepare report.
9. Interface resistive sensors (e.g., RTD, thermistor) with a signal conditioning circuit.
10. Design a simple signal conditioning circuit for an inductive sensor
11. Design and implement an amplifier circuit for signal conditioning.
12. Setup a data acquisition system using an ADC and display sensor data on a computer
13. Log data from a temperature sensor using a data acquisition system.
14. Collect the information about Data logger for different applications
15. Prepare microproject based on digital display device

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 instrumentation	7	C	00	08	00	8
			O	02	00	00	2
2	Transducer and Sensor	10	C	02	04	06	12
			O	02	04	00	6
3	Measurement of non-electrical quantity	15	C	02	04	12	18
			O	00	04	06	10
4	Signal Conditioning	10	C	02	04	06	12
			O	00	04	04	8
5	Data Acquisition System.	9	C	02	04	04	10
			O	00	00	04	4
6	Data Transmission,Telemetry and Display Devices	9	C	02	04	04	10
			O	00	04	06	10
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	2R2	3R2	4R2	5R2	6R2	1R2	2R2	5	7
2	1U4	1U4	2U4	2U4	3U4			3	5
3	3U4	4U4	5U4	4U4	5A4			3	5
4	6U4	5A4	6A4	4A4	6U4			3	5
5	2A6	3A6	3A6					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	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	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	Electric & Electronic Measurement & instrumentation	A.K. Sawhney, Dhanpat Rai & Co. (P) Limited, 2015	10: 8177001000
2	Instrumentation Devices and System	C. S. Rangan, G. R. Sharma. & V. S. V. Mani -Pen ram International Publishing India Pvt. Ltd. Fifth edition	10: 0074633503
3	Electronics and instrumentation	V. K. Mehata, S. Chand & Company Pvt. Ltd., Third Edition- Reprint, 2010	10: 81-219-2729-3
4	Industrial Instrumentation & Control	S. K. Singh Edition, reprint. Publisher, Tata McGraw-Hill, 1987.	10: 007451914X, 13:9780074519141.

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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	Mr. M.C. Musale	I/C HoD, Electrical Engineering	Government Polytechnic, Nagpur
2	Dr. P. M. Daigavane	HoD, Electrical Engineering	G.H.Raisoni College of Engineering,Nagpur
3	Mrs. Divya Piprode	Sr. Engineer	Power Grid Corporation of India, Nagpur
4	Dr. G.V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
5	Mrs. A.P Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSE
Course Code	:	EE208H
Course Title	:	Renewable Energy Technologies

I Rationale:

This course is designed to develop the industry-relevant competency of implementing renewable energy systems. It equips students with practical skills to operate, test, and maintain solar, wind, hydrogen, biomass, and other renewable energy technologies. By addressing the growing demand for sustainable energy solutions, the course prepares students to meet industry needs effectively. This aligns with national goals for clean energy transition, enabling students to contribute to sustainable development and bridge the skill gap in the renewable energy sector.

II Industry Identified Competency:

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

Implement rewable energy systems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Design** grid connected solar PV system for small power applications.

CO2: **Maintain** solar thermal systems.

CO3: **Maintain** the working of small wind power plant.

CO4: **Use** hydrogen fuel cells for various applications.

CO5: **Identify** various waste to energy technologies.

CO6: **Identify** the componets of other renewable technologies.

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: Solar PV Systems	1a	Justify the given factors affecting electricity generated by a solar PV module.	1.1	Solar Cell, Module, and Array. Rating of PV module, Standard PV Module Parameters, Factors affecting Electricity Generated by a Solar PV Module. Measurement of Voc and Isc, Bypass Diode, Blocking Diode.	CO1
	1b	Estimatie number of modules and their total power based on given data.	1.2	Connections of module in series-parallel. Estimation of number of modules to be connected in series-parallel and their total power.	
	1c	Justify the fuctions of given components of solar PV system.	1.3	Grid-connected PV Systems for Small Power Applications. Configuration of Grid-connected Solar PV Systems without battery back-up, its components.	
	1d	Design a grid-connected PV systems for small power applications from given data.	1.4	Grid-connected PV System Design for Small Power Applications: Step-wise design procedure, estimation of energy output.	

UNIT II: Solar Thermal Technologies	2a	Compare given types of solar collectors.	2.1	Solar Thermal Technologies: Principle of conversion of solar radiation into heat, Types of collectors-flat-plate collectors, Concentrating collectors-Focusing, and non-focusing type.	CO2
	2b	Distinguish between given type of SWHS.	2.2	Solar Water Heating System (SWHS): Flat plate collector-components, description and features. Evacuated tube type-components, description and features. Selection of size of solar water heating system, Economics of solar water heating system, Calculation of payback period.	
	2c	Compare given types of solar thermal power plants.	2.3	Solar Thermal Power Plant: Medium Temperature with Cylndrical , Parabolic Collector, High Temperature with Receiver on Tower and Mirror arrangement: Block diagram, components, description and features.	
ergy	3a	Distinguish between given types of WPPs.	3.1	Generalized electrical generator working principle, classification of wind power plant (WPP) based on electrical generators: Type A, Type B, TYpe C, TYpe D- their block diagrams and features.	
	3b	Compare given types of WPPs on given points.	3.2	Need of direct drive WPP, comparison of electrical generator efficiencies, performance characteristics of WPPs for various wind speeds, comparative performance of WPPs.	

UNIT III: Wind En	3c	Select given PECs for specified application.	3.3	Power Electronics Converters (PEC) in WPP: Benefits of incorporating PECs in WPPs, PEC classification: Voltage Source Inverter (VSI), Current Source Inverter (CSI). Application of PECs in WPPs. Back to Back PEC: working principle, its strenght and limitation.	CO3
	3d	Apply tips for electrical maintenace of given equipment of WPP.	3.4	Maintenance of WPP: General, Unscheduled, Scheduled. Personal protective equipments for maintenace. Tips for WPP maintenance. Electrical Maintenance of WPP: Electrical generator, transformer and switchgear: points to be check.	
UNIT IV: Hydrogen and Fuel Cell	4a	Compare the properties of given types of fuels.	4.1	Hydrogen energy: Comparison of hydrogen properties with Petrol Gasoline, Methane, Methanol. Merits of hydrogen over other fuels, application of hydrogen.	CO4
	4b	Distinguish between given hydogen storage/ transportation methods.	4.2	Hydrogen storage: Necessity and methods, their description, advantages and limitations. Hydrogen transportation methods: their description, advantages and limitations.	
	4c	Compare given types of fuel cell on given points.	4.3	Fuel Cells: Difference between fuel cell and battery, Fuel cell Terminologies. Principle of operation of Fuel Cell, fuel cell construction. Comparison of PEM, AFC, PAFC, MCFC, SOFC, DMFC on operating temperature, power, efficiency, and applications.	

UNIT V: Waste to Energy	5a	Classify given types of wastes.	5.1	Classification of waste- Agriculture Waste, Animal Manure, Forestry Waste, Municipal Waste, Industrial Waste, Biomass Waste, Biomedical Waste. Advantages of setting waste to energy power plants.	CO5
	5b	Compare given types of given waste to energy conversion process.	5.2	Waste to energy conversion process: Solid waste- combustion, gasification, pyrolysis. Oil crops- Extraction- Esterification. Sugar Crops- Fermentation. Wet Biomass- Anaerobic Digestion.	
	5c	Justify the function of given block of bio-methanantion power plant.	5.3	Bio-methanation process: Fixed Dome and Floating Dome Digesters. Electricity generation by bio-methanation process: Block diagram and description.	
UNIT VI: Other Sources	6a	Compare given types of geothermal power plants.	6.1	Geothermal power plant: General arrangements, types: Dry type, Wet Type and Binary type- working principle, advantages and limitations.	CO6
	6b	Compare given types of ocean energy systems.	6.2	Ocean Energy: Ocean Thermal Electric Conversion, Tidal energy, wave energy, marine current; General arrangement and working principle, Prospects in India	
	6c	Select site for micro-hydro power plant for specified location.	6.3	Hydroelectric Power Plant: Classification: Small, Mini, Micro, Pico. General arrangement of micro-hydro power plant working principle, description, turbines used, site selection.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Determine various parameters of Solar PV Module.	2#	CO1
I	2	Test the effect of Light, temperature, and shadow on Solar PV Module.	2#	CO1
I	3	Calculate various parameters by connecting the solar PV modules in series and parallel.	2#	CO1
I	4	Design Solar PV system for residential/ commercial unit.	2#	CO1
II	5	Maintain Solar PV system/ power plant.	2#	CO2
II	6	Design solar water heating system and calculate its Payback Period.	2#	CO2
II	7	Maintain a solar water heating system.	2#	CO2
III	8	Measure output voltage and current of given type of induction generator for different wind speeds.	2#	CO3
III	9	Prepare a visit report on Wind Power Plant by actual visit/ observing video.	2#	CO3
IV	10	Identify different components of fuel cell by dismantling experimental kit/ observing video.	2#	CO4
IV	11	Assemble the fuel cell kit and operate fuel cell on load.	2	CO4
V	12	Identify the different components of bio-mithanantion based power plant.	2	CO5
V	13	Prepare a report on biogas operated Power Plant by observing video.	2#	CO5
VI	14	Prepare a report on tidal and wave power plant by observing video.	2	CO6
VI	15	Prepare a report on micro-hydro power plant by observing video.	2#	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Perform comparative study of solar PV modules available in market and submit report.
2. Prepare a project report for installation and commitioning of solar PV system for a residential unit.
3. Prepare a project report for installation and commitioning of solar PV system for a small commercial unit.
4. Troubleshoot and maintain solar PV system and submit report.
5. Prepare Solar PV system experimental kit for laboratory.
6. Perform comparative study of wind turbines available in market and submit report.
7. Prepare model of any type vertical axis wind turbine.
8. Prepare a model of any type of horizontal asix wind turbine.
9. Perform comparative study of fuel cells available in market and submit report.
10. Prepare a visit report of waste to energy power plant.
11. Prepare a visit report of micro-hydro power plant.
12. Prepare any micro-project based on curriculum content.

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	Solar PV Systems	10	C	02	04	12	18
			O	04	00	06	10
2	Solar Thermal Technologies	8	C	02	04	06	12
			O	02	04	00	6
3	Wind Energy	8	C	02	06	04	12
			O	00	00	06	6
4	Hydrogen and Fuel Cell	6	C	04	00	04	8
			O	00	04	04	8
5	Waste to Energy	7	C	02	04	04	10
			O	02	04	00	6
6	Other Sources	6	C	02	04	04	10
			O	00	04	00	4
Total		45	C	14	22	34	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	1R2	2R2	3R2	5R2	6R2	2R2	5R2	5	7
2	1U4	2U4	4R4	1R4	2U4			3	5
3	3A4	4A4	5U4	4U4	4A4			3	5
4	5A4	6U4	6A4	5U4	6U4			3	5
5	1A6	1A6	1A6					2	3
6	2A6	3U6	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	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	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
CO2	3	-	-	3	3	-	-	-	-
CO3	3	-	-	3	3	-	-	-	2
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	Renewable Energy Technologies - A Practical guide for beginners.	Chetan Singh Solanki, PHI Learning Pvt. Ltd., First, 2008.	13: 978-81-203-3434-2
2	Solar Photovoltaic: Fundamentals, Technologies and Application.	Chetan Singh Solanki, PHI Learning Pvt. Ltd., 3rd Edition, 2015	13: 978-81-203-5111-0
3	Solar Photovoltaic Technology and Systems- A Manual for Technicians, Trainers and Engineers	Chetan Singh Solanki, PHI Learning Pvt. Ltd., 5th Edition, 2013	13: 978-81-203-4711-3
4	Wind Power Plants and Project Development	Joshua Earnest, Tore Wizelius, PHI Learning Pvt. Ltd., 2nd Edition, 2015	13: 978-81-203-5127-1
5	Renewable Energy Sources and Emerging Technologies	D.P.Kothari, K.C.Singal, Rakesh Ranjan, PHI Learning Pvt. Ltd., 2nd Edition, 2015	13: 978-81-203-4470-9

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2. https://www.youtube.com/watch?v=FQXkMt0Zm1A assessed on 10th December, 2024.
3. https://www.youtube.com/watch?v=bNBQKlHt6rg assessed on 10th December, 2024.
4. https://www.youtube.com/watch?v=a4pXAmljdUA assessed on 12th December, 2024.
5. https://www.youtube.com/watch?v=gUj827ioDnw assessed on 12th December, 2024.
6. https://www.youtube.com/watch?v=8miWW2QyN_4 assessed on 12th December, 2024.

XVI List of Major Equipment/Machineries with Specification:

1. Solar Panel: 75 Watt/12 Volts or available capacity
2. Solar Water Heating System- Flat Plate or Evacuated tube type: 100 LPD Capacity
3. Small wind turbine (Horizontal/Vertical axis) experimental kit, Output- 20W/50W/75W/100W/ whichever is available in small size
4. Fuel cell experimental kit. Power in Hydrogen and Oxygen Mode: 900 mW Power in Hydrogen and Air Mode: 300 mW Generated Voltage: 0.45 - 0.96 V

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
2	Dr. P. M. Daigavane	HOD, Electrical Engineering	G.H.Raisoni College of Engineering, Nagpur
3	Ms. Divya Piprode	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	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
6	Mrs. N. J. Suryawanshi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

(Mr. M. C. Musale)
HOD & Chairman PBOS, EE

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

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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 EE
Course Category	:	DSE
Course Code	:	EE209H
Course Title	:	Electric Vehicle Technologies

I Rationale:

Electric vehicle (EV) technology has emerged as a critical area for electrical engineers due to the global shift towards sustainable energy. The goal of this course is to give students the fundamental knowledge and abilities they need to comprehend, test, and operate EV systems. By combining classroom learning with practical laboratory through experiments, students will gain a comprehensive understanding of EV technology, preparing them for employment in the quickly growing electric vehicle sector.

II Industry Identified Competency:

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

Install and maintain EV charging stations and systems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** components and subsystems used in electric vehicles.

CO2: **Choose** an electric vehicle drive for a specific application.

CO3: **Choose** the relevent converters as per given application.

CO4: **Apply** the concept of charging system in EV.

CO5: **Test** the performance of batteries and energy storage systems used for EV applications.

CO6: **Implement** Indian and state EV policies for EV 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 Electric Vehicle	1a	Compare electric vehicles and internal combustion engine vehicles on the given points.	1.1	History and evolution of electric vehicles (EV), need of EV, Electric vehicles and internal combustion engine vehicles: Comparison on the basis of power source, noise level, vibration level, maintenance gear, capictal cost, running cost and environmental impact.	CO1
	1b	Compare given EVs on the basis of given points.	1.2	Electric vehicle architecture, Types of EV: Battery Electric Vehicle (BEV), Hybrid Electric Vehicle (HEV), Plug-in Hybrid Electric Vehicle (PHEV), Fuel Cell Electric Vehicle (FCEV) - Their comparison on basis of Driving Component, Energy Source used, Features, Problems and models available in market.	
	1c	Justify the function of given EV subsystems.	1.3	Block diagram of EV subsystems: energy source subsystem, propulsion subsystem and auxiliary subsystem.	

UNIT II: Electric Vehicle Drives	2a	Classify given Electric Vehicles.	2.1	Classification of electric drives used in EV: DC Motor drives, AC Motor drives.	CO2
	2b	Interpret the characteristics of the given electric motor(s) used in EV.	2.2	Brushed DC Motor, Brushless DC Motor (BLDC), Permanent Magnet Synchronous Motor (PMSM), Induction Motor (IM), Synchronous Reluctance Motor (SynRM), PM Assisted Synchronous Reluctance Motor, Axial Flux Ironless Permanent Magnet Motor: Salient features, characteristics, advantages, limitations, and usage of different motor types in EV models.	
	2c	Distinguish between given EV motors on the basis of given points.	2.3	Comparison of EV motors based on power-weight ratio,torque-speed characteristic, cost of controllers required and cost of motors.	
	2d	Select given electrical drives for EV applications.	2.4	Physical location of motor in EV, Rating of motors, Connections (Mechanical and Electrical), and Selection criteria of various types of EV motors.	
UNIT III: Converters	3a	Classify given types of converter.	3.1	Introduction to power electronics used in EV, classification of converters : DC-DC converters, DC-AC converters, AC-DC converters and Bi-directional converter.	CO3
	3b	Justify the need of given type of converter.	3.2	Block diagram of typical EV: Functions, types, description and application of following converters. i. DC to DC Converter, ii. DC to AC Converter, iii. AC to DC Converter (Rectifier) and iv. Bi-directional converter. Role of filters in EV converters.	

UNIT IV: EV Chargers	4a	Distinguish between given types of charging method.	4.1	Charging methods: Home charging, Trickle charging, Household AC charging, Public charging (DC Fast charging): Description and application.	CO4
	4b	Classify given type of charging systems.	4.2	Charging System: Classification- Wireless, On board and Off board charging, V1G (Uni-directional smart charging), V2B/V2H (Vehicle-to-Building/ Vehicle-to-Home), V2X (Vehicle-to-Everything), V2G (Vehicle-to-Grid, Bi-directional smart charging).	
	4c	Calculate charging time based on given data.	4.3	Charging Stations: Types of charging station, Public charging station: Selection and sizing, components and, single line diagram. Calculation of charging time and concept of battery swapping. Precautions observed while charging, Installation and maintenace of EV charging stations.	
	5a	Justify given terms related to battery parameter.	5.1	Energy storage technology: EV Batteries, Supercapacitors, flywheel energy storage. Battery Parameters: Cell and Battery Voltages, Charge (or Amphour) Capacity, Energy Stored, Specific Energy, Energy Density, Specific Power, Amphour (or Charge) Efficiency, Energy Efficiency, Self-discharge Rates, Battery Geometry, Battery Temperature, Heating and Cooling Needs, Battery Life and Number of Deep Cycles.	

UNIT V: Batteries and Energy Storage Systems	5b	Compare given types of batteries on given points.	5.2	Batteries: Lead-acid, NiMH (Nickel-Metal Hydride), Li-Ion(Lithium-Ion), Ni-Zn (Nickel-Zinc), Ni-Cd (Nickel-Cadmium), Aluminium–Ion batteries (Al–Ion batteries), Aluminium–air batteries (Al–air batteries)- their basic construction components, life time (cycles), efficiency, advantages and disadvantages.	CO5
	5c	Calculate EV battery capacity based on mileage and load on given data.	5.3	Comparison of various batteries. Factors influencing the operation of battery, and selection of battery. Series and Parallel connection of Batteries, Calculation of battery capaciy.	
	5d	Justify the fucntion of given block of battery Management System (BMS).	5.4	Battery Management Systems (BMS): Need of BMS, Block diagram of BMS, function of each block, Battery Condition Monitoring, "3R" (Reduce, Reuse, Recycle) process for battery.	
	5e	Compare given type of fuel cells based on given points.	5.5	Fuel Cell: Difference between fuel cell and batteries, Fuel Cell Terminology: Anode, Cathode, Electrolyte, Catalyst, Reformer, Direct Fuel Cell, Working principle of fuel cell. Types of Fuel Cells used in EVs: Alkaline Fuel Cell (AFC), Polymer Electrolyte Membrane Fuel Cell (PEMFC), Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell (MCFC), Solid Oxide Fuel cell (SOFC), Their comparison on the basis of Electrolyte type, Cell voltage, Operating temperature, System output (kW), Efficiency (%) and Applications.	

