

OUTCOME BASED CURRICULUM 2016

Program Diploma in Metallurgical Engineering



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OUTCOME BASED CURRICULUM 2016



Program: Diploma in Metallurgical
Engineering



by

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DIPLOMA IN METALLURGICAL ENGINEERING

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CHAPTER 1

Government Polytechnic, Nagpur an Introduction

This chapter gives the history of Government Polytechnic, Nagpur.

1.1 History

The **Government Polytechnic, Nagpur** is an oldest technical institution in central India. It was founded on 14th July 1914 as the Government Engineering School. At its commencement the school had 16 students on roll and was located in the Victoria Science College (now the Institute of Science) in Nagpur. During its first year the school provided courses in Civil Engineering & Mechanical Engineering up to diploma standard. Later in 1915 Automobile Engineering Course was also established which was subsequently converted into Post Diploma in Automobile Engineering. The institution has given birth to Engineering College presently known as Visvesvaraya National Institute of Technology, Nagpur (VNIT). The school was expanding rapidly & from 16 students enrolled in 1914 increased to nearly 2000 in current year and Govt. Engineering School converted to Government Polytechnic, Nagpur.

1.2 Autonomy

The Institute has recently celebrated its Centenary year. Government Polytechnic, Nagpur has history of 102 Glorious Years. The Government Polytechnic, Nagpur is committed to contribute to through excellence in technical education, to serve as valuable resource for industry and society. The institute is always upright in responding to educational needs of its changing world's scenario.

From academic session 1995 the institute was conferred with autonomous status by Government of Maharashtra as per Government Resolution No. WBP-1093/(2640) (69)VE-5 Dated- 31st March, 1994, in context of academic matter viz. identification of

need of new programs, requisite curriculum design, implementation of self-designed curriculum, assessment, evaluation and certification of students.

1.3 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”

1.4 Geographical Location of Nagpur City

The latitude of Nagpur, India is 21.146633, and the longitude is 79.088860. Nagpur, India is located at India country in the Cities place category with the gps coordinates of 21° 8' 47.8788" N and 79° 5' 19.8960" E. Nagpur, India elevation is 311 meters height. Nagpur is located at the exact centre of the Indian peninsula. Figure 1.1 shows the location. The city has the Zero Mile Stone locating the geographical centre of India, which was used by the British to measure all distances within the Indian subcontinent. [Wikipedia]. The city gets its name from the river Nag, which flows through the city, originating at a small village called Lavha. It is famous for the Nagpur orange and is known as the "Orange City" for being a major trade centre of oranges cultivated in the region.



Figure 1.1. Location of Nagpur City

1.5 Government Polytechnic, Nagpur 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. The campus map of GPN is shown in Fig. 1.2.



Figure 1.2. Government Polytechnic, Nagpur Campus

CHAPTER 2

Polytechnic Education System

This chapter describes the polytechnic education system in India. Various bodies responsible for polytechnic education in India are also described below.

2.1 Higher Education System in India

The aim of any country's higher education system is sustainable development and achieving higher growth rates. It is enabled through creation, transmission and dissemination of knowledge. To achieve this, India has setup a school education system and higher education system. The higher education system is one of the strongest parts of the Indian education system.

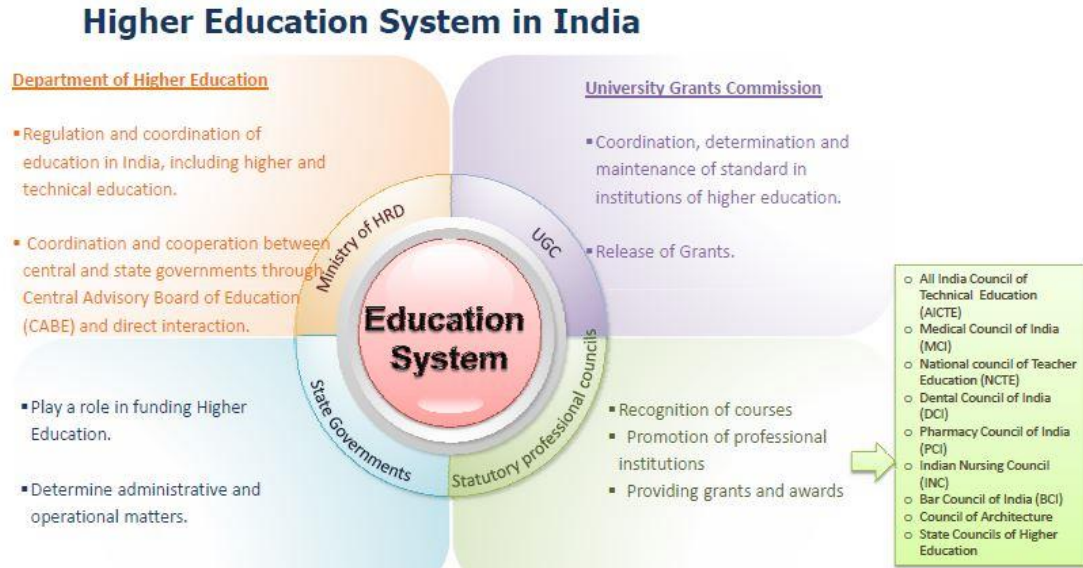


Figure 2.1. Higher Education System in India

Figure 2.1 shows the various bodies responsible for higher education in India, with their roles; as follows:

1. Ministry of Human Resource Development (HRD)

- Regulating and coordination of education in India
 - Coordination and cooperation between central government through central advisory board of education (CABE) and direct interaction
2. University Grant Commission
 - Coordination, determination and maintenance of standards in institutes of higher education
 - Release of grants
 3. State Governments
 - Funding Higher Education
 - Determine administrative and operational matters
 4. Statutory Professional Councils their roles and responsibilities.
 - Recognition of Courses
 - Promotion of Professional institutions
 - Providing grants and awards

The higher education in India is categorised in to following three categories as shown in fig 2.2:

1. General Education
2. Professional Education
3. Vocational Education

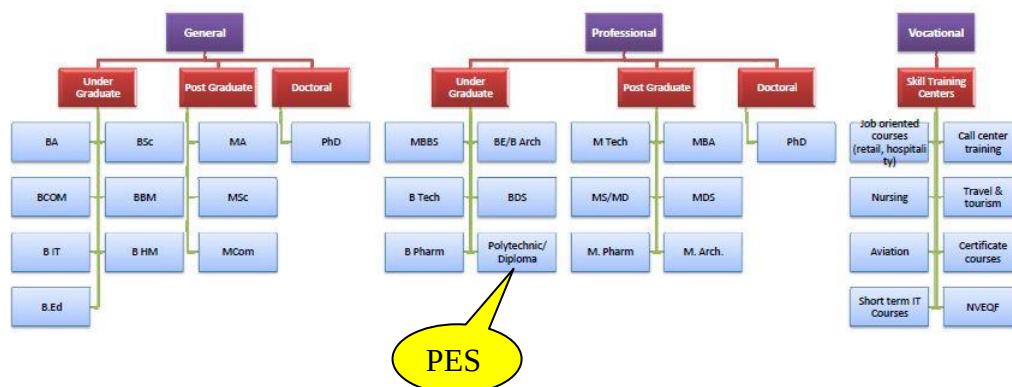


Figure 2.2. Classification of Higher Education System in India

Polytechnic Education System (PES) in India is the undergraduate level category of professional Education.

GPN is one of the autonomous polytechnic of PES in India. It is mandatory for GPN to follow the guidelines framed by the various bodies responsible for technical education, which are as follows:

2.1.1 Department of Higher Education, MHRD

The Department of