UNIT VI: Electric Vehicle (EV) Policies	6a	Use given policy of EV.	6.1	Goal of EV30@30 campaign. Goals of electric vehicles initiative in India. National Electric Mobility Mission Plan 2020(NEMMP): Objectives, Steps taken by Indian Government for faster adoption of electric vehicles, Barriers to adoption of electric mobility, E-mobility strategy, NEMMP 2020 Implementation structure.	CO6
	6b	Compare incentives policies for the given types of electric vehicle .	6.2	Maharashtra Electric Vehicle Policy, 2021: Objectives, Basic demand incentives for electric vehicles, Vehicle segment-wise scrappage incentives, Incentives for charging infrastructure.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the different components of electric vehicle.	2#	CO1
I	2	Identify the different subsystems of electric vehicles.	2#	CO1
II	3	Identify terminals of various motors used in EVs.	2#	CO2
II	4	Determine and compare the characteristic of various motor.	2#	CO2
III	5	Simulate a DC-DC buck converter to step down voltage and test its performance under various load conditions.	2#	CO3
III	6	Simulate a single-phase DC-AC inverter and analyze its output waveform, efficiency, and harmonic content.	2	CO3
III	7	Simulate a bidirectional DC-DC converter for battery charging and regenerative braking applications, and evaluate its performance.	2#	CO3
IV	8	Charge an EV battery using various methods, and record charging times and efficiency.	2#	CO4
IV	9	Simulate the charging process of a charging station using any open-source software.	2	CO4
IV	10	Calculate the charging time for different battery capacities using given formulas.	2#	CO4
V	11	Measure the different parameter of the battery using multimeter and also identity of charged, discharged and dead battery condition status.	2#	CO5
V	12	Perform Active Lithium-Ion cell balancing using plastic platform scale.	2	CO5
V	13	Design battery pack for specified capacity of EV.	2#	CO5
VI	14	Prepare a report on Indian EV policy.	2#	CO6
VI	15	Prepare a report on Maharashtra EV Policy, 2021.	2#	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Develop EV system model and simulate using any open source software.
2. Perform sub-system simulations of an electric vehicle using any open-source software.
3. Build and test simple DC-DC converters and inverters.
4. Test sensors and systems for autonomous EVs and submit report on it.
5. Prepare a report on the performance analysis of DC-DC converters and inverters in an EC setup.
6. Prepare a report on comparative study of various two-wheeler EVs available in market.
7. Prepare a report on setting of fast DC charging station.
8. Prepare a report on EV battery swapping technology.
9. Prepare a report on comparative study of various four-wheeler EVs available in market.
10. Prepare any one mirco project on EVs.

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 Electric Vehicle	6	C	02	04	00	6
			O	02	00	00	2
2	Electric Vehicle Drives	10	C	02	04	10	16
			O	00	04	04	8
3	Converters	6	C	06	00	06	12
			O	00	00	04	4
4	EV Chargers	6	C	02	04	06	12
			O	00	04	06	10
5	Batteries and Energy Storage Systems	12	C	02	04	10	16
			O	00	04	06	10
6	Electric Vehicle (EV) Policies	5	C	00	08	00	8
			O	02	04	00	6
Total		45	C	14	24	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	6R2	5	7
2	1U4	2U4	2A4	2U4	2A4			3	5
3	3R4	4U4	5U4	4U4	5U4			3	5
4	5A4	6U4	6U4	3A4	6U4			3	5
5	2A6	3A6	4A6					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 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/skill	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	-	-	-	-	-	3	-	-
CO2	3	-	-	3	-	-	3	-	-
CO3	3	-	-	3	-	-	3	-	-
CO4	3	-	-	3	-	-	3	-	-
CO5	3	-	1	3	1	-	3	-	-
CO6	3	-	-	-	-	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Electric Vehicle Technology Explained	James Larminie, John Lowry, Willey-Blackwell, 2012	13:978-1119942733
2	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles	Mehrdad Ehsani, Yimin Gao, Stefano Longo, and Kambiz Ebrahimi, CRC press, 2019	13:978-0367137465.
3	Electric Vehicle (Green and Sustainable Transportation)	Dr. Nitesh Tiwari, Dr. Shekhar Yadav, S.K.Kataria & Sons, 2023	13:987-81-963589-0-7
4	Electrical Vehicle Technology: The Future Towards Eco-Friendly Technology	Sunil R. Pawar, Notion Press Publication, 2021	10:1685545610

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2. https://www.niti.gov.in/sites/default/files/2023-02/EV_Handb, accessed on 31th December 2024
3. https://archive.nptel.ac.in/courses/108/103/108103009, accessed on 31th December 2024
4. https://www.cleanenergyministerial.org/initiatives-campaigns, accessed on 31th December 2024
5. https://www.mdpi.com/1996-1073/15/3/1241, accessed on 31th December 2024

XVI List of Major Equipment/Machineries with Specification:

1. Electric Vehicle two-wheeler
2. BLDC motor
3. Three phase induction motor
4. Permanent magnet synchronous motor
5. Synchronous reluctance motor
6. Lithium-Ion E-bike battery, 20Ah capacity
7. Plasctic platform sacle active lithium cell balancing, size A3, capacity 80Ah

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
2	Dr. P. M. Daigavane	HoD, Electrical Engineering	G.H Raisoni College of Engg, Nagpur
3	Mrs. Divya Piparode	Sr. Engineer	Powern Grid 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
(An Autonomous Institute of Govt. of Maharashtra)
Near Mangalwari Bazar, Sadar, Nagpur-440001

COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	SEC
Course Code	:	EE252H
Course Title	:	Repair of Electrical Machines and Appliance

I Rationale:

This course aims to equip learners with essential skills and knowledge in repair and maintenance of electrical machines and appliances. Main focus is on use of various repairing tools and equipment. Identification and securing the proper wiring of electrical machines and appliances. Emphasis on hands-on experience and adherence to practice of repairing of appliances among the future electrical technicians/ supervisor, ensuring they are well-prepared for the demands of the field.

II Industry Identified Competency:

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

Diagnose and troubleshoot electrical faults and problems in electrical equipment and domestic appliances.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Use** electrical tools and equipment for troubleshooting electrical machines and domestic appliances.

CO2: **Perform** repair and maintenance of Heating appliances.

CO3: **Perform** repair and maintenance of motor-driven appliances.

CO4: **Perform** repair and maintenance of domestic electrical appliances.

CO5: **Perform** repair of squirrel cage induction motor and transformer.

CO6: **Perform** rewinding of squirrel cage induction motor and transformer.

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: Electrical Repairing and Safety tools	1a	Follow safety rules in workshop.	1.1	Need of general Safety rules. List of general safety rules to be followed while handling repair tools & equipment.	CO1
	1b	Select the tools and equipment used for repairing & maintenance of equipment.	1.2	Tools and equipment use for repairing and maintenance of Electrical Equipment such as Screw Driver, Nose Pliers, Wrenches, Wire Cutter / Stripper, Spanners, Multimeter, Electrician tester, Test lamp, Continuity tester, Bearing Puller, Growler, Mallet, Wrenches, Hammers, Soldering gun.	
	1c	Use test lamp and multimeter for various electrical tests.	1.3	Testing: Open circuit test, Short circuit test, Earth fault test using test lamp and multimeter.	

UNIT II: Repair of Heating Appliances	2a	Identify common faults and their remedies in Electric Iron.	2.1	Electric Iron: Types of Electric Iron, Basic working principle of electric irons, Construction and major Components, Circuit diagram, Common faults and remedies, Rewiring and replacement of faulty components.	CO2
	2b	Identify common faults and their remedies in Electric Kettle.	2.2	Electric Kettle: Types of Electric Kettle, Basic working principle of electric Kettle, Construction and major Components, Circuit diagram, Common faults and remedies, Rewiring and replacement of faulty components.	
	2c	Identify common faults and their remedies in Electric Toaster.	2.3	Electric Toaster: Types of Electric Toaster, Basic working principle of electric Toaster, Construction and major Components, Circuit diagram, Common faults and remedies, Rewiring and replacement of faulty components.	
	2d	Identify common faults and their remedies in Induction Heater.	2.4	Induction Heater: Types of Induction Heater, Basic working principle of Induction Heater, Construction and major Components, Circuit diagram, Common faults and remedies, Rewiring and replacement of faulty components.	
	2e	Repair of OTG.	2.5	OTG: Types of OTG, Basic working principle of OTG, Construction and major Components, Circuit diagram, Common faults and remedies, Rewiring and replacement of faulty components.	

UNIT III: Repair of motor-driven appliances	3a	Identify common faults and their remedies in Ceiling Fan.	3.1	Ceiling Fan: Types of ceiling fans, Components of a ceiling fan, Wiring diagrams and connections, Working principle of a ceiling fan, Motor types used in ceiling Fan, Identifying common problems, Repair of ceiling fan including replacing faulty components, Bearing replacement, Cleaning and lubricating the motor, Balancing the Fan blade, Rewinding the motor.	CO3
	3b	Identify common faults and their remedies in Wall Fan/ Pedestal Fan/ Table Fan.	3.2	Components of a Wall fan, Wiring diagrams and connections, Working principle of a wall fan, Identifying common problems, Repair of Wall fan including replacing faulty components, Bearing replacement, Cleaning and lubricating the motor, Balancing the Fan blade, Rewinding the motor.	
	3c	Identify common faults and their remedies in Mixer-Grinder,	3.3	Working principle of Mixer-Grinders, Identification of various parts and their functionalities, Identifying common problems and their remedies, Opening the packaged Mixer-Grinder and reassembly.	
Washing Machine	4a	Identify common faults and their remedies in Air Cooler.	4.1	Air Cooler: Construction, Wiring diagram, Major Components and their functions, Fan and pump motor type and their specification, Common faults and their remedies, Hands-on practice on electrical testing of air cooler.	

UNIT IV: Repair of Air Cooler, Refrigerator and	4b	Identify common faults and their remedies in Domestic Refrigerator.	4.2	Refrigerator : Principles of refrigeration, Brief about Refrigeration cycle, Wiring diagram, Major Components and their functions, Compressor motor working principle, Common faults and their remedies	CO4
	4c	Identify common faults and their remedies in Washing Machine.	4.3	Washing Machine: Working principle of washing machines. Types of washing machines: Semi-automatic, fully automatic (top load and front load), Overview of the washing process (washing, rinsing, spinning), Wiring diagram, Major Components and their functions, Common faults and their remedies	
UNIT V: Repair of Motors and Transformer	5a	Identify common faults and their remedies in Single Phase Induction Motor	5.1	Single Phase Induction Motor: Construction and working principle, Major Components and their functions, Common faults, step by step troubleshooting of faults, Various Electrical test and their necessity.	CO5
	5b	Identify common faults and their remedies in Three Phase Squirrel Cage Induction Motor	5.2	Three Phase Squirrel Cage Induction Motor: Construction and working principle, Major Components and their functions, Common faults, step by step troubleshooting of faults, Various Electrical test and their necessity.	
	5c	Identify common faults and their remedies in Single Phase Transformer	5.3	Single Phase Transformer: Construction and working principle, Major Components and their functions, Common faults, step by step troubleshooting of faults, Various Electrical test and their necessity.	

UNIT VI: Rewinding of Motors	6a	Test Single Phase Induction Motor and rewind it.	6.1	Basics of single phase Winding, Winding connections, Rewinding Process - Removing old windings, Preparing slots and inserting coils, Insulating and varnishing process, Electrical testing of rewind single phase induction motor.	CO6
	6b	Test Three Phase Squirrel Cage Induction Motor and rewind it.	6.2	Basics of three phase Winding, Winding connections, Rewinding Process - Removing old windings, Preparing slots and inserting coils, Insulating and varnishing process, Electrical testing of rewind three phase induction motor.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify the following given tools used for repair and maintenance of electrical machine and appliances.[Bearing Puller, Growler, Mallet, Screwdrivers, pliers, Spanners, Wrenches, Wire stripper, Cutter, Hammers etc]	2#	CO1
I	2	Use multimeter for Continuity test and Resistance measurement for repairing and maintenance of electrical machine and appliances.	2#	CO1
I	3	Perform open circuit, short circuit, earth fault test on various electrical appliances and motor using test lamp (Part - I)	2#	CO1
I	4	Perform open circuit, short circuit, earth fault test on various electrical appliances and motor using test lamp (Part - II)	2	CO1
I	5	Use crimping tool for crimping and termination of wire and cable in domestic appliances.	2#	CO1
II	6	Use Electric drill machine to remove or tighten screws and bolts in the repair and maintenance of domestic appliances.	2	CO2
II	7	Test the functionality of Electric Iron using test lamp and multimeter.	2	CO2
II	8	Perform the troubleshooting of Semi automatic electric iron for various abnormalities.	2#	CO2
II	9	Perform the troubleshooting of Electric Kettle for various abnormalities.	2	CO2
II	10	Perform the troubleshooting of Electric Toaster for various abnormalities.	2#	CO2
II	11	Perform the troubleshooting of Induction heater for various abnormalities.	2#	CO2
II	12	Perform the troubleshooting of OTG for various abnormalities.	2	CO2
III	13	Perform the troubleshooting of Ceiling Fan for various abnormalities.	2#	CO3
III	14	Test the functionality of Ceiling Fan after rewinding the motor.	2	CO3
III	15	Perform the troubleshooting of Wall mounted Fan for various abnormalities.	2	CO3

III	16	Perform the troubleshooting of Mixture - Grinder for various abnormalities.	2#	CO3
IV	17	Test the functionality of Air Cooler using test lamp and multimeter.	2	CO4
IV	18	Perform the troubleshooting of Air Cooler for various abnormalities.	2#	CO4
IV	19	Perform the troubleshooting of Refrigerator for various abnormalities.	2	CO4
IV	20	Perform the troubleshooting of Washing Machine for various abnormalities.	2	CO4
V	21	Test the functionality of Single Phase Induction Motor using test lamp and multimeter.	2	CO5
V	22	Perform the troubleshooting of Single Phase Induction Motor for various abnormalities.	2#	CO5
V	23	Test the functionality of Three Phase Squirrel Cage Induction Motor using test lamp and multimeter.	2	CO5
V	24	Perform the troubleshooting of Three Phase Squirrel Cage Induction Motor for various abnormalities.	2#	CO5
VI	25	Perform the rewinding of Single Phase Induction Motor (Part - I)	2#	CO6
VI	26	Perform the rewinding of Single Phase Induction Motor (Part - II)	2	CO6
VI	27	Perform the rewinding of Three Phase Squirrel Cage Induction Motor (Part - I)	2#	CO6
VI	28	Perform the rewinding of Three Phase Squirrel Cage Induction Motor (Part - II)	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	Electrical Repairing and Safety tools	5	C	0	0	0	0
			O	0	0	0	0
2	Repair of Heating Appliances	5	C	0	0	0	0
			O	0	0	0	0
3	Repair of motor-driven appliances	5	C	0	0	0	0
			O	0	0	0	0
4	Repair of Air Cooler, Refrigerator and Washing Machine	5	C	0	0	0	0
			O	0	0	0	0
5	Repair of Motors and Transformer	5	C	0	0	0	0
			O	0	0	0	0
6	Rewinding of Motors	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	Selection of equipment	10
2	Performance	20
3	Measurement of Parameters	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	-	-	1	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	Installation Maintenance and Repair of Electrical Machine and Equipments	Madhavi Gupta, S. K Sons Publishers 2019	13: 978-9350145463
2	Fundamentals of Maintenance of Electrical Equipments	K. B. Bhatia, Khanna Publications 1995	13: 978-9387394315
3	Troubleshooting and repairing of Major Appliances	Eric Kleinert, Mc-Graw Hill Publications 2013	13: 9780071770187
4	Electrical Equipment Handbook: Troubleshooting and Maintenance	Philip Kiameh, , Mc-Graw Hill Publications 2003	13: 978-8120345737
5	Engineering Workshop Practice on Electrical & Electronics Engineering	Ms. J. Glory Priyadharshani, Dr. K. Sheela Sobana, , Mc-Graw Hill Publications 2015	13: 978-1639203819

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2. https://www.youtube.com/watch?v=w1Yr5ddTyf8 , accessed on 20th December, 2024
3. https://www.youtube.com/watch?v=Ct1dKhvQjOs , accessed on 20th December, 2024
4. https://www.youtube.com/watch?v=o3XmEm3fM1U , accessed on 20th December, 2024
5. https://www.youtube.com/watch?v=XRYSFalqe2U , accessed on 20th December, 2024

XVI List of Major Equipment/Machineries with Specification:

1. Electric Iron, Electric Kettle, Induction Heater, OTG
2. Ceiling Fan, Wall Fan, Mixer-grinder
3. Air Cooler, Refrigerator, Washing Machine
4. Single Phase Induction Motor and Three phase squirrel cage Induction Motor
5. Tools and Equipments for repair and rewinding work
6. Digital Multimeter, Insulation Resistance Tester
7. Earth Resistance Tester. Windnig Resistance Tester

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1	Mr. M. C. Musale	I/C HoD, Electrical Engineering	Government Polytechnic, Nagpur
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3	Mrs. Divya Piparode	Sr. Engineer	PGCIL 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. B. D. Wadhai	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur

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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/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	-

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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:

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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)
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(Dr. G. V. Gotmare)
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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	
surements	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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2. https://www.youtube.com/watch?v=ovGnF-yZZ2E accessed on 24 th Dec. 2024
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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

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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 processess 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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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
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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
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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: Trai	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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3. https://www.youtube.com/watch?v=sAO9gY, accessed on 10th May , 2024
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. 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.

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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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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).	CO3
	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.	

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

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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:

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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.

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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

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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)
HOD & Chairman PBOS, IT

(Dr. G. V. Gotmare)
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
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4	Dr. Y.Y. Mahajan	Assistant Professor Metallurgy & Material Science	VNIT, Nagpur
5	Shri.D.P Mukherjee	Works Manager (Rtd.)	Ordnance factory Ambhajhari, Nagpur

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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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1. https://textilelearner.net/dyeing-of-cotton-fabric-with-reactive-dyes/ , assessed on 18th September 2024
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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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:

Perform maintenance and repair of two wheeler systems.

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
4	Automotive Mechanics	Crouse. W.H., Anglin, McGraw Hill Education (India) Private Limited, 10th Edition, 2006	10: 0070634351
5	Vehicle Body Layout and Analysis	John Fenton, Hutchinson, London, 1986	10: 0852984456

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4. https://www.youtube.com?v=yYexaLUp610, accessed on 7, August 2024
5. https://www.youtube.com?v=mhhDiz3bwk, accessed on 7, August 2024
6. https://www.youtube.com/watch?v=Jk6V1Kdeons
7. https://www.youtube.com/watch?v=AAJyUk4wHfI&list=PLyqSpQzTE6
8. https://www.youtube.com/watch?v=NJkU8wbjgjs&list=PLyqSpQzTE6
9. https://www.youtube.com/watch?v=54GyDX_pzvw&list=PLyqSpQzTE6
10. https://www.youtube.com/watch?v=QWAhLyL2lBk

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, Automobile Engineering	Government Polytechnic, Nagpur
2	Prof. D. K. Bawane	Lecturer, Auomobile Engineering	Government Polytechnic, Nagpur
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
7	Dr. Manoj Baseshankar	HOD, Mechanical Engineering	Suryodaya Polytechnic & Engineering College, Nagpur
8	Dr. Suhas Kongre	Sr.Lecturer in Mechanical	ASTS Polytechnic, Wardha

(Dr. G.K Awari)
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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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2. http://www.madehow.com/Volume-1/Corrugated-Cardboard.html assessed on 13 aug 2024
3. http://www.fibrebox.org/Info/WhatIsCorrugated.aspx assessed on 13 aug 2024
4. https://imperialbox.net/four-panel-style-boxes/#reverse-tuck-end assessed on 13 aug 2024
5. https://en.wikipedia.org/wiki/Folding_carton assessed on 13 aug 2024
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8. https://www.internationalpaper.com/packaging/solid-fiber assessed on 13 aug 2024
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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.)
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/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 Link	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 I\	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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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)
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Member Sectretary PBOS, CM

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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
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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
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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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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/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

XV e-References:

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,

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

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/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.	
T 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:

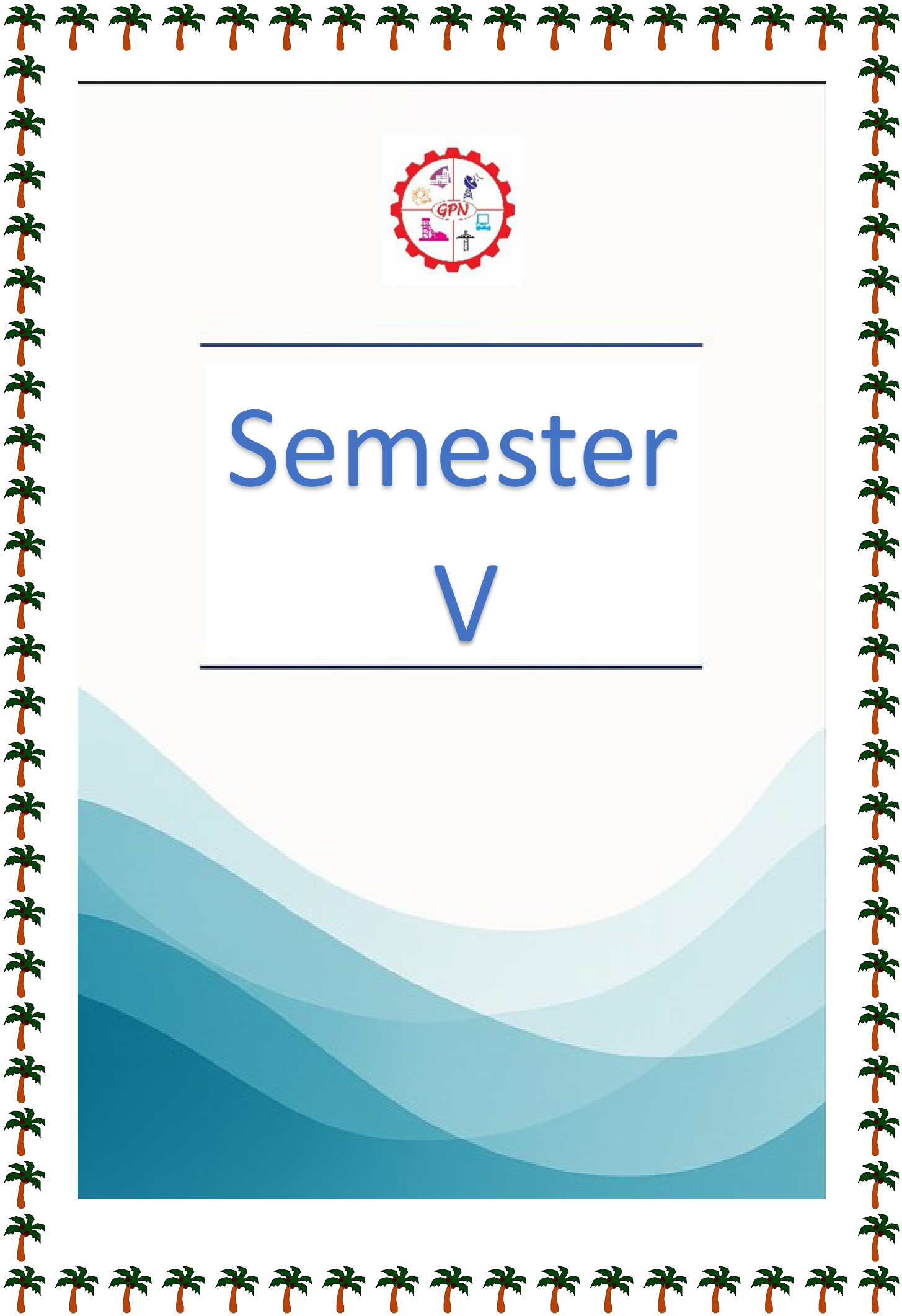
1. Desktop computers
2. Laser Printer
3. DLP

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 EE
Course Category	:	DSC
Course Code	:	EE301H
Course Title	:	Industrial Electronics

I Rationale:

Power Electronics finds extensive applications in efficient conversion, control and conditioning of electric power from its available input into the desired electrical output form. This course will enable the diploma students to develop the knowledge and skill sets of operating and testing different power electronic devices and their applications.

II Industry Identified Competency:

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

Test the Performance of Power Electronic Devices and Circuits.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Test** the functionality of power electronic devices.

CO2: **Test** the switching performance of silicon controlled rectifier.

CO3: **Test** given controlled converter.

CO4: **Test** the performance of DC-DC converter

CO5: **Test** the performance of inverter using simulation technique

CO6: **Identify** given industrial control circuits and special converters

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: Power Electronic Devices	1a	Identify given parts of power electronic system.	1.1	Power electronic system: general block diagram, need, advantages and disadvantages.	CO1
	1b	Select SCR for given requirements.	1.2	SCR: Symbol, construction, working principle, Static V-I characteristics, switching characteristics, ratings of SCR.	
	1c	Identify given devices for given application.	1.3	DIAC, TRIAC and TRIAC: Symbol, construction, working principle, Static V-I characteristics, and applications.	
	1d	Identify Power MOSFET and IGBT for given application.	1.4	Power MOSFET, IGBT: Symbol, construction, working principle, Static V-I characteristics, and applications..	
	2a	Classify turn on methods of SCR.	2.1	SCR turn on Methods: Forward voltage triggering, dv/dt triggering, thermal triggering, light triggering, and gate triggering.	

UNIT II: Silicon Controlled Rectifier	2b	Select suitable triggering circuit of SCR for given application.	2.2	SCR triggering circuit classification, circuit diagram, working, waveforms: resistance triggering circuit, RC triggering circuit, UJT triggering, Pulse transformer triggering.	CO2
	2c	Select suitable commutation technique of SCR for given application.	2.3	SCR commutation: Class A, Class B, Class C, Class D, Class E, and Class F commutation. Classification, Working, Circuit diagram, waveforms.	
	2d	Select proper protection scheme for the protection of SCR.	2.4	Need, Classification and working principle of protection schemes: di/dt, dv/dt, over current protection using electronic crowbar and over voltage protection.	
UNIT III: Phase controlled rectifiers	3a	Classify given types of rectifier	3.1	Basic terminologies: conduction angle, firing angle, output voltage, output current, voltage across switch, source current, source voltage. Classification of rectifiers.	CO3
	3b	Evaluate the performance of single phase half wave-controlled rectifier for given data.	3.2	Single phase half wave-controlled rectifier with R, RL load: Circuit diagram, working, input-output waveforms, derivation for average output voltage, equations for output currents, voltages & power, effect of freewheeling diode and numerical.	
	3c	Evaluate the performance of single phase full wave-controlled rectifier for given data.	3.3	Single phase full wave-controlled bridge rectifier with R, RL load: Circuit diagram, working, input-output waveforms, derivation for average output voltage, equations for output currents, voltages, effect of freewheeling diode and numerical.	

	3d	Evaluate the performance of single phase semi converter for given data.	3.4	Single phase semi converter with R load: Circuit diagram, working, input-output waveforms, derivation for average output voltage, voltages, effect of freewheeling diode and numerical	
	3e	Calculate the output voltage of the three phase controlled rectifier for given data.	3.5	Three phase full wave controlled bridge rectifier: working principle with R load, input-output waveforms and numerical.	
UNIT IV: DC-DC converters	4a	Classify given type of DC-DC Converters.	4.1	Type of DC-DC converters, Basic terminologies: duty ratio, turn on period, turn off period, chopping period.	CO4
	4b	Classify given control strategies used for DC-DC converter.	4.2	Control strategies of DC-DC converter: Constant frequency control, variable frequency control.	
	4c	Select a suitable DC-DC Converter for given application.	4.3	Step down chopper: circuit diagram, working, waveforms, derivation of output voltage equation and numerical. Step Up chopper: circuit diagram, working, waveforms, derivation of output voltage equation and numerical. Step Up-Down Chopper: circuit diagram, working, waveforms, derivation of output voltage equation and numerical.	
	5a	Classify given type of inverters.	5.1	Classification: based on type of source, based on number of phases, based on control strategy.	

UNIT V: Inverters	5b	Select a suitable inverter topology for given application.	5.2	Single phase half bridge inverter: Construction, working, input-output waveforms. Single phase full bridge inverter: Construction, working, input-output waveforms. Three phase inverter: Construction, working, input-output waveforms, 180 degree and 120 degree conduction modes.	CO5
	5c	Select suitable modulation technique for inverter.	5.3	Pulse width modulation: Importance/need, types; Single pulse width modulation, Multiple pulse width modulation. Sinusoidal pulse width modulation: Concept, working principle and waveforms.	
UNIT VI: Applications of Power Electronics	6a	Identify the given type of static circuit breaker.	6.1	Static circuit breaker: AC and DC, working and waveforms, applications.	CO6
	6b	Select suitable high frequency heating technique for given application.	6.2	High frequency Heating: Induction heating, Dielectric Heating, working principle and applications.	
	6c	Identify dual converter for given application.	6.3	Dual Converter: Working principle, classification, applications.	
	6d	Identify a single phase cycloconverter for given application.	6.4	Cycloconverter: Working principle, classification, applications.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Test the working of SCR on the basis of VI characteristics.	2#	CO1
I	2	Test the working of IGBT on the basis of VI characteristics.	2#	CO1
I	3	Test the working of MOSFET on the basis of VI characteristics.	2#	CO1
I	4	Test the working of DIAC on the basis of VI characteristics.	2#	CO1
II	5	Test the variation of R on firing angle in R triggering circuit of SCR.	2	CO2
II	6	Test the variation of R on firing angle in RC triggering circuit of SCR.	2	CO2
II	7	Test the variation of R on firing angle in UJT triggering circuit of SCR.	2	CO2
II	8	Perform the operation of Class C - Complimentary commutation of SCR.	2#	CO2
III	9	Test the performance of single phase half wave controlled rectifier for R load.	2#	CO3
III	10	Simulate the operation of Single phase full wave controlled rectifier with R, RL load using simulation software.	2#	CO3
IV	11	Test the performance of step down DC-DC converter.	2#	CO4
IV	12	Test the performance of step up DC-DC converter.	2#	CO4
V	13	Simulate the operation of Single phase half bridge and full bridge inverter with and without PWM.	2#	CO5
V	14	Simulate the operation of the operation of three phase inverter for 180 degree and 120 degree conduction mode.	2#	CO5
VI	15	Simulate the operation of cycloconverter.	2#	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Build the circuit for testing the functioning of SCR and prepare a report.
2. Build the circuit for testing the functioning of MOSFET and prepare a report.
3. Build the circuit for testing the functioning of IGBT and prepare a report.
4. Build the circuit for testing the functioning of DIAC and prepare a report.
5. Build and test the circuit: R triggering of SCR and prepare a report.
6. Build and test the circuit: RC triggering of SCR and prepare a report.
7. Build and test the circuit: UJT as relaxation oscillator and prepare a report.
8. Build and test the circuit: light dimmer using TRIAC and prepare a report.
9. Simulate the step down dc-dc converter and prepare a report.
10. Simulate the step up dc-dc converter and prepare a report.
11. Simulate the single phase half wave or full wave controlled rectifier and prepare a report.
12. Simulate single phase or three phase inverter and prepare a report.
13. Simulate single phase cycloconverter and prepare a report.
14. Simulate single phase dual converter 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	Power Electronic Devices	6	C	2	4	4	10
			O	2	4	0	6
2	Silicon controlled rectifier	9	C	2	8	4	14
			O	0	4	4	8
3	Phase controlled rectifiers	8	C	2	4	6	12
			O	0	0	6	6
4	Choppers	8	C	2	4	6	12
			O	0	4	0	4
5	Inverters	8	C	2	4	6	12
			O	0	4	6	10
6	Applications of Power Electronics	6	C	0	4	6	10
			O	2	4	0	6
Total		45	C	10	28	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	5R2	6R2	1R2	5	7
2	1U4	2U4	3U4	1U4	2U4			3	5
3	4U4	5U4	2U4	4U4	6U4			3	5
4	6U4	1A4	2A4	2A4	5U4			3	5
5	3A6	4A6	3A6					2	3
6	5A6	6A6	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	Selection of topic	5
2	Performance/Simulation/Fabrication	10
3	Report writing	5
4	Demonstration	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	-	3	3	-	-
CO2	3	-	-	3	-	3	3	-	-
CO3	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	Power Electronics	Dr. P. S. Bhimbhra, khanna publishers	13: 978-8174092793
2	Power Electronics	M D Singh, K B Khanchnadani, McGraw Hill Education,	13: 9780070583894
3	Power Electronics: Devices, Circuits, and Applications	Muhammad H. Rashid, Pearson Education	13: 978-8120345317
4	Power Electronics-Converters, Applications and Design	Ned Mohan, T. M. Undeland, W. B. Robbins, John Wiley & Sons	13: 9788126510900

XV e-References:

1. https://nptel.ac.in/courses/108102145, Course on Power Electronics by IIT Delhi
2. https://nptel.ac.in/courses/108105066, Course on Power Electronics by IIT Kharagpur
3. https://nptel.ac.in/courses/108101038, Course on Power Electronics by IIT Bombay
4. https://ocw.mit.edu/courses/6-334-power-electronics-spring-2, Course on Power Electronics by MIT Opencourseware

XVI List of Major Equipment/Machineries with Specification:

1. SCR: 25RIA120, TYN612, or equivalent.
2. Power Mosfet: IRFP250N or equivalent.
3. IGBT: IRG4BC20U, G4PH50UD or equivalent.
4. Isolation Transformer: 1kVA, 230/230V or equivalant.
5. CRO/DSO with probes: 20MHz, dual channel, sensitivity = 1mV/div., Max Input = 600V, Power supply = 230VAC.
6. Clamp on meter: Current = 0 to 400A, Voltage = 0 to 600V.
7. Multimeter: 2000 count digital display, 1000V DC/750 V AC ranges, 10 A AC/DC ranges.

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
2	Dr. P. M.Daigavane	HoD, Electrical Engineering	G.H.Raisoni College of Engineering, Nagpur
3	Mrs. Divya Piprode	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	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
6	Mr. J. K. Pandit	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

(Mr. M. C. Musale)
HOD & Chairman PBOS, EE

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

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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 EE
Course Category	:	DSC
Course Code	:	EE302H
Course Title	:	Testing & Maintenance of Electrical Machines

I Rationale:

Most of the electrical engineers are working either in industries or state electricity board as supervisor/executive. They have to understand instructions from superiors and pass on the same to the skilled workers working under them, during installation; testing & maintenance work in these areas. The work that is encountered in industry/electricity board consists of erection, installation as well as testing and maintenance requires the knowledge of installation, testing and maintenance of various electrical equipments.

II Industry Identified Competency:

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

Prioritize safety in electrical engineering practices and adhere to established safety protocols.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Follow** safe practices to prevent electrical accidents while using electrical equipments.

CO2: **Perform** various tests on electrical machines.

CO3: **Maintain** electrical machines.

CO4: **Troubleshoot** AC and DC machines.

CO5: **Maintain** insulation system of electricaal equipments.

CO6: **Select** proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers.

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

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
: Electrical safety and prevention of accident.	1a	Justify the safety actions for the given situation.	1.1	Concept of electrical safety, electrical accident, its causes & preventions. Safety signs and symbols used in industry.	CO1
	1b	Compare given method of artificial respiration.	1.2	Electrical shocks and its treatments. Artificial Respiration- Schaefer's method, Sylvester's method, mouth to mouth respiration Procedure of artificial respiration.	
	1c	Prepare Dos and Donts for operator working in substation/ powerstation.	1.3	Dos and donts regarding safety in domestic electrical appliances as well for substation/ power station operators.	
	1d	Justify the procedure of permit of given situation.	1.4	Concept of permit system and its preparation and regulation for attending to electrical work in substations. Electrical safety as per indian electricity rules.	

UNIT I	1e	Select given types of fire extinguisher for specified applications.	1.5	Electrical safety in industry/ power stations / substations at the time of operation/ control/maintenance , operation of fire extinguisher, classification of fire extinguisher and fire-fighting equipments.	
UNIT II: Testing of electrial machines	2a	Compare the types of test on basis of given points.	2.1	Concept of testing, objectives of testing and Roles of Indian Standard Specifications in testing of electrical equipment.	CO2
	2b	Calculate various parameters of DC machines using various tests based on data.	2.2	Types of tests- routine tests, type tests, supplementary test and special tests. Methods of testing-Direct / Indirect/Regenerative testing.	
	2c	Justify the given type of testing of transformer.	2.3	Testing of transformer as per indian standard- Open circuit test, Short circuit test, Polarity test, Phasing out test, Insulation resistance test, Impulse test, HV test, Temperature rise test and tests before comminsioning of trasnformer.	
	2d	Justify the given type of testing of three phase induction motor.	2.4	Testing of three-phase Induction motor as per Indian Standards.- Measurement of DC resistance, Measurement of insulation resistance, High voltage test, No load test, Open circuit voltage ratio test, Reduced voltage running up test, Locked rotor test, Measurement of slip, Momentary overload test.	

	2e	Justify the given type of testing of single phase induction motor.	2.5	Testing of single-phase induction motor as per Indian Standards.- Resistance measurement, Insulation resistance test, High voltage test, Quiet running test, No load test, Locked rotor test, Load test, Temperature rise test, Momentary overload test, Leakage current test.	
UNIT III: Maintenance of electrical machines	3a	Compare the given types of maintenance on basis of given points.	3.1	Concept of maintenance, types of maintenance Routine, preventive & breakdown maintenance.	CO3
	3b	Justify the given factor affecting preventive maintenance.	3.2	Causes of failure of electrical machines, Preventive maintenance- advantages and procedure for developing preventive maintenance schedules for electrical machines and Factors affecting preventive maintenance schedule.	
	3c	Classify given types of faults.	3.3	Identification of different types of faults developed such as mechanical, electrical and magnetic faults due to poor maintenance.	
	3d	Prepare preventive maintenance schedules for given electrical machines.	3.4	Maintenance schedules of the following as per Indian Standards. Distribution transformer, Power transformer Single phase induction motors, three phase Induction motors, Synchronous machines and Batteries.	
	3e	Chose given tool for given type of maintenance.	3.5	Maintenance tools such as bearing puller, filler gauges, dial test indicator, spirit level, megger, earth tester and growler.	
electrical	4a	Justify the limits of given parameters for safe operation of electrical machines.	4.1	Limits of voltage, current, frequency and speed for safe working of electrical machines.	

UNIT IV: Troubleshooting of machines	4b	Identify the causes for given types of failure of equipments.	4.2	Internal & external causes for failure/ abnormal operation of equipments.	CO4
	4c	Suggest the reason and remedies for given type of fault.	4.3	List of mechanical faults, electrical faults and magnetic faults in the electrical equipments and remedies.	
	4d	Prepare trouble shooting chart for given machine.	4.4	Preparation of trouble shootingcharts for D.C. Machines, AC Machines & Transformers.	
UNIT V: Testing and reconditioning of insulating material	5a	Classify given insulating materials.	5.1	Factors affecting life of insulating materials, classifications of insulating materials as per IS:8504-1994	CO5
	5b	Predict the condition of insulation failure from given data.	5.2	Measuring insulation resistance by different methods such as i)Polarization, ii) Dielectric absorption, iii) Megger and to predict the condition of insulation.	
	5c	Use given reconditioning methods.	5.3	Reconditioning of insulation-cleaning and drying the insulation, re-varnishing, vacuum impregnation.	
	5d	Choose the given method of testing oil as per Indian Standards.	5.4	Insulating oil-properties of insulating oil, causes of deterioration of oil, testing of transformer oil - acidity test, crackle test, flash test, fire test and dielectric test. purification of insulating oil.	
and Erection	6a	Justify the requirement of foundation for given electrical machines.	6.1	Concept of foundation for installation of machinery, Requirements of foundation for static & rotating electrical machinery.	
	6b	Use the leveling and alignment procedure for erection of given motor.	6.2	Concept of leveling and aligning, procedure for leveling and aligning, alignment of direct coupled drive, effect of misalignment.	

UNIT VI: Installation &	6c	Apply indian standard prodecure for installation of given type of transformer.	6.3	Installation of transformer as per indian standards & procedure of installation of transformer, Requirements of installation of pole mounted transformer.	CO6
	6d	Apply indian standard prodecure for installation of given type of rotating machines.	6.4	Requirements of installation of rotating electrical machines as per indian standards, Devices and tools required for loading, unloading, lifting, and carrying heavy equipments & precautions to be taken while handling them.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Demonstrate sylvester and schaefer types of artificial respiration on dummy.	2#	CO1
I	2	Use fire extinguisher on fire.	2#	CO1
I	3	Prepare a permit for obtaining shutdown or maintenance related activities.	2#	CO1
II	4	Measure impedance of three-phase transformer.	2#	CO2
II	5	Measure load losses of three phase transformer.	2#	CO2
II	6	Perform open circuit voltage ratio test on the three phase induction motor.(as per relevant IS)	2#	CO2
II	7	Perform phasing out test on three phase transformer.(as per relevant IS)	2#	CO2
II	8	Perform polarity test on three phase transformer.(as per relevant IS)	2	CO2
II	9	Find regulation and efficiency of single-phase Transformer by direct loading test.	2#	CO2
II	10	Perform regulation and efficiency of single-phase transformer by back-to-back connection method.	2#	CO2
II	11	Perform reduced voltage running up test on three-Phase Induction motor. (as per relevant IS)	2#	CO2
II	12	Determine efficiency of D.C. machine by Swinburn’s test.	2#	CO2
II	13	Determine efficiency of D.C. machine by Hopkinson's test.	2#	CO2
II	14	Perform no load test on single phase Induction Motor for the measurements of no load current, at rated voltage. (as per relevant IS)	2#	CO2
III	15	Prepare the maintenance schedule chart for single phase induction motor as per relevent IS.	2	CO3
III	16	Prepare the maintenance schedule chart for three phase induction motor as per relevent IS.	2#	CO3
III	17	Prepare the maintenance schedule chart for three phase transformer as per relevant IS.	2#	CO3
III	18	Use different maintenance tools such as bearing puller, growler, dial test indicator, filler gauge, spirit level etc.	2#	CO3

IV	19	Prepare troubleshooting chart and perform troubleshooting on three phase induction motor.	2	CO4
IV	20	Prepare troubleshooting chart and perform troubleshooting on single phase transformer.	2#	CO4
IV	21	Prepare troubleshooting chart and perform troubleshooting on three phase transformer.	2#	CO4
IV	22	Prepare troubleshooting chart and perform troubleshooting on DC motor.	2	CO4
V	23	Perform polarization test on insulating material.	2#	CO5
V	24	Perform insulation resistance test on induction motor.	2#	CO5
V	25	Perform insulation resistance test on transformer.	2#	CO5
V	26	Check the conditioning of insulation. (Cleaning and Drying)	2#	CO5
V	27	Perform crackle test on insulating oil as per relevent IS.	2	CO5
V	28	Determine Breakdown Strength of Transformer Oil by using Oil Testing Kit.	2#	CO5
VI	29	Check the leveling of foundation of electrical machine.	2#	CO6
VI	30	Check the leveling and alligning of direct coupled drive.	2	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Prepare a report/poster of any one method of artificial respiration.
2. Prepare a poster of electrical safety signs and symbols.
3. Prepare a poster of various types of fire extinguishers showing its application.
4. Carry out preventive maintenance on any one machine in lab and prepare report on it.
5. Perform electrical maintenance related activity in given area of college campus and submit report.
6. Prepare a market survey report on three phase induction motor.
7. Collect sample of various class of insulating material and prepare report on it.
8. Prepare power point presentation related to D.C. Machines.
9. Prepare any one micro-project based on curriculum content.

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 safety and prevention of accident.	6	C	02	04	04	10
			O	02	04	00	6
2	Testing of electrial machines	14	C	02	04	10	16
			O	00	04	10	14
3	Maintenance of electrical machines	5	C	02	04	06	12
			O	00	04	00	4
4	Troubleshooting of electrical machines	6	C	02	04	04	10
			O	00	00	06	6
5	Testing and reconditioning of insulating material	7	C	02	04	06	12
			O	00	00	04	4
6	Installation and Erection	7	C	00	04	06	10
			O	02	04	00	6
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	3U4	1U4	2U4			3	5
3	1A4	2A4	4U4	3U4	2A4			3	5
4	5U4	4A4	6U4	5A4	6U4			3	5
5	2A6	3A6	2A6					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	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/skill	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	-	-	3	3	-	3	-	-
CO2	3	-	-	3	3	-	3	-	-
CO3	3	-	-	3	3	-	3	2	-
CO4	3	-	-	3	3	-	3	2	-
CO5	3	-	-	3	3	-	3	2	-
CO6	3	-	-	3	3	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Operation & Maintenance of Electrical Equipments Vol-I	BV S Rao, AsiaClub House, First Reprint, 2011	10: 8185099022
2	Design & Testing of Electrical Machines	M. V. Deshpande. PHI Learning Pvt.Ltd., 2010	10: 8120336453, 13: 9788120336452
3	Installation, Maintenance and Repair of Electrical Machine	M. Gupta, S.K. Kataria & Sons, Edition 2014	10:9350145464; 13:978-9350145463
4	Maintenance & Repairs	Rosenberg, McGRAW-HILL, 1st Edition, May 2003	13: 9780071396035

XV e-References:

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2. https://www.youtube.com/watch?v=IIGhKLdCk7U, accessed on 25th Dec 2024
3. https://www.youtube.com/watch?v=QK5dMp43NJE,accessed on 25th Dec 2024
4. https://www.youtube.com/watch?v=2o6tB4H04Mw,accessed on 25th Dec 2024

XVI List of Major Equipment/Machineries with Specification:

1. Oil testing kit.
2. Three-phase induction motor.
3. Theee-phase transformer.
4. Theee-phase auto transformer.
5. DC shunt motor.
6. Single phase induction motor.
7. Single phase transformer.

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
2	Dr. P. M. Daigavane	HoD, Electrical Engineering	G.H Raisoni College of Engg, Nagpur
3	Mrs. Divya Piparode	Sr. Engineer	Powerngrid Corporation of India Ltd., Nagpur
4	Mr. M. N. Gawande	Lecturer, Electrical Engineering	Government Polytechnic, Gondia
5	Dr. G. V. Gotmare	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur
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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSE
Course Code	:	EE303H
Course Title	:	Energy Conservation & Audit

I Rationale:

Incorporating energy conservation and audit into educational programs is essential for addressing current energy challenges. It equips individuals with the knowledge and skills to drive efficiency, achieve economic savings, and contribute to environmental sustainability. By emphasizing these subjects, we not only prepare a workforce capable of tackling energy issues but also foster a culture of responsible energy use that benefits both society and the planet.

II Industry Identified Competency:

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

Optimize energy usage and promote energy efficiency in electrical systems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** energy conservation techniques in lighting system.

CO2: **Apply** energy conservation techniques for induction motors and transformers.

CO3: **Suggest** energy conservation techniques for reducing losses in transmission line.

CO4: **Suggest** suitable energy conservation techniques for industries.

CO5: **Apply** remedies for reducing environmental pollution.

CO6: **Prepare** energy audit report for electrical installation system.

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: Energy Conservation in Lighting Systems	1a	Identify role of given Govt. body in energy conservation	1.1	Need of energy conservation, Energy Conservation Act 2001, Energy Conservation Ammendment Bill 2022, role of BEE, MEDA, MNRE in energy conservation.	CO1
	1b	Select suitable luminaries for given conditions.	1.2	Recommended Luminance Levels as per National Lighting Code 2010 SP 72:2010.	
	1c	Assess lighting system for a given facility.	1.3	Procedure for assessing existing lighting system in a facility.	
	1d	Apply energy conservation techniques / methods in given lighting system.	1.4	Energy conservation techniques / methods in lighting system by- Replacing lamp sources, Using Energy efficient luminaries, Using light control gears/ circuits, Installation of exclusive transformer/servo stabilizer for lighting, Periodic survey and adequate maintenance program.	

UNIT II: Energy Conservation in motor and transformer	2a	Apply suitable energy conservation methods / techniques for given electrical motors.	2.1	Energy Conservation Methods/Techniques for ElectricaL Motors by- Improving power quality, Matching motor ratingwith required load, Minimizing idle and redundant running of motor, Operating in star mode, Rewinding of motors, Improving mechanical power transmission efficiency, Periodical maintenance.	CO2
	2b	Use various energy conservation techniques in given machines.	2.2	Energy Conservation Methods/Techniques for Electrical Motors by- Use of Energy efficient motors, Using equipments like Soft starters, Automatic power facto controller, Variable frequency drives.	
	2c	Use various energy conservation techniques in given transformer.	2.3	Energy Conservation Methods/Techniques for transformers- Using Energy efficient transformer, Using Amorphous core for Transformers, using Epoxy Resin cast / Encapsulated Dry type Transformer, Periodic maintenance	
UNIT III: Energy Conservation in Transmission and Distribution Systems	3a	Identify technical losses in given transmission and distribution system.	3.1	Indian Electricity Act 2003, Energy Conservation opportunities in Transmission and Distribution Systems by - Overcoming technical losses, Reducing commercial losses	CO3
	3b	Compare given energy conservation techniques for transmission and distribution Systems on given points.	3.2	Energy Conservation opportunities in Transmission and Distribution Systems by - Compensating Reactive power flow, Demand side management, Optimization of system voltage, Balancing of phase currents.	

UNIT IV: Energy Conservation in Industries	4a	Identify type of given consumer.	4.1	Classification of Consumers- Low Tension and High Tension, Recent Maharashtra State Electricity Distribution company Limited tariff structure.	CO4
	4b	Calculate electric bill using given tariff system.	4.2	Application of Tariff System to reduce Energy bill, Energy Conservation in industry by- TOD tariff, Power factor tariff	
	4c	Suggest measures for reducing losses in given industries using different measures.	4.3	Energy Conservation in industry by- Improving load factor, using Maximum Demand Controller	
	4d	Identify energy conservation opportunities in given system.	4.4	Energy conservation opportunities in Pumping Systems.	
	4e	Apply different measures for saving energy in given equipment.	4.5	Tips for energy saving in fans and blowers and DG sets.	
UNIT V: Co-generation and Environmental Issues	5a	Justify need of Co-generation in given system.	5.1	Need for cogeneration. Classification of Cogeneration Systems on the basis of the sequence of energy use.	CO5
	5b	Select cogeneration system based on given factors.	5.2	Topping cycle cogeneration system, Bottoming Cycle cogeneration system, Advantages of cogeneration, Factors governing selection of cogeneration Systems.	
	5c	Suggest remedy for given environmental issue.	5.3	Relation between Energy and Environment. Environment and social concerns related to energy generation. Global Environmental issues, Causes and effects of Ozone layer depletion, causes, effect and remedy for Global warming, The Green House Gas effect. .	

UNIT VI: Energy Audit	6a	Use given energy audit method for specified application.	6.1	Energy audit, need, types, Energy audit instruments and their use. Procedure of Energy audit (walk through audit & detailed audit.)	CO6
	6b	Identify role of energy manager for given energy system.	6.2	Energy Management, role of energy manager.	
	6c	Calculate payback period and Return on Investment based on given data.	6.3	Calculation of Payback period and Return on Investment , ABC analysis.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Calculate energy saving by using electronic ballast as compared to conventional chokes.	2#	CO1
I	2	Calculate energy saving in lighting system by retrofitting tube lights with LED lamps.	2#	CO1
I	3	Identify star labelled electrical apparatus and compare data for various star rating.	2#	CO1
II	4	Prepare a report on energy conservation in a given energy efficient motor based on design, material etc.	2#	CO2
II	5	Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.	2#	CO2
II	6	Determine the saving in energy by using soft starter in place of conventional starter for three-phase induction motor.	2#	CO2
II	7	Simulate the the saving in energy in transformer by replacing a CRGO core by amorphos core.	2	CO2
III	8	Prepare a report on energy conservation opportunities in transmission and distribution systems.	2#	CO3
IV	9	Prepare a report on energy conservation opportunities in a small scale industry.	2	CO4
IV	10	Collect electrical bill of a commercial consumer and suggest suitable tariff for conservation and reduction of its energy bill.	2	CO4
IV	11	Collect electrical bill of a residential consumer and suggest suitable measures for conservation and reduction of its energy bill.	2#	CO4
V	12	Prepare a report on energy conservation by co-generation systems.	2#	CO5
VI	13	Use power guard meter for measurement of different electrical quantities.	2#	CO6
VI	14	Measure illumination level of working place with the help of Digital Lux Meter.	2#	CO6
VI	15	Perform Energy audit of any electrical installation.	2#	CO6
VI	16	Calculate payback period of lighting installation.	2	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Carry out internet survey to collect information releted to energy conservation project and submit report.
2. Collect the catalogues of any electrical star labeled equipment and prepare comparative analysis.
3. Prepare report on performence of motor after rewinding.
4. Prepare comparative analysis of energy efficient motors available in market.
5. Prepare comparative analysis of energy efficient transformers available in market.
6. Collect information about energy efficient luminaries and prepare comparative analysis.
7. Summerise salient features of energy conservation act 2001 and its ammendment 2022 and submit report.
8. Prepare energy audit of any electrical installation and submit report.
9. Collect literature on energy conservation and enviromental issues and submit report.
10. Collect recent tarrif structure of MSEDCL for LT consumer and prepare detailed report.
11. Collect recent tarrif structure of MSEDCL for HT consumer and prepare detailed report.
12. Prepare any micro-project based on curriculum content.

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	Energy Conservation in Lighting Systems	6	C	00	04	06	10
			O	04	00	04	8
2	Energy Conservation in motor and transformer	11	C	04	00	10	14
			O	00	08	00	8
3	Energy Conservation in Transmission and Distribution Systems	6	C	04	04	04	12
			O	00	04	00	4
4	Energy Conservation in Industries	10	C	04	08	00	12
			O	02	00	06	8
5	Co-generation and Environmental Issues	6	C	00	04	06	10
			O	02	04	00	6
6	Energy Audit	6	C	02	04	06	12
			O	00	00	06	6
Total		45	C	14	24	32	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	1R2	1R2	5R2	5R2	6R2	4R2	3R2	5	7
2	3R4	1U4	5U4	2R4	1U4			3	5
3	4U4	3U4	6U4	2A4	1A4			3	5
4	3U4	6U4	5A4	2U4	4U4			3	5
5	4A6	1A6	6A6					2	3
6	2A6	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	Drawing circuit diagram, selection of equipment	5
2	Performance	10
3	Calculation, Result, Drawing Graphs (if any)/ report preperation	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	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	-	2	1	-	-	-	-
CO2	3	-	-	2	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-
CO5	3	-	-	-	1	-	-	-	-
CO6	3	1	-	2	-	1	1	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Energy Management Handbook	Stephen A. Roosa, Steve Doty, Wayne C. Turner, River Publishers; 9th Edition, 2018	13: 978-1138666979
2	Guide Books No. 1 & 3 for National Certification Examination of Energy Managers and Energy Auditors	Beureau of Energy Efficiency, (BEE), Fourth Edition, 2025	-
3	Energy Management and Conservation	K. V. Sharma, P. Venkataseshaiah, I K International Publishing House Pvt. Ltd, 2013	13: 978-9381141298

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1. https://aipnpc.org/Guidebooks.aspx , accessed on 30th December, 2024
2. https://www.indiacode.nic.in/bitstream/123456789/2003/1/A2001-52.pdf , accessed on 30th December, 2024
3. https://www.4cleanair.org/wp-content/uploads/Documents/Chapter_10.pdf , accessed on 30th December, 2024
4. https://www.youtube.com/watch?v=qG7SlVfAuPA , accessed on 30th December, 2024

XVI List of Major Equipment/Machineries with Specification:

1. Electronic Ballast
2. Lux meter
3. Power Guard meter
4. Energy audit equipments

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 Piprode	Sr. Engineer	Power Grid Corporation of India, Nagpur
4	Mr. M. N.Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
5	Ms. Puja Rithe	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
6	Dr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSE
Course Code	:	EE304H
Course Title	:	Illumination Engineering

I Rationale:

Electrical engineering students should develop skills in the field of illumination engineering. This course is intended to teach the students various aspects of Illumination scheme .Student will be in a position to apply principles & laws of Illumination & Illumination schemes. This course imparts the concept, principle and design of illumination schemes. After completion of this course diploma engineering students will able to design and installed recent trends in illumination engineering and work as supervisor in this field.

II Industry Identified Competency:

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

Select suitable Illumination level & luminaries given lighting applications.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Apply** different laws, terminologies related to Illumination engineering to different applications.

CO2: **Select** suitable luminaries for different applications.

CO3: **Select** the lighting accessories required for selected wiring scheme

CO4: **Select** appropriate control gear for selected Illumination scheme

CO5: **Design** Illumination Scheme for Indoor Installation

CO6: **Design** Illumination Scheme for Outdoor Installation

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
mentals of Illumination	1a	Examine the properties of different types of light and light theories.	1.1	Electromagnetic spectrum, Types of lights: Visible light, Ultraviolet light, Infrared light. Theories of Light: Reflection of Light, Refraction of Light., Double Refraction.	CO1
	1b	Apply various terminologies to calculate given parameters of Illumination.	1.2	Terminology Used in Illumination Such As- Light, Luminous Flux, Solid Angle, candle power, Luminous Intensity, Radiant efficiency, Luminous Efficacy of Source and Radiation, Lumen, candle power, plane angle, solid angle, mean horizontal candle power (MHCP), mean spherical candle power (MSCP), Illumination or Luminance, Lux, Space-Height Ratio, Utilization Factor, Depreciation Factor. Calculation of flux and luminous efficiency.	

UNIT I: Fundar	1c	Use laws of illumination to calculate illumination at given location.	1.3	Laws of Illumination-Inverse Square Law, Cosine Law Factors affecting the illumination and advantages of good lighting scheme. Calculation of illumination based on Laws of illumination.	
	1d	Use polar curve and photometry for given applications.	1.4	Polar curve: Its meaning, application of polar curve for designing the illumination and concept of photometry.	
	1e	Apply the standards of illumination while designing given illumination scheme.	1.5	Standards of illumination: Role of lighting standards and regulation of illumination. Organizations used to decide lighting standards for different occupancies. Factors affecting the lighting standards.	
UNIT II: Lamps and Lighting Accessories	2a	Classify given lamps.	2.1	Classification of lamps: Construction of-Fluorescent lamp, Arc lamp: DC carbon arc lamp, AC carbon arc lamp, Flame arc lamp.	CO2
	2b	Analyze the performance of given type of lamps.	2.2	Other lamps: Construction, working principle, advantages, disadvantages and application-LED lamp, CFL lamp, Neon lamp, Metal halide lamp.	
	2c	Compare given luminaries on given points.	2.3	Comparison between lamps on the basis of color of light, lumens per watt, life in hours, maintenance, cost etc.	
	2d	Select the relevant mounting arrangement for the given light source.	2.4	Selection criterion for lamps	
nes and Methods	3a	Select the appropriate lighting scheme as per given conditions and application.	3.1	Design consideration of good lighting scheme. Lighting schemes: selection of lamp, illumination efficiency, glare and power consumption- Direct & Indirect, semi direct & semi-indirect, General lighting scheme.	

UNIT III: Lighting scher	3b	Calculate average illumination on floor using appropriate lighting calculation method.	3.2	Lighting calculation methods: Watt per square meter method, Lumens or light flux method, Point to point method. calculation of average illumination on floor.	CO3
	3c	Prepare illumination auditing plan for given installation.	3.3	Illumination auditing: definition, objective of illumination auditing, process of illumination auditing and factors considered in illumination auditing.	
UNIT IV: Illumination Control and Control Circuits	4a	Select the relevant lighting control method for given luminaries.	4.1	Purpose and principle of lighting Control, energy Benefits of Light Control-Types of lighting control: Working principle and operation, Dimmer: Resistance type dimmer, Salt water dimmer. Dimmer Transformer: Auto transformer dimmer, Two winding transformers dimmers	CO4
	4b	Select the given type of electronic dimmer for specified application.	4.2	Electronic Dimmer: Working principle and operation: Thyristor operated dimmer, Triac operated dimmer.	
	4c	Compare given light control methods on given points.	4.3	Methods used for light control: Manual Control, Automatic Control. Manual Control-On /Off from single or multiple Positions using fixed switches, On /Off / dimming from fixed switch position- time switch, Daylight sensor.	
	4d	Draw given control circuits for lamps.	4.4	Control circuits for lamps:single lamp controlled by single switch, two switches. Single Lamp control by two point's method, three-point method & four-point method.	
ation	5a	Apply the given standards of interior illumination.	5.1	Standards for various situations/locations of Interior Illumination: Residential, Educational, Commercial, Healthcare, Industrial.	

UNIT V: Design Of Illumination Scheme for interior Applic	5b	Design illumination scheme for given unit.	5.2	Lighting design objectives. Design considerations for Interior location of Residential, Commercial, Industrial premises. Design Illumination scheme for different Interior locations of Residential, Commercial, Industrial unit. Commercial- Lighting Layouts, Lighting requirements for shop interiors, illumination level required for shop/mall. Residential- Illumination level required for different areas of home, numerical based on design. Industrial-General Considerations of design for lighting.	CO5
	5c	Use recent advancement in interior lighting for specified applications.	5.3	Recent advancement in interior lighting. Key aspects of Hunam-Centric Lighting (HCL), Smart lighting integration: IoT intergration, Remote Control, Advanced lighting: OLED lighting, Laser ligthing, Micro LEDs etc.	
esign Of Illumination Scheme for Outdoor Installation	6a	State general and specific requirement of outdoor lighting scheme.	6.1	General and specific Requirements for Lighting Schemes.	CO6
	6b	Recommond illuminace level for given outdoor places.	6.2	Outdoor factory Lighting-General Lighting Requirements and types of installation, Recommended Values for Illuminance.	
	6c	Select appropriate design methods for street lighting.	6.3	Street Lighting-Main objects of street lighting, Types of fixtures used and their suitable application, Lamp and Luminaries selection, illumination level for street lighting and mounting height of lamps, Different Design Procedures, Beam Lumen Method, Point by Point Method-calculate average luminance on the road surface.	

UNIT VI: D	6d	Distinguish between given types of lightings.	6.4	Other Lighting: Concept - Flood lighting, Lighting for advertisement, Agriculture and horticulture lighting, Garden lighting

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Measure average Illumination level of machine laboratory/computer laboratory by lux meter.	2#	CO1
I	2	Conduct Illumination assessment in work place by using lux meter.	2	CO1
I	3	Interpret the polar curve of a given type of lamp and verify it using the lux meter.	2	CO1
II	4	Estimate and compare luminous efficiency of compact fluorescent lamp(CFL) and LED lamp.	2#	CO2
II	5	Compare performance of electronic ballast used in fluorescent tube light & LED tube and estimate the energy saving with electronic ballast.	2#	CO2
II	6	Prepare a report of luminaries available in the market & collect the technical data-visit local market/use internet for data collection	2	CO2
II	7	Evaluate performance of 40/60/100-watt incandescent lamp, 8/12-watt CFL and 6–7-watt LED lamp.	2#	CO3
II	8	Measure illumination received exactly underneath 10/18-watt CFL, 60 watts fluorescent and 10/18-watt LED lamp and when surface is moved horizontally uses laws of illumination.	2#	CO3
III	9	Fit the given lamp in selected mounting.	2#	CO3
III	10	Prepare a report of illumination auditing.	2	CO3
IV	11	Identify the given type of dimmer transformer and their parts after watching the video and prepare a report	2#	CO4
V	12	Identify the given type of dimmer transformer and their parts after watching the video and prepare a report	2#	CO5
V	13	Design an illumination scheme for 1 BHK flat.	2#	CO5
V	14	Prepare a report of recent advancements in indoor lighting	2	CO5
V	15	Design an illumination scheme for a medium size workshop.	2#	CO5
V	16	Design an illumination scheme for street lighting.	2#	CO5
VI	17	Design an illumination scheme for flood lighting.	2#	CO6
VI	18	Prepare visit report on luminaries used in platform by visiting Nagpur metro rail station and draw layout.	2	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Collect specifications of different illumination schemes used in various units and prepare a technical report.
2. Calculate load current and illumination level for certain lighting scheme and submit report.
3. Prepare report on different advance luminaries available in market with their specification and prepare report.
4. Develop a dimmer circuit to control the brightness of lamp.
5. Prepare report on different dimmer circuit available in market.
6. Prepare a report of safety precautions which are to be taken while working with different illumination scheme.
7. Prepare a report on the IS codes used for lighting.
8. Prepare visit report of the metro station / railway station/garden/photo studio for illumination schemes and luminaries used.
9. Prepare a report on Light Pollution: A Case Study in Framing an Environmental Problem
10. Prepare a report on methodology of Lighting System Energy Efficiency Study.

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 Illumination	8	C	02	04	06	12
			O	00	04	04	8
2	Lamps and Lighting Accessories	8	C	02	04	06	12
			O	04	02	00	6
3	Lighting schemes and Methods	8	C	02	04	06	12
			O	00	00	06	6
4	Illumination Control and Control Circuits	8	C	02	00	10	12
			O	00	08	00	8
5	Design Of Illumination Scheme for interior Application	8	C	04	04	04	12
			O	02	04	00	6
6	Design Of Illumination Scheme for Outdoor Installation	5	C	02	08	00	10
			O	00	00	06	6
Total		45	C	14	24	32	70
			O	6	18	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	2U2	5R2	5	7
2	1U4	3U4	5A4	1U4	1A4			3	5
3	5R4	5U4	2U4	5U4	2R4			3	5
4	6U4	6U4	4A4	4U4	4U4			3	5
5	1A6	2A6	3A6					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	Diagrams	5
2	Performance	10
3	Result	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/skill	10
3	Report writing	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	3	-	-
CO2	3	-	-	1	-	-	3	-	-
CO3	3	-	-	1	2	3	3	-	-
CO4	3	1	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	1
CO6	3	-	-	-	-	-	-	-	1

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Applied Illumination Engineering	Jack L. Lindsey, Publisher: Fairmont Pr; 2nd edition, 1996.	10: 0881732125 13: 978-0881732122
2	Lighting Engineering: Applied calculations	R.H. Simons, Robert Bean	10: 0750650516
3	Handbook of Applied photometry	Casimer M. Decusatis	10: 1563964163
4	Illuminating Engineering	Kamlesh RoyPublisher: Laxmi PublicationYear of publishing: 2006	13: 9789380386553
5	Electrical Estimating and costing	Surjitsingh, DhanpatRai& co., 2011 Edition.	13-1234567150995
6	Electrical Design Estimating and Costing -	K.B. Raina and Dr. S.K.Bhattacharya New Age International Ltd., First Edition, 1991, Reprint 2011	10: 81-224-0363-8 13: 978-81-224-0363-3
7	National Lighting Code 2010, SP: 72 (2010)	Bureau Of Indian Standards, New Delhi, 2010	-

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2. www.lightinglab.fi/IEAAnnex45/guidebook/6_lighting%20control.pdf, assessed on 5th October, 2024
3. https://sebringdesignbuild.com/top-trends-in-interior-lighting-design/ assessed on 06102024
4. https://www.electrical4u.com/road-lighting-design/ assessed on 11th October, 2024
5. http://freevideolectures.com/Course/2344/Illumination-Engineering assessed on 11th October, 2024
6. http://electrical-engineering-portal.com/7-key-steps-in-lighting-design-process, assessed on 11th October, 2024
7. https://law.resource.org/pub/in/bis/S05/is.sp.72.2010.pdf assessed on 11th October, 2024
8. https://beeindia.gov.in/sites/default/files/3Ch8.pdfassed on 11th October, 2024
9. https://electrical-engineering-portal.com/an-example-of-calculating-the-number-of-indoor-lighting-fixturesassed on 11th October, 2024
10. https://electricalnotes.wordpress.com/2014/06/02/calculate-street-light-poles-distance-fixture-watt-lighting-area/assed on 11th October, 2024

XVI List of Major Equipment/Machineries with Specification:

1. Lux meter- Display: 3-1/2-digit 18mm LCD, Ranges: 0 - 50,000 Lux.3 ranges
2. Lighting accessories
3. Lighting fixtures
4. Lighting control gears
5. Control circuits for various Luminaries
6. Auto transformer
7. Wattmeter, voltmeter, wattmeter, energy meter
8. Magnetic ballast,electronic ballast

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
2	Dr. P. M. Daigavane	HOD, Electrical Engineering	G. H. Raisoni College of Engineering, Nagpur
3	Mrs. Divya Piprode	Sr. Engineer	Powergrid Corporation of India Ltd Nagpur
4	Shri. M N Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
5	Dr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
6	Shri. N.H.Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

(Mr. M. C. Musale)
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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 EE
Course Category	:	SEC
Course Code	:	EE351H
Course Title	:	Electrical Software & CAD

I Rationale:

The "Electrical Software and CAD" course equips diploma engineering students with essential skills in Computer-Aided Drawing (CAD), MATLAB, and Python programming. These tools are vital for designing, analyzing, and automating electrical systems in modern engineering. CAD enhances visualization and precision in drafting, MATLAB facilitates simulation and complex computations, while Python enables efficient coding for automation and data processing. This course prepares students to meet industry demands by integrating technical drawing, computational analysis, and programming, fostering innovation and problem-solving capabilities.

II Industry Identified Competency:

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

Create and interpret electrical drawings and use software in electrical engineering.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Explore** CAD Tools and Commands for Electrical Drawings.

CO2: **Draw** various electrical drawing using CAD software.

CO3: **Apply** MATLAB programming to solve electrical engineering problems and perform basic analysis.

CO4: **Simulate** electrical system models using MATLAB Simulink for performance analysis.

CO5: **Develop** Python programs to solve basic problems in electrical engineering using fundamental concepts.

CO6: **Apply** Python libraries to perform calculations and automate tasks in electrical engineering systems.

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	Install CAD software and locate components of CAD classic screen by creating new drawings CAD Screen layout, drawing area, menu and toolbar, satus bar.	2#	CO1
I	2	Explore various toolbar and commands of CAD software.	2#	CO1
I	3	Draw a line diagram using absolute coordinate method use LIMITS, UNITS, LINE, ARC Comands: Absolute coordinate method.	2#	CO1
I	4	Draw a 2D figure using Draw and Modify commands. Use LINE, CIRCLE, OFFSET, TRIM, FILLET commands.	2#	CO2
I	5	Modify two diamensinal drawings using modify commands-copy, mirror, trim, rotate, and chamfer.	2	CO2
II	6	Draw symbols of different electrical and electronic components using CAD software.	2#	CO2
II	7	Draw Single Line Diagram of the 11kV/433V distribution substation using CAD software.	2#	CO2
II	8	Draw electrical installation plan of small residential installation using CAD Software.	2	CO2
II	9	Draw single line diagram electrical installation of small residential unit using CAD Software.	2#	CO2

II	10	Use print command to produce hard copies or digital outputs of above drawings.	2#	CO2
III	11	Install MATLAB. Navigate MATLAB workspace and command window. Perform basic arithmetic operations and create simple scripts.	2#	CO3
III	12	Perform operations on matrices. Compute transpose, determinant, inverse, and eigenvalues of matrices.	2#	CO3
III	13	Create 2D plots (line, scatter, bar) and customize plots by adding titles, legends, axis labels, and grids.	2#	CO3
III	14	Develop MATLAB scripts for solving mathematical problems. Create user-defined functions with input and output arguments.	2#	CO3
III	15	Solve linear algebraic equations representing electrical circuits.	2	CO3
IV	16	Create a basic Simulink model to simulate RL, RC, and RLC circuits and analyze their transient responses.	2#	CO4
IV	17	Build a Simulink model for a single-phase transformer using an ideal transformer block and simulate the transformer under no-load and load conditions to observe input and output voltages.	2#	CO4
IV	18	Use the Simulink Induction Motor block to simulate and analyze the speed-torque characteristics under different load conditions.	2#	CO4
IV	19	Create a Simulink model to simulate the direct-on-line (DOL) and star-delta starting methods for a three-phase induction motor. Compare the starting current and torque in both methods.	2	CO4
IV	20	Simulate the dynamic braking of a three-phase induction motor and observe speed reduction and braking torque characteristics.	2#	CO4
V	21	Install Python, set up an IDE (IDLE, Anaconda, or VS Code), and execute a "Hello, World!" program.	2#	CO5
V	22	Perform operations using Python data types (int, float, string, boolean) by declaring variables and executing arithmetic calculations.	2#	CO5
V	23	Develop a program in Python using if, if-else, and elif to find the largest number among three inputs.	2#	CO5

V	24	Develop a program to generate a multiplication table using for and while loops, simulating a counting mechanism.	2#	CO5
V	25	Perform operations like adding, removing, and accessing elements in lists and tuples to manage an electrical components inventory.	2	CO5
VI	26	Create user-defined functions with arguments and return values to calculate the total resistance in a series or parallel circuit.	2#	CO6
VI	27	Develop a Python programs for string manipulation (concatenation, slicing, and formatting) to display voltage, current, and power values neatly.	2#	CO6
VI	28	Develop a Python program to create, read, and write data to a text file to save and retrieve motor specifications for electrical engineering analysis.	2	CO6
VI	29	Develop a Python program that uses try, except, and finally blocks to handle errors in user inputs while entering electrical quantities.	2#	CO6
VI	30	Perform basic array operations using NumPy to solve simultaneous linear equations for electrical circuits.	2#	CO6
VI	31	Perform matrix operations using NumPy to analyze and solve power flow equations in electrical networks.	2	CO6
VI	32	Perform Fourier transform using NumPy to analyze the frequency components of a signal in an electrical circuit.	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	Drawing work	20
2	Skill	10
3	Printout layout aesthetic	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	-	-
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	Computer Aided Electrical Drawing.	M. Yogesh, B. S. Nagaraja, N. Nandan, PHI Learning;1st Edition, 2014	13: 978-81-203-4953-7
2	AutoCAD Electrical 2021: A Tutorial Approach	Prof. Sham Tickoo, CADCIM Technologies, 2nd Edition. 2020	13: 9781640571006

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3. https://www.youtube.com/watch?v=PhfKDHIOH9Y&list=PLho7ncbqgQbviwKeoJybXPnFY5t590dRJ&index=3 assessed on 15th December, 2024
4. https://law.resource.org/pub/in/bis/S05/is.sp.30.2011.pdf assessed on 15th December, 2024

XVI List of Major Equipment/Machineries with Specification:

1. Computer Systems latest version
2. Printer, laserjet

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

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1	Mr. M. C. Musale	I/C HoD, Electrical Engineering	Government Polytechnic, Nagpur
2	Dr. P. M. Daigavane	HOD, Electrical Engineering	G.H. Raisoni College of Engineering, Nagpur
3	Mrs. Divya Piprode	Sr. Engineer	Powergrid Corporation of India Ltd. Nagpur
4	Dr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
5	Mrs. N. J. Suryawanshi	Lecturer in Electrical 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 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
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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

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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

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	:	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

(Dr. G. V. Gotmare)
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GE Courses

Sem: 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 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:

S.N.	Name	Designation	Institute / Industry
1	Dr.D.K.Parbat	HOD in Civil Engineering	Government Polytechnic, Nagpur
2	N.K.Deshmukh	Lecturer in Civil Engineering	Government Polytechnic, Nagpur
3	Mr.V.B.Dhait	Lecturer in Civil Engineering	Government Polytechnic, Nagpur
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Member Secretary 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/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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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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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
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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

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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
2	Dr. V. H. Mankar	HOD, Electronics & Telecomm. Engg.	Government Polytechnic, Nagpur
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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HOD & Chairman PBOS, EC

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

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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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1. https://nptel.ac.in/courses/106/106/106106144, accessed on 18/09/2024 assesed on 20 aug 2024
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:

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4	Mrs. V. A. Raje	System Analyst	MSBTE, RO, Nagpur
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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	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

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

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(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	:	TX391H
Course Title	:	Fashion and Garment Technology

I Rationale:

This courseis designed for the students of other than Textile Deprtment. The Fashion and Garment 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	3	-
CO3	3	-	-	-	-	-	3	3	-
CO4	3	-	-	2	-	-	3	3	-
CO5	3	-	-	2	-	-	3	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	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
6	Dr Ganesh Kakad	HOD Textile Engineering	JDIT, Yavatmal
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 / (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

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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
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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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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/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

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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
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3	Mr.P.S.Thakre	Lecturer in CM	Government Polytechnic, Nagpur
4	Dr.U.B.Aher	Lecturer in CM	Government Polytechnic, Nagpur
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7	Mrs.V.A.Raje	System Analyst	MSBTE ,RO,Nagpur

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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	:	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

(Dr. G. K. Awari)
HOD & Chairman PBOS, MK

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

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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: **Examine** latest adventure tourism activities like Astro Tourism, Space Tourism.

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: **Execute** Wildlife Tourism.

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	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	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	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	Indentify 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)

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	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	-	-
CO6	-	-	-	-	-	-	-	-	-

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:

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(Dr. P. P. Virkhare)
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Semester VI

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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSC
Course Code	:	EE305H
Course Title	:	Switchgear & Protection

I Rationale:

This course deals with Switchgear and protection systems for ensuring the safe and reliable operation of power systems. Operating skill of switchgear and protective systems are much essential for the technician working in the particular work area such as substation, grid station, switching station.They manage the distribution of electrical energy and protect against faults, such as short circuits and overloads, which can damage equipment and disrupt service. This knowledge is fundamental for maintaining system integrity and operational efficiency in real-world applications. Essential efforts are being made in this course to ensure that students develop skills in operating various controls and switchgear in power system.

II Industry Identified Competency:

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

Maintain electrical switchgears and protection systems to safeguard equipment and personnel.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Determine** the various parameters of fault KVA calculations of given faults.

CO2: **Suggest** suitable switchgears for different applications as per the requirement.

CO3: **Select** relevant protective relay for given power system protection.

CO4: **Maintain** protection systems of alternators and transformers.

CO5: **Select** suitable protection schemes for motors and bus bars for given faults.

CO6: **Choose** the appropriate protection schemes for power system components for over voltages.

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
of Faults and switchgear Protection	1a	Identify the functions of given components protective system.	1.1	Need of protection of power system, Functions of protective system, Components of Protective system, Different types of faults and their causes.	CO1
	1b	Classify given protective zones.	1.2	Concept of Protection zones and its Necessity, Classification of Protection zone - Main and backup protection, Schematic diagram of Power system protection zone.	
	1c	Select suitable current limiting reactors for the given situation with justification.	1.3	Need of current limiting reactors and their classification according to arrangements, Selection aspects of current limiting reactors.	

UNIT I: Basic Concept c	1d	Determine the given parameters of fault KVA calculations of given faults.	1.4	Fault kVA calculation - Need of fault kVA calculation, Derivation for base impedance, Fault kVA, Per unit system, Procedure of fault kVA calculation, Calculate various parameters of fault kVA calculation of given faults.	
	1e	Justify the functions of given automation system.	1.5	Introduction to Automation in electrical protection systems, Introduction of PLC & SCADA in protection systems, Role of SCADA for remote monitoring and control	
UNIT II: Circuit Breakers	2a	Select given isolator as per the application.	2.1	Isolator: Function of Isolator, Types of Isolator - Horizontal break, Vertical break, pantograph and their application.	CO2
	2b	Calculate the given parameters of arc extinction method based on given data.	2.2	Circuit Breaker: Function of circuit breaker, Classification of circuit breakers on the basis of H.T and L.T, Medium use for Arc Extinction, Arc formation process, Methods of arc extinction - High resistance Method, Low Resistance Method, Terms related to Arc Extinction - Arc voltage, Recovery voltage, Restriking voltage, RRRV, Making capacity, Breaking capacity, Short time rating and numericals based on it.	
	2c	Select the relevant H.T. circuit breakers for the given application.	2.3	H.T. circuit breakers construction and working, Advantages and disadvantages, Applications of Air blast circuit breaker, Oil circuit breaker, Vacuum circuit breaker , Sulphur-hexa-Fluoride (SF6) circuit breaker, Selection of H.T. circuit breakers	

	2d	Identify the given components of gas insulated switchgear.	2.4	Gas insulated switchgear, its merits, demerits and applications.	
	2e	Distinguish between given type of Insulation co-ordination.	2.5	Concept of Insulation Coordination : Type1 & Type2 coordination	
UNIT III: Protective Relays	3a	Calculate the given parameters of relays on given data.	3.1	Protective relay: Operation of relay, Sequence of operation of relay, Fundamental requirements of protective relay. Basic terminology - Protective relay, Relay time, Pick up, Reset current, Current setting, Plug setting multiplier, Time setting multiplier, Calculation of actual operating time of relay.	CO3
	3b	Compare given types of protective relays.	3.2	Protective relays: Classification according to different criteria. Electromagnetic type relay - Circuit diagram, Construction and working, merits and demerits. Thermal relay - Circuit diagram, Construction and working.	
	3c	Select given protective relay for power system protection with justification	3.3	Static relay - Block diagram, Contruction and working, Merit and demerits. Microprocessor based relay - Block diagram, Contruction and working, merit and demerits. Numerical relay - Block diagram, Contruction and working, merit and demerits. Selection criteria of protective relays.	
	3d	Distinguish between given relays.	3.4	Directional relay and Non directional relay : its need and operation of Directional power relay and overcurrent relay.	

	3e	Implement the suitable relay for the protection against given fault.	3.5	Distance relay - Its classification, Operating Principle and R-X Diagram of Impedance relay, reactance relay, mho relay and its application. Differential relay - Its classification, Operating Principle of different types of differential relay.	
of Alternator and Transformer	4a	Select given protection scheme for given condition.	4.1	Alternator Protection: Different abnormal conditions in the alternator, Selection of suitable protection scheme to overcome above abnormal condition.	
	4b	Calculate the percentage of winding remain unprotected on given data.	4.2	Protections to stator of alternator: Overload or Overcurrent protection, Biased differential protection for delta and star connection. Earth fault protection , Restricted earth fault protection, Stator Inter turn fault protection	
	4c	Maintain suitable protection to the rotor winding of alternator against given fault	4.3	Protection to Rotor of alternator: Rotor earth fault protection by resistance and sensitive earth fault relay, Loss of excitation or field failure protection, Rotor overheating protection. Negative sequence relay Protection.	CO4

UNIT IV: Protection	4d	Maintain suitable protection scheme against given fault into the transformer .	4.4	Transformer Protection: Types of faults in transformer, Protection system of transformer: Construction, operation of Buchholz relay, Differential protection of transformer, principle of differential protection, Biased or percentage differential Protection: different connection of biased differential protection, Earth fault protection, Combined over current and Earth Fault Protection.	
	4e	Calculate CT ratio of the specified transformer protection scheme on given data.	4.5	Selection of CT, CT connections, determination of CT ratio of the specified transformer protection scheme .	
UNIT V: Protection of Motor and Bus bar	5a	Identify the causes and remedies of the given faults in given Motor.	5.1	Protection of Motors: Different faults in motor and their remedies. Protections circuit for Induction motor.	CO5
	5b	Use the given protection scheme for high H.P. motor against given type of faults.	5.2	Protections of high HP motor- Single phase preventer, Ground Fault Protection, Phase Fault Protection, Phase and earth Fault Protection, Phase Reversal protection.	
	5c	Select busbar protection scheme for the given fault.	5.3	Busbar protection: Current differential protection of bus bar, Problems in bus zone by Differential protection, Biased differential protection of bus, Bus zone protection by directional inrterlock, Selection of CT for Buz zone Protection, Earth fault and over current protection of bus bar, Frame leakage protection.	

UNIT VI: Transmission line and overvoltage protections	6a	Select given types of protections to transmission line.	6.1	Transmission line Protection: Time graded protection -Radial feeder, Parallel feeder protection and ring mains protection. Current graded protection to radial feeder.	CO6
	6b	Select given types of protections to transmission line.	6.2	Overloading protection, Earth Fault Protection, Current balance differential pilot wire protection. Carrier current protection, Distance protection.	
	6c	Identify given types of lightening arrestors with respect to its application	6.3	Overvoltage protection: Internal causes of over voltages, Lightening phenomenon, types of lightning strokes. Construction and working of Lightening Arrestors	
	6d	Apply given concept in switchgear and protection.	6.4	Concept of AI and its Applications in electrical engineering, Different ways to improve safety and efficiency of switchgear using IOT.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify various switchgear components in the laboratory and write a report on their specifications.	2#	CO1
I	2	Test rewirable fuse/ HRC and Plot time current characteristics of re-wireble fuse.	2#	CO1
II	3	Perform the operation of MCB/MCCB under the normal and abnormal condition.	2#	CO2
II	4	Identify the components of different types of circuit breakers with their specifications.	2#	CO2
III	5	Use universal relay test kit under given faulty condition.	2#	CO3
III	6	Measure the current and time of operation of microprocessor based relay and plot its characteristic.	2#	CO3
III	7	Measure the current and time of operation of IDMT relay and plot its characteristic.	2	CO3
IV	8	Test the performance of differential Protection of Alternator on power simulation model.	2#	CO4
IV	9	Test the performance of Merz-price Protection relays of Transformer on power simulation model.	2#	CO4
V	10	Perform the Simulation of Radial Feeder Protection Unit on simulation model.	2#	CO5
V	11	Test the performance of three phase induction motor for Phase Failure protection and Phase Reversal protection.	2	CO5
V	12	Test the performance of three phase induction motor for Earth leakage fault protection and Over current fault protection.	2#	CO5
VI	13	Perform the Simulation of Transmission Line Protection with load on simulation model.	2#	CO6
VI	14	Prepare the report on various Lightening arrestors used for high voltage protection.	2#	CO6

Note: # Compulsory

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

1. Collect specifications of different switchgear equipment used in electrical power system through market survey/visit and prepare a technical report.
2. Prepare a visit report on 400 kV/ 220kV / 132 kV substation.
3. Collect data of different protective schemes used for alternator through internet/ industrial visit and submit report.
4. Perform market survey on Lightning arresters used in substation and submit report.
5. Collect data of different protective schemes used for transformer and submit report.
6. Collect data of different protective schemes used for bus bar and transmission lines and submit report.
7. Calculate load current and decide specifications of MCBs required for a load circuit of 5 kW or more and install it.
8. Prepare a report on past major grid failure in India / abroad and submit a report.
9. Perform comparative analysis of static relays / microprocessor relays and submit report.
10. Prepare any microproject based on curriculum content.

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 Concept of Faults and switchgear Protection	8	C	00	04	06	10
			O	02	04	00	6
2	Circuit Breakers	8	C	02	04	06	12
			O	00	04	00	4
3	Protective Relays	8	C	02	04	06	12
			O	02	00	06	8
4	Protection of Alternator and Transformer	8	C	02	04	10	16
			O	00	04	06	10
5	Protection of Motor and Bus bar	8	C	02	04	04	10
			O	00	04	04	8
6	Transmission line and overvoltage protections	5	C	02	04	04	10
			O	00	00	04	4
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	2R2	3R2	4R2	5R2	6R2	1R2	3R2	5	7
2	1U4	2U4	3U4	1U4	2U4			3	5
3	4U4	5A4	6A4	4U4	5U4			3	5
4	4A4	5U4	6U4	5A4	6A4			3	5
5	1A6	2A6	3A6					2	3
6	4A6	4A6	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	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	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	-	-	3	-	-	-	-	-
CO3	3	-	-	3	-	-	-	-	-
CO4	3	1	-	3	-	2	2	-	1
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	Principles of Power System	Mehta V. K; Rohit Mehta, S.Chand and Co., New Delhi, 2016.	13: 978-8121924962
2	Switchgear and Protection	Sunil S Rao, Khanna Publishers, New Delhi, 2015	13: 978-8174092323
3	Switchgear and Protection	J.B. Gupta, S. K. Kataria and Sons, New Delhi, 2015	13: 978-9350143728
4	Power System Protection and Switchgear	Ram, Badri Vishwakarma D. N, McGraw-Hill, New Delhi. 2015	13: 978-0071077743

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5. https://youtu.be/2G3CEPu2OB4, protection zones, accessed on 20th Aug 2024
6. https://youtu.be/2vUsMWqBc2g, switchgears, accessed on20th Aug 2024
7. https://youtu.be/UQE1xfcdGr4 , Protective relays, accessed on 24th Aug 2024
8. https://youtu.be/jMemjV_UxvE , protection of alternator , accessed on 24th Aug 2024
9. https://youtu.be/2n6E1vjOqso , protection of transformer, accessed on 28th Aug 2024
10. https://youtu.be/s_IrsNHv4aQ, protection of transmission line, accessed on 28th Aug 2024

XVI List of Major Equipment/Machineries with Specification:

1. Universal relay test kit
2. Microprocessor based relay test kit
3. Power simulation model of differential Protection of Alternator
4. Power simulation model of Merz-price Protection of Transformer
5. Power simulation model of three phase induction motor
6. Simulation model of Transmission Line Protection with load

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
2	Dr. P. M. Daigavane	HOD Electrical Engineering	G. H. Raisoni College of Engineering Nagpur
3	Mrs. Divya Piparode	Sr. Engineer	Powergrid Corporation of India Ltd., Nagpur
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5	Dr. G. V. Gotmare	Lecturer, Electrical Engineering	Government Polytechnic, Nagpur
6	Mr. B. D. Wadhai	Lecturer, Electrical Engineering	Government 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 EE
Course Category	:	DSC
Course Code	:	EE306H
Course Title	:	Electrical Utilization & Traction

I Rationale:

Electricity is used in industries for processes such as heating,welding,refrigeration,air-conditioning and for motive power.Also country is leading towards total railway electrification.Every diploma electrical engineer therefore shouldknow to operate and maintain electrical utilities and traction systems for their efficient operations.This course will enable the students to develop knowledge and skills to operate and maintain electrical equipments in utilities and traction systems.

II Industry Identified Competency:

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

Select and operate electrical equipments for utilities and elctric traction systems.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Select** proper electric heating & welding process.

CO2: **Select** proper electric drive motor for particular application/service.

CO3: **Identify** mechanical & electrical components of refrigerator and air-conditioner.

CO4: **Apply** principles of tariff and power factor improvement for energy conservation.

CO5: **Identify** various components of Electrical Traction Systems.

CO6: **Apply** the concept of traction dynamics of passenger train services.

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
ectrical Heating & Welding	1a	Differentiate between given modes of heat transfer.	1.1	Electric heating- Introduction, advantages, modes of transfer of heat, classification of electric heating methods.	CO1
	1b	Calculate physical dimensions of heating element for resistance heating furnace based on given data.	1.2	Resistance heating- Principle, direct & indirect resistance heating, resistance furnace, heating materials, desirable properties, design of heating element, temperature control of resistance furnace, infra-red or radiant heating, applications. Arc heating- Principle, types- Direct arc furnace, submerged arc furnace and indirect arc furnace, applications.	
	1c	Calculate rating & efficiency of induction heating furnace from given data.	1.3	Induction heating- Principle, core type and coreless induction furnace, applications, efficiency and losses. Dielectric heating- Principle, applications.	

UNIT I: El	1d	Compare Resistance & Arc welding processes based on given parameters.	1.4	Electric resistance welding- Principle, types- spot, seam, butt, projection and percussion welding, applications. Electric arc welding- Principle, types- carbon arc, shielded metal arc, atomic hydrogen arc, inert gas metal arc, submerged arc welding, applications. comparision between resistance and arc welding.	
	1e	Compare the given modern welding techniques on given points.	1.5	Modern welding techniques - Electron beam welding, ultra sonic welding, laser beam welding, applications.	
UNIT II: Electric Drives	2a	Identify components of electric drive system.	2.1	Eiectric Drive - Block diagram, main components, advantages, factors governing selection of motor for Electric Drive.	CO2
	2b	Compare types of electric braking on the basis of given points.	2.2	Electrical braking, - types, comparative advantages and disadvantages, Electric braking applied to DC shunt, DC series and three-phase induction motor.	
	2c	Identify given mechanical componets of electric drive system.	2.3	Mechanical factors - Enclosure- types, IP codes. Bearings- types,comparison. Transmission of mechanical power-methods.	
	2d	Determine rating of Electric drive motor for given load cycle.	2.4	Rating of Electric Machines,choice of rating of drive motor, calculation of rating of electric drive motor, load equalization.	
	2e	Select suitable AC & DC drive motor for particular applications and service.	2.5	Selection of Electric drive motor for industrial applications and particular service based on load characteristics and requirements.	

UNIT III: Refrigeration and air conditioning	3a	Select refrigerants for given application of refrigeration.	3.1	Vapour compression refrigeration system, refrigerants- desirable properties, refrigerants for domestic & commercial refrigeration.	CO3
	3b	Identify the given compoents of domestic refrigerator.	3.2	Domestic refrigerator- Constructional features, refrigerant used, working, Electric circuit, power rating of refrigerator.	
	3c	Identify the given compoents of Split type room air-conditione.	3.3	Air conditioning - Functions involved, Split type room air-conditioner-Constructional features, refrigerant used, working, Electric circuit, power rating of air-conditioner.	
UNIT IV: Economic Aspects	4a	Select given tarrif for specified class of consumer.	4.1	Tariff – objectives, types, type of Tariff used for residential (LT) and industrial (HT) consumers.	CO4
	4b	Justify the given method of power factor improvement and its locations.	4.2	Power factor improvement – causes of low lagging power factor, disadvantages of low power factor, methods of improving power factor & their location.	
	4c	Apply the concept of energy conservation in given type of installation.	4.3	Energy conservation – need, benefits, energy conservation opportunities in residential & industrial installations.	
	4d	Compare given types of energy audit methods on given points.	4.4	Energy audit –definition, need, types.	
	4e	Apply method of electricity theft prevention for specified theft.	4.5	Electricity Theft- Types of Electricity Theft in distribution line & service connection, methods of electricity theft prevention.	

UNIT V: Electrical Traction Systems & Power Supply Arrangements	5a	Distinguish between given types of track electrification system.	5.1	Traction systems- Electric traction system, advantages & limitations. Power supply systems of track electrification, advantages of 25 KV AC system over DC system, problems of single phase traction systems.	CO5
	5b	Identify given components of electric traction OHE.	5.2	Power supply arrangements for AC Track Electrification- Sectioning arrangement, Substation, Feeding post, SP, SSP, Elementary section. Overhead equipment (OHE)- Components of single catenary polygonal OHE, Neutral section, Insulated & Un-insulated Overlap.	
	5c	Identify given components of electric AC locomotive.	5.3	AC locomotive- Power circuit block diagram (with DC series motor and three-phase induction motor), main equipments and their functions. current collection systems.	
	5d	Differntiate between given Train Lighting System on given points.	5.4	Train lighting- requirements, methods of obtaining supply for train lighting – SG, EOG and HOG system, comparative advantages & disadvantages.	
	5e	Compare given types of EMU trains on given points.	5.5	EMU Trains- Types- MEMU, Metro, Mono rail- supply systems, benefits, schemes in India. Maglev Train- Concept, types, benefits & limitations.	
	6a	Select suitable Traction Motor for given train service.	6.1	Traction motors – desirable characteristics, Suitable motors for traction service.	

UNIT VI: Traction Motor Control & Traction Mechanics	6b	Use given type of control and braking method for DC series traction motor.	6.2	Suitability of D.C. series motor for traction duty, field control, rheostatic braking.	CO6
	6c	Use given type of control and braking method for three-phase induction traction motor.	6.3	Suitability of Three-phase Induction motor for traction duty, advantages over dc series motor , vvvf control, regenerative braking.	
	6d	Calculate given parameters of passenger train service on given data.	6.4	Speed- time curve of mainline, urban & sub-urban passenger train services, average and schedule speed, Dead,accelerating and adhesive weight, coefficient of adhesion,simplified speed-time curves.	
	6e	Calculate specific energy consumption of an Electric Train running on given schedule.	6.5	Tractive effort, propulsion of train vehicle,power of traction motors, specific energy consumption, factors affecting specific energy consumption.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Select suitable resistance heating material and design it's physical dimensions for an elecrical heating application.	2#	CO1
I	2	Operate Electric resistance heating furnace and prepare technical report on Resistance furnace and it's heating operation.	2	CO1
I	3	Operate Electrical Welding machine and prepare tecnical report on welding machine and it's operation.	2#	CO1
II	4	Control the speed of three-phase induction drive motor using VVVF control method.	2#	CO2
III	5	Identify different parts of Domestic Refrigerator & draw it's electric circuit.	2#	CO3
III	6	Identify different parts of Split type room air-conditioner & draw it's electric circuit.	2#	CO3
IV	7	Collect recent electricity tariff structure of MSEDCL and validate one LT & one HT electricity bill from tariff structure.	2#	CO4
IV	8	Prepare a report on energy conservation opportunities in Institute Workshop.	2#	CO4
IV	9	Carry out Energy Audit of Boys/Girls Hostel and prepare Audit report.	2#	CO4
V	10	Visit Electric Traction Substation: Observe various equipments and their functions.(Part I)	2#	CO5
V	11	Prepare a visit report of Electric Traction Substation and draw its single line diagram. (Part II)	2#	CO5
V	12	Visit Electric Train Lighting System Installation and identify components of systems. (Part I)	2	CO5
V	13	Prepare a visit report of Electric Train Lighting System Installation. (Part II)	2	CO5
VI	14	Visit Electric Traction Locoshed: Investigate working of each section.(Part I)	2#	CO6
VI	15	Prepare a visit report of Electric Traction Locoshed. (Part II)	2#	CO6

Note: # Compulsory

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

1. Select and design a heating element for resistance furnace used drying motor or transformer windings and submit report.
2. Prepare any utility article using metal arc welding method and submit report.
3. Prepare any utility article using spot welding method and submit report.
4. Prepare any utility article using seam welding method and submit report.
5. Prepare any utility article using projection welding method and submit report.
6. Prepare market survey on electric drives and submit report.
7. Prepare comparative analysis of domestic refrigerators available in market.
8. Prepare comparative analysis of split air conditioner available in market.
9. Prepare energy audit report of any commercial installation.
10. Prepare report on TOD tarrif applicable to HT consumers.
11. Prepare a report on emerging technologies in traction systems.
12. Prepare any micro-project based on curriculum content.

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 Heating & Welding	8	C	04	00	10	14
			O	00	08	00	8
2	Electric Drives	7	C	00	04	06	10
			O	04	00	04	8
3	Refrigeration and air conditioning	7	C	00	04	06	10
			O	02	04	00	6
4	Economic Aspects	7	C	04	04	04	12
			O	00	04	00	4
5	Electrical Traction Systems & Power Supply Arrangements	8	C	04	08	00	12
			O	02	00	06	8
6	Traction Motor Control & Traction Mechanics	8	C	02	04	06	12
			O	00	00	06	6
Total		45	C	14	24	32	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	1R2	1R2	4R2	4R2	6R2	3R2	5R2	5	7
2	5R4	2U4	4U4	2R4	1U4			3	5
3	3U4	5U4	6U4	1A4	2A4			3	5
4	5U4	6U4	4A4	1U4	3U4			3	5
5	3A6	2A6	6A6					2	3
6	1A6	6A6	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/ Report writing (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	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	2	1	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	1	-	-
CO5	3	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Utilization of Electric Power and Electric Traction	J.B.Gupta, S. K. Kataria & Sons, Reprint, 2001.	13: 978-9350142585
2	Utilization of Electric Power and Electric Traction	G. C. Garg, Khanna Book Publishing; First Edition, 2019.	13: 978-8174091642
3	Utilization of Electric Power	N.V. Suryanarayana, New Age International Publishers, Reprint 2010.	13: 978-8122405460
4	Modern Electric Traction	H.Partab, Dhanpat Rai & Co.(Pvt.)Ltd,1998	13: 1234567147206

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2. https://www.youtube.com/watch?v=qxfrdTGB9Y0 accessed on 30th December, 2024
3. https://www.youtube.com/watch?v=TqvTLKEngbI accessed on 30th December, 2024
4. https://www.youtube.com/watch?v=HOvlvN1F0hk accessed on 30th December, 2024

XVI List of Major Equipment/Machineries with Specification:

1. Electric resistance furnace
2. Electric arc welding machine
3. Domestic refrigerator
4. Split air conditioner
5. Induction motor VVVF control kit

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

S.N.	Name	Designation	Institute / Industry
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2	Dr. P. M. Daigavane	HOD. Electrical Engineering	G.H.Raisoni college of Engineering, Nagpur
3	Mrs. Divya Piprode	Sr. Engineer	Powergrid Corporation of India Ltd., Nagpur
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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSC
Course Code	:	EE307H
Course Title	:	Electrical Estimating & Contracting

I Rationale:

This course enables students to excel in electrical estimating and contracting by learning to plan, estimate, and execute electrical installations for residential, commercial, industrial, and public infrastructure projects. It emphasizes acquiring practical skills in preparing quotations, tenders, and contracts, along with accurate material estimation and cost calculation. By integrating technical and managerial aspects, the course ensures students develop the expertise required to meet industry standards and excel in professional electrical contracting.

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: **Prepare** documents for quotations, tenders, contracts, and supply order.

CO2: **Prepare** estimate of domestic and commercial electrical installations.

CO3: **Prepare** estimate of industrial electrical installations.

CO4: **Prepare** estimate of public lighting installations.

CO5: **Prepare** estimate of overhead and underground distribution lines.

CO6: **Prepare** estimate of 11 kV distribution substation.

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

@ 4 Hours Duration

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
I: Introduction	1a	Apply the principles of NEC 2023 for specified work.	1.1	Scope and features of National Electrical Code 2023 (NEC 2023), Types of electrical installation- Non industrial and industrial, Standard value of voltages and their limits, undamental principles for electrical installations, Safety in electrical work, permit to electrical work, safety instruction and safety practices.	CO1
	1b	Compare given types of estimation.	1.2	Purpose of estimating and costing, Qualities of good estimator, essential elements of estimating and costing, Meaning and purpose of- Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate, Factors to be considered while preparation of detailed estimate and economical execution of work.	

UNIT	1c	Apply the concept of contracts for specified work.	1.3	Concepts of contracts, types of contracts, contractor, role of contractor, qualities of good contractor.	
	1d	Prepare tender, quotations, and supply order for given requirements.	1.4	Types of tenders, tender notice, preparation of tender document, and method of opening of tender, Government e-Market Place (GeM), features and benefits of GeM, Quotation, quotation format, 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.	
	2a	Interpret electrical installation plan and electrical diagrams.	2.1	Electrical symbols used in electrical diagrams as per NEC 2023, multiline and single line representation of conductors, Electrical diagrams, their Classification. Methods of representation for the wiring diagram- multiline and single line representation, conversion of multiline representation into single line and vice versa. Necessity and reading of Civil Engineering building drawing. Interpretation of electrical installation plan and electrical diagrams.	

UNIT II: Domestic and Commercial Installations	2b	Design illumination scheme for given installation.	2.2	Terminology used in illumination such as- Luminous flux, Luminous intensity, Lumen, Illumination or illuminance, Lux, Space-height ratio, utilization factor, depreciation factor, luminous efficiency-definition & values for different luminaries. Luminous flux of different types of light sources, Lux level required for different places as per SP 72: 2010. Design of illumination scheme for residential/ commercial unit.	CO2
	2c	Prepare estimation of given domestic installation.	2.3	Steps to be followed for design and estimation of domestic installations. Design consideration of electrical installation in domestic installations. Design, drawing, estimation, and costing of a domestic installation having maximum 5 kW load.	
	2d	Prepare estimation of given commercial installation.	2.4	Steps to be followed for design and estimation of commercial installations. Design consideration of electrical installation in commercial installations. Design electrical installation scheme of small commercial installations of classrooms in educational institutions, small shops, and dispensaries.	
	2e	Prepare estimation of given type of service connection.	2.5	Underground and overhead, it's diagram and description. Calculation of material required for underground and overhead service connection.	

UNIT III: Industrial Installation	3a	Differentiate between given types of industrial installations on given points.	3.1	Classification of industrial installations based on fire safety and power consumption, Difference between non-industrial and industrial installations, General characteristics of industrial installation, selection of wiring system.	CO3
	3b	Draw specified diagrams related to industrial installations.	3.2	Wiring diagram and single line diagram for single phase and three phase motors. Drawing of Installation plan.	
	3c	Calculate various parameters of industrial installations from given data.	3.3	Design Considerations of industrial installations: Calculation of Motor current, deciding the cable size, deciding the size of Conduit, deciding the fuse rating, deciding distribution board and main switch/MCB, deciding the starter for Motors.	
	3d	Prepare estimate of given industrial installation.	3.4	Design electrical installation scheme and preparation of estimate of agricultural pump, flourmill and small industrial unit having total aggregate three -phase load less than 30 kW.	
Installation	4a	Apply NEC 2023 for public lighting installation.	4.1	Classification of outdoor installations, streetlight/ public lighting installation, Terminology used according to NEC 2023– Terms related to highway, lighting installation, photo metric terms, luminaries etc. Aim of public lighting installation, classification of roads, standard layout of roads	

UNIT IV: Public Lighting	4b	Select materials and equipment for specified street light installation.	4.2	Streetlight pole structures. Selection of equipment, sources used in streetlight installations. Cables, recommended types and sizes of cable. On off Control of equipment of street light installation.	CO4
	4c	Select materials and equipment for specified high-mast installation.	4.3	High-mast pole structure, selection of equipment, wiring diagram.	
	4d	Prepare estimates of street light and high-mast installation based on given data.	4.4	Design, estimation and costing of streetlights and High-mast lighting.	
UNIT V: Distribution Lines	5a	Compare given types of distribution lines on given points.	5.1	Block Diagram of Electrical Power system, Types of Distribution lines - Primary and Secondary, Overhead and Underground, and it's comparison.	CO5
	5b	Select materials for given types of distribution lines.	5.2	Materials used for distribution line HT (11kV) and LT (415V), Cables used for distribution line, factors determining selection of LT/ HT power cables, and cable termination methods.	
	5c	Prepare estimation of given types of distribution lines based on given data.	5.3	Design, estimation and costing of HT (11kV), LT (415 V) overhead line and underground cabling.	

UNIT VI: 11 kV substation	6a	Select materials for given types of distribution substation.	6.1	Introduction to different sub-stations in power system, their representation using single line diagram and various voltage levels, reason for establishing substations. Types of 11 KV Distribution substations: Outdoor- H- pole mounted, Platform mounted, floor mounted and Indoor- floor mounted, their line diagrams, typical layout, and specifications according to IS, functions of various equipment in substations.	CO6
	6b	Prepare estimates of given types of distribution substation.	6.2	Design, estimation and costing of outdoor and indoor 11 KV substation.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Prepare quotations, comparative statement from quotation and supply order from comparative statement.	2#	CO1
I	2	Prepare tender document for purchase of an electrical equipment or electrical installation work costing more than 5 lacs.	2	CO1
II	3	Design and estimate domestic installation (Part I): Calculate total load for domestic installation. Draw electrical installation plan from civil engineering drawing.	2#	CO2
II	4	Design and estimate domestic installation (Part II): Calculate number of subcircuits, ratings of main switch and distribution board. Draw single line diagram. Prepare estimates.	2#	CO2
II	5	Draw any one drawing required for domestic installation using any electrical software.	2	CO2
II	6	Design and estimate small commercial installation (Part I): Calculate total load for commercial installation. Draw electrical installation plan from civil engineering drawing.	2#	CO2
II	7	Design and estimate small commercial installation (Part II): Calculate number of subcircuits, ratings of main switch and distribution board. Draw single line diagram. Prepare estimates.	2#	CO2
II	8	Draw any one drawing required for small commercial installation using any electrical software.	2	CO2
III	9	Design and estimate small industrial installation (Part I): Calculate total load for industrial installation. Draw electrical installation plan from civil engineering drawing.	2#	CO3
III	10	Design and estimate small industrial installation (Part II): Calculate ratings of main switch and distribution board. Draw single line diagram. Prepare estimates.	2#	CO3
III	11	Draw any one drawing required for small industrial installation using any electrical software.	2	CO3
IV	12	Design and estimate street light installation of small premises (Part I): Draw installation plan and wiring diagram.	2#	CO4

IV	13	Design and estimate street light installation of small premises (Part II): Prepare estimates.	2#	CO4
V	14	Design and estimate LT line installation (Part I): Draw single line diagram and details of pole structure.	2#	CO5
V	15	Design and estimate LT line installation (Part II): Prepare estimates.	2#	CO5
VI	16	Design and estimate 11 kV substation (Part I): Draw single line diagram and details of pole structures.	2#	CO6
VI	17	Design and estimate 11 kV substation (Part II): Prepare estimates.	2#	CO6

Note: # Compulsory, Use extra periods for practical (if required).

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

1. Collect civil engineering drawing of any existing 1 BHK residential installation and prepare detailed estimate and drawing required for installation using any electrical software for the same.
2. Collect civil engineering drawing of any existing commercial installation and prepare detailed estimate and drawing required for installation using any electrical software.
3. Collect civil engineering drawing of any existing industrial installation and prepare detailed estimate and drawing required for installation using any electrical software for the same.
4. Collect site plan of any existing premises, design street light installation scheme and prepare detailed estimate.
5. Prepare detailed estimate for high-mast installation for any play ground and prepare wiring diagram for the same using any electrical software.
6. Collect site plan of any existing premises, design 11 kV HT overhead distribution line installation and prepare detailed estimate.
7. Collect site plan of any existing premises, design 11 kV HT underground distribution line installation and prepare detailed estimate.
8. Collect site plan of any existing premises, design 440 V LT overhead distribution line installation and prepare detailed estimate.
9. Collect site plan of any existing premises, design 440 V LT underground distribution line installation and prepare detailed estimate.
10. Prepare estimate for 11 kV pole mounted distribution substation having 100 kVA transformer and draw detailed drawing.
11. Prepare estimate for 11 kV indoor distribution substation having 250 kVA transformer and draw detailed drawing.

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	00	06	8
			O	02	00	00	2
2	Domestic and Commercial Installations	12	C	02	06	12	20
			O	00	00	12	12
3	Industrial Installation	10	C	00	06	12	18
			O	02	00	12	14
4	Public Lighting Installation	6	C	02	00	06	8
			O	00	06	00	6
5	Distribution Lines	6	C	02	00	06	8
			O	00	00	06	6
6	11 kV substation	6	C	02	06	00	8
			O	00	00	06	6
Total		45	C	10	18	42	70
			O	4	6	36	46

*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	4R2	5R2	6R2	1R2	3R2	5	7
2	1A6	4A6	4U6					2	3
3	2U6	5A6	5A6					2	3
4	3U6	6U6	6A6					2	3
5	2A12	2A12						1	2
6	3A12	3A12						1	2

*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 diagrams	5
2	Calculations	10
3	Preparation of estimates	10
	TOTAL	25

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

S.N.	Criteria	Max. Marks
1	Drawing diagrams	5
2	Calculations	10
3	Preparation of estimates	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	-	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	Electrical Design Estimating and Costing	K.B.Raina, S.K.Bhattacharya, New Age International Publisher, First, Reprint 2010	13: 978-8122443585
2	Electrical Estimating and Costing	Surjit Singh, RaviDeep Singh, Dhanpat Rai and Sons, New Delhi, 2014.	13: 1234567150995
3	A Course in Electrical Installation Estimating and Costing	J.B. Gupta, S.K. Kataria and Sons; New Delhi, Reprint Edition, 2013.	13: 978-9350142790
4	SP-30:2023, National Electrical Code, 2023	Bureau of Indian Standards	--
5	IS: 732-1989, Code of Practice for Electrical Wiring Installation	Bureau of Indian Standards	--

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2. https://law.resource.org/pub/in/bis/S05/is.732.1989.pdf assessed on 8th Dec 2024
3. https://www.electrical4uonline.com/what-is-high-mast-lighting/ assessed on 8th Dec 2024
4. https://www.electrical4u.com/road-lighting-design/ assessed on 8th Dec 2024
5. https://www.youtube.com/watch?v=yhzhloBF_eo assessed on 8th Dec 2024
6. https://www.youtube.com/watch?v=yDFIIsnvlxM&t=5s assessed on 8th Dec 2024

XVI List of Major Equipment/Machineries with Specification:

1. All In One Computer latest version
2. Laser jet multifunction printer
3. Open-source drawing Software

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 Head,Electrical Engineering,	Government Polytechnic, Nagpur
2	Dr. P. M. Daigavane	HOD. Electrical Engineering	G.H.Raisoni college of Engineering, Nagpur
3	Mrs. Divya Piprode	Sr. Engineer	Powergrid Corporation of India Ltd., Nagpur
4	Mr. M. N. Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Gondia
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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSE
Course Code	:	EE308H
Course Title	:	Microcontroller

I Rationale:

This course focused on the foundation of Microcontroller and their application to the students of Electrical Engineering. As microcontroller are most widely used in various industrial application such as Consumer electronics, Automotive, Healthcare and manifacturing etc. Understanding microcontroller and their application helps the students to know about the field of embedded system, IOT development, Robotics and Automation etc. This course emphasizes on the basics of Microcontroller and its developments to controlling application of different devices interfaced in a complex system.

II Industry Identified Competency:

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

Apply industrial automation techniques for improved efficiency.

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Analyze** features of various versions of 8051 microcontrollers.

CO2: **Interpret** the concept of Embedded System.

CO3: **Interpret** the features of advance microcontrollers.

CO4: **Develop** the concept of Arduino Uno R3.

CO5: **Interfacing** Arduino with Input and Output Device.

CO6: **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
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
70	30	100	40	25	10	25+	10	25	0

VI Classroom Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Cognitive Domain)		Topics and Sub-topics		Aligned Cos
UNIT I: 8051 Microcontroller	1a	Differentiate Microprocessor and Microcontroller on the basis of given features.	1.1	Overview of Microcontroller, Evolution of Microcontrollers, Comparison of Microprocessor and Microcontroller. Need of Microcontroller, Family of 8051 Microcontroller and their key features.	CO1
	1b	Justify the function of given blocks of 8051 microcontroller.	1.2	Basic Architecture of 8051 Microcontroller - Von Neuman Architecture and Harward Architecture. Block diagram of 8051 -Microcontroller. Function of each block of 8051 - Microcontroller.	
	1c	Justify the function of given pins of 8051 microcontroller.	1.3	8051 - Microcontroller - Pin diagram, function of each pin, Concept of Internal and External ROM memory, Internal RAM memory, Reset and Clock circuit, Various registers and SFR of 8051.	

	1d	Develop a assembly language program on given instruction.	1.4	Assembly language Instruction format, Various addressing modes, Classification of instruction set: Data transfer, Arithmetic, Logical, Branching, Bit manipulation, stack, subroutine and interrupt related instructions, Simple assembly Language Programs based on above instructions set.	
UNIT II: Embedded System	2a	Identify the given Components of Embedded System.	2.1	Introduction to embedded systems, Classification of embedded systems based on generation and complexity, Purpose of embedded systems, Block diagram of different components of embedded system hardware, Advantages and applications of embedded systems.	CO2
	2b	Compare embedded system with general computing system on given points.	2.2	Difference between Embedded Systems and General computing systems. The embedded system design process - requirements, specification, architecture design, designing hardware and software, components, system integration.	
	2c	Identify the given peripherals used in embedded system.	2.3	Applications of embedded systems and its characteristics. Peripherals in Embedded system, their types and Applications.	

	2d	Compare the processor used in embedded systems on given points.	2.4	Core of the embedded system-general purpose and domain specific processors, Memory - ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems, Sensors, actuators, I/O components: seven segment LED, relay, push button switch, other sub-systems: reset circuit. protection circuit, oscillator circuit real time clock.	
UNIT III: Advanced Microcontroller & Application	3a	Compare the features of given Advance Microcontrollers.	3.1	Overview of advanced microcontrollers, Features of advanced microcontrollers - AT89C51, PIC, AVR, ARM Microcontrollers with their applications. Comparison between 89C51, PIC, AVR and ARM.	CO3
	3b	Justify the function of given pins of ATMega128.	3.2	ATMega128: Features, Pin Configuration and Block Diagram.	
	3c	Justify the function of given pins of ATMega328.	3.3	ATMega328: Features, Pin Configuration and Block Diagram, Program & Data Memory Map, Clock System.	
	3d	Compare ATMega128 and ATmega328 on the basis of given points.	3.4	Comparision between ATMega128 and ATMega328.	
evelopment Board)	4a	Identify theComponents of Arduino UNO R3.	4.1	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.	

UNIT IV: Open Source D (Arduinc	4b	Use Arduino Variables and Structure for intefacing.	4.2	Introduction to Arduino Functions (Input/Output only), Variables (Constants, Data Types only) and Structure.	CO4
	4c	Identify the features of Interrupt in Arduino.	4.3	Arduino IDE Sketch of Blinking Inbuild LED in Arduino IDE. Concept and Features of Interrupt in Arduino.	
UNIT V: Interfacing of Input and Output Devices with Arduino	5a	Interface Arduino based system with given components.	5.1	Interfacing Arduino based system with LED, Relay and Switches, Seven Segment Display and LCD, Interfacing with 4x4 Keyboard.	CO5
	5b	Design Arduino based system with given Motor.	5.2	Interfacing Arduino based system with Stepper Motor.	
	5c	Design Arduino based system for given applications.	5.3	Interfacing Arduino based system with IR Sensors, LDR, Temperature Sensors and Buzzer system.	
UNIT VI: Introduction to Internet of Things (IoT)	6a	Identify the features of IOT.	6.1	Introduction to IoT (Internet of Things): Features of IoT, Advantages and Disadvantages of IoT, Embedded Devices (System) in IoT, IoT Architecture Applications.	CO6
	6b	Identify given IoT Devices.	6.2	Introduction of IoT Devices: Major IoT Board sin Market (Arduino, Raspberry Pi, ESP8266).	
	6c	Design IoT System for given applications.	6.3	IoT Platforms and ThingWorx platform System for Controlling home light using Arduino/ Raspberry Pi/ ESP8266 and Relay module.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Identify various blocks of 8051 microcontroller development board.	2#	CO1
I	2	Utilize different menus available in a simulator software RIDE/KEIL and demonstrate their use.	2#	CO1
I	3	Develop an Assembly language programs using Arithmetic Instructions/Logical Instructions and demonstrate outcome for a given input.	2#	CO1
I	4	Develop an Assembly language program to transfer data from source to destination of Internal/External memory using directives and demonstrate outcome for a given input data.	2	CO1
II	5	Identify the hardware components of an embedded system, such as sensors, actuators, and processors.	2#	CO2
II	6	Develop an Assembly language program to transfer data from source to destination of memory using RISC based system.	2#	CO2
III	7	Interpret blocks of 89C51 microcontroller using datasheet.	2#	CO3
III	8	Interpret blocks of ATMega 128 microcontroller using datasheet.	2#	CO3
III	9	Interpret blocks of ATMega 328 microcontroller using datasheet.	2	CO3
IV	10	Install Arduino IDE in Windows OS.	2#	CO4
IV	11	Interpret blocks of Arduino using datasheet/IDE development board.	2#	CO4
IV	12	Design Arduino sketch for blinking inbuild LED connected to pin 13.	2#	CO4
V	13	Develop Arduino based system to interface Seven Segment Display with Arduino and display the numeric value 0 to 9	2#	CO5

V	14	Develop Arduino based system to interface LCD with Arduino and display the string "Electrical Engineering Department.	2	CO5
V	15	Develop Arduino based system to interface 4x4 keyboard with Arduino and display the key pressed.	2#	CO5
V	16	Develop Arduino based system to interface stepper motor with Arduino and rotate it in clockwise and anti-clockwise direction	2#	CO5
V	17	Develop Arduino based system to interface Buzzer/ Sensor.	2#	CO5
VI	18	Interpret Blocks of Raspberry Pi 4 Model using Datasheet.	2	CO6
VI	19	Design IoT System for Controlling home light using WiFi	2#	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Build a circuit using 8051 micrcontroller to display numbers from 0 to 9.
2. Build a circuit using Arduino for traffic light control.
3. Build a circuit using Arduino for ringing a bell after 1hr of class.
4. Build a circuit using Arduino to turn buzzer ON after 10 sec.
5. Build a circuit using Arduino to blink LED.
6. Build a circuit using Arduino to turn buzzer ON after a key pressed.
7. Build a circuit using Arduino IDE on LCD.
8. Build a circuit using IOT for Home automation.
9. Build a circuit using IOT to turn buzzer ON after 10 sec.
10. Prepare any one microproject on curriculum content.

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	8051 Microcontroller	6	C	02	04	06	12
			O	02	04	00	6
2	Embedded System	8	C	00	04	06	10
			O	02	00	04	6
3	Advanced Microcontroller & Application	10	C	02	04	10	16
			O	00	08	00	8
4	Open Source Development Board (Arduino)	8	C	02	04	06	12
			O	00	00	06	6
5	Interfacing of Input and Output Devices with Arduino	8	C	02	04	04	10
			O	00	00	04	4
6	Introduction to Internet of Things (IoT)	5	C	02	04	04	10
			O	00	04	06	10
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	3R2	4R2	5R2	6R2	1R2	2R2	5	7
2	1U4	2U4	3U4	2A4	3U4			3	5
3	3A4	4U4	5U4	3U4	5A4			3	5
4	5A4	6U4	6A4	1U4	6U4			3	5
5	1A6	3A6	4A6					2	3
6	2A6	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	Writing Assembly language program	5
2	Performance	10
3	Showing Execution process and outcomes	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	Execution and performance	10
3	Report Writing	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	-	2	3	-	2	-	-	-
CO5	3	-	-	3	-	2	-	-	-
CO6	3	-	2	3	-	2	1	-	-

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	13: 978-8131710265
2	Introduction to Embedded Systems: Using Microcontrollers	Manuel Jiménez, Rogelio Palomera, Isidoro Couvertier	13: 978-1461431435
3	AVR Microcontroller and Embedded Systems: Using Assembly and C	Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi	13: 978-0138003319
4	Exploring Arduino: Tools and Techniques for Engineering Wizardry	Jeremy Blum, Publisher - John Wiley & Sons, 22 July 2013	13: 978-1118549360

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3. https://resources.pcb.cadence.com/blog/2023-microcontroller-types-and-applications, assessed on 14th Aug 2024
4. https://www.youtube.com/watch?v=iXSXIJn_Xwc, assessed on 14th Aug 2024
5. https://www.youtube.com/watch?v=S4WG3NBxlzw, assessed on 14th Aug 2024
6. https://www.eit.edu.au/resources/types-and-applications-of-microcontrollers, assessed on 14th Aug 2024
7. https://www.javatpoint.com/arduino
8. https://www.javatpoint.com/major-iot-boards-in-market
9. https://www.arduino.cc/

XVI List of Major Equipment/Machineries with Specification:

1. Desktop Computer - 12th Gen Intel® core(TM) i5-12500T 2.00 GHZ
2. Multipurpose Starter Kit for Arduino IDE
3. Digital Ammeter and Voltmeter
4. General Peripherals Breaddboard
5. LED, Key, Buzzer,LCD, 4x4 keyboard, IR
6. Sensor module
7. Stepper Motor module
8. IOT kit board

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

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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	DSE
Course Code	:	EE309H
Course Title	:	PLC & SCADA

I Rationale:

The course in PLC and SCADA provides diploma students in electrical engineering with essential knowledge and skills in industrial automation. Covering microcontroller basics, PLC fundamentals, wiring diagrams, ladder logic, and troubleshooting, it emphasizes practical applications of PLCs. Additionally, students learn about SCADA, distributed control systems, and human-machine interfaces, preparing them to design, monitor, and maintain automated systems, which are critical for efficiency and control in modern industrial environments.

II Industry Identified Competency:

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

Apply Industrial Automation techniques for improved efficiency

III Course Outcomes (COs):

After completing this course students will be able to:

CO1: **Identify** various parts of the given PLC .

CO2: **Convert** given relay schematics into PLC ladder programs

CO3: **Identify** Input and Output devices used for PLC installation

CO4: **Develop** PLC ladder diagrams for simple application

CO5: **Identify** different elements of SCADA/DCS

CO6: **Prepare** application of Human Machine Interface

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
Microcontroller	1a	Identify given parts of 8051 architecture with block diagram.	1.1	Block diagram of 8051, Microcontroller Architecture shows that 8051 Microcontroller consists of a CPU, RAM (SFRs and Data Memory), Flash (EEPROM), I/O Ports and control logic.	
	1b	Identify given pins of 8051 chip.	1.2	Pin Diagram with respect to a 40– pins, function of each Pin.	
	1c	Configure given registers of 8051 for specific condictions.	1.3	PSW register Internal memory structure (RAM and ROM), Reset and clock, various registers.	

UNIT I: Introduction to M	1d	Develop the given program of 8051.	1.4	I/O port pins and their functions and I/O bit manipulation programming, Programming 8051 timer, counters, serial communication, The Program of I/O ports for interfacing external memory, 8051 instruction set, Overview of 8051 instruction set and addressing modes, Moving the data (Internal and External), Arithmetic instructions, logical operations, JUMP and CALL instructions, Bit level instructions, Stack, subroutine and interrupts, Simple programs based on above instructions.	CO1
UNIT II: PLC Fundamentals	2a	Classify the parts of PLC	2.1	Classification, Function of given parts of PLC such as CPU, Memory, and Power Supply and IO modules.	CO2
	2b	Select given IO module for specific application	2.2	Digital IO module of PLC, Block diagram, specification and application, Analog IO module of PLC,Block diagram and specification.(Analog Input Module and Analog Output Module), Special modules of PLC: Communication module PID controller module Stepper motor control module.	
	2c	Compare the salient features of the given two PLCs on given points.	2.3	PLCs in market based on CPU type,no of IOs, speed and memory	
der Logic	3a	Compare the given PLC Programming languages.	3.1	The 5 most popular types of PLC programming languages are Structured Text (ST), Sequential Function Charts (SFC), Ladder Logic Diagram (LD), Function Block Diagram (FBD),Instruction List (IL)	

UNIT III: PLC Wiring Diagrams and Ladc	3b	Develop ladder logic diagram for the given situation.	3.2	Binary system, bit, byte, word, logic gates, Programming PLC using ladder diagram, Components of ladder diagram, Program scan process applied to single rung.	CO3
	3c	Design a PLC program and prepare a typical I/O connection diagram and ladder logic program for the given motor control specifications.	3.3	Output control devices found in PLC Installation, PLC based water level controller, A motor must be started and stopped from any one of three START/STOP, Pushbutton stations: Each START/STOP station contains one NO START button and one NC STOP button, Three phases magnetically operated Motor OL contacts are to be hardwired.	
UNIT IV: PLC Application and Troubleshooting	4a	Prepare sequence of events for PLC process applications for the given parameters of processes.	4.1	PLC process applications of Bottle filling plant, Temperature control ON/OFF, Traffic light control, Process level control.	CO4
	4b	Develop Ladder Logicdiagram for PLC process applications for the given Parameters of processes.	4.2	Application of Analog Input and Output Devices of PLC, Ladder logic diagram of the following Bottle filling plant Temperature control ON/OFF, Traffic light control, Process level control.	
	4c	Justify the trouble shooting procedure for the given malfunctions.	4.3	Trouble shooting of Input Malfunctions, Output, Malfunctions, Ladder Logic Program.	
d Control System	5a	Identify given part of SCADA with block diagram.	5.1	SCADA contains five levels-Sensors; Programming Devices, Local Control and HMI, Coordination, Central Control, Function of SCADA –Monitoring, Control and user interface functions.	

UNIT V: SCADA and Distributed Control System (DCS)	5b	Select SCADA system for the given industrial application.	5.2	Application of SCADA:-Traffic density control, water distribution, pipeline control.	CO5
	5c	Identify given part of DCS with block diagram.	5.3	Four basic elements of distributed control system.	
	5d	Select given system elements of DCS.	5.4	System elements of DCS: Field station, Intermediate, Station, Central Computer station.	
	5e	Compare given automation systems.	5.5	Comparison of SCADA,DCS and PLC	
UNIT VI: Human Machine Interface (HMI)	6a	Select the given HMI software for specific applications.	6.1	Concept of HMI, Concept of IOT, Basic block diagram and their Function contains Graphical user interface with a DC motor, benefits and importance of given HMI, HMI software based on: Factory talk view machine, Rockwell software, Factory talk view point	CO6
	6b	Justify the given application of HMI	6.2	Application of HMI software based Automotive Dashboards, Electronic Displays, Audio/Video production and Building Automation and Integration of PLCC, IOT AND HMI.	

VII Laboratory Learning Content:

Unit No	Specific Learning Outcomes (SLO) (In Psychomotor Domain)		Hours	Aligned COs
I	1	Develop assembly language program for arithmetic and logic operation with 8051 simulator.	2#	CO1
I	2	Develop assembly language program for study of timer/ counter in mode 1 and 2 using simulator	2#	CO1
II	3	Identify various parts of the given PLC and front panel status indicators	2#	CO2
III	4	Develop ladder program for Traffic density control system.	2#	CO3
III	5	Use the PLC for sensing level of water in tank using float switch and control level of water using ON/OFF solenoid valve	2	CO3
IV	6	Use PLC for ON/OFF temperature control.	2#	CO4
IV	7	Use PLC for simulating traffic light control.	2#	CO4
IV	8	Simulate Bottle filing process on PLC simulator. Verify operation of the same process using actual PLC. Draw connection details for the same process.	2#	CO4
V	9	Identify the components of SCADA system.	2#	CO5
V	9	Develop interfacing program of PLC with SCADA.	2#	CO5
V	10	Identify and select system elements of DCS.	2#	CO5
V	11	Develop a SCADA mimic diagram for Tank level control or Flow control in a given system.	2#	CO5
VI	12	Use PLC HMI for display input switch status on screen.	2#	CO6
VI	13	Use PLC HMI for display speed of motor on screen.	2	CO6
VI	14	Use PLC HMI for display timer status on screen.	2	CO6

Note: # Compulsory, Use virtual laboratory whereever possible.

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

1. Design and simulate a basic traffic light system and prepare a report.
2. Create a temperature monitoring system using PLC and prepare a report
3. Program a microcontroller to control the speed of a DC motor based on user input and prepare a report.
4. Develop a basic PLC program to control an LED using push buttons and prepare a report.
5. Simulate a conveyor belt system with start/stop controls in a PLC simulator and prepare a report.
6. Program a PLC to implement a sequential control system for a washing machine and prepare a report.
7. Create a wiring diagram for a motor control circuit with forward/reverse operation and prepare a report.
8. Develop a ladder logic program to implement an emergency stop system for an industrial setup and prepare a report.
9. Design and implement a control system for water level monitoring in a tank and prepare a report.
10. Build a PLC program to control the operation of a simple robotic arm and prepare a report.
11. Create an interactive HMI panel for a home automation system (lights and fans) 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	Introduction to Microcontroller	6	C	2	4	4	10
			O	2	4	0	6
2	PLC Fundamentals	9	C	2	8	4	14
			O	0	4	4	8
3	PLC Wiring Diagrams and Ladder Logic	8	C	2	4	6	12
			O	0	0	6	6
4	PLC Application and Troubleshooting	8	C	2	4	6	12
			O	0	4	0	4
5	SCADA and Distributed Control System (DCS)	8	C	2	4	6	12
			O	0	4	6	10
6	Human Machine Interface (HMI)	6	C	0	4	6	10
			O	2	4	0	6
Total		45	C	10	28	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	5R2	6R2	1R2	5	7
2	1U4	2U4	3U4	1U4	2U4			3	5
3	4U4	5U4	2U4	4U4	6U4			3	5
4	6U4	1A4	2A4	2A4	5U4			3	5
5	3A6	4A6	3A6					2	3
6	5A6	6A6	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	Selection of topic	5
2	Performance/Simulation/Fabrication	10
3	Report writing	5
4	Demonstration	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	-	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	1	3	-	3	-	3	-	-

XIV Textbooks, BIS Codes References:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Programmable Logic Controllers and Applications	Webb, John W, Ronald Reis. A. Prentice Hall of India, New Delhi, (latest Edition)	13:9780136794080
2	Programmable Logic Control, Principles and Applications	NIIT, Prentice Hall of India, New Delhi, 2005.	10:81-203-2525-7
3	Programmable Logic Controllers	Petruzella, Frank, McGraw-Hill Education, 2010	13:9780073510880
4	Programmable Logic Controllers	Bolton, William, Newnes, 2015	13:9780128029299
5	Introduction to PLC	Dunning Gary, Cengage India, 2005	13:9788131503027

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3. https://www.youtube.com/watch?v=PLYosK87D8E
4. https://www.youtube.com/watch?v=Hci-eW5IihM
5. https://www.youtube.com/watch?v=1pRv-p_HbRk
6. www.electrical4u.com

XVI List of Major Equipment/Machineries with Specification:

1. Master PLC with Power supply and Hand held PLC programmer.3 NO
2. 24 analog input module (8 analog input module 3 NO)
3. 24 analog output module (8 analog input module 3 NO)
4. 24 Digital input module (8 digits input module 3 NO)
5. 24 Digital output module (8 digits input module 3 NO)
6. 3 level switch
7. PLC with min 8 I/O"s and HMI and its simulation /programming software
8. Traffic light simulation practical model
9. Temperature control system

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
2	Dr. P. M.Daigavane	HoD, Electrical Engineering	G.H.Raisoni College of Engineering, Nagpur
3	Mrs. Divya Piprode	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	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
6	Mr. J. K. Pandit	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur

(Mr. M. C. Musale)
HOD & Chairman PBOS, EE

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Member Sectretary PBOS, EE

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COURSE CURRICULUM

Program	:	Diploma in EE
Course Category	:	SEC
Course Code	:	EE352H
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, execute, and manage electrical projects effectively.

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
	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

Unit II: Planning	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
NIT IV: 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
	22	Continue project task.	2#	CO4

U	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.	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

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	Practical Electrical Project Engineering	L. B. Roe McGraw-Hill, First Edition, 1978	13: 9780070533929
2	71 Electrical & Electronic Porjects	Nikhil Shukla, V&S Publishers, 2014	13: 978-9350571675

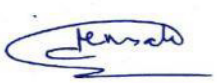
XV e-References:

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:

S.N.	Name	Designation	Institute / Industry
1	Mr. M. C. Musale	I/C HOD, Electrical Engineering	Government Polytechnic, Nagpur
2	Dr. Mrs. P. M. Daigavane	HOD, Electrical Engineering	G. H. Raisoni College of Engineering, Nagpur
3	Mrs. Divya Piprode	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	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur



(Mr. M. C. Musale)
HOD & Chairman PBOS, EE

(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	:	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

(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)
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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

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(Dr. G. V. Gotmare)
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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/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
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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
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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
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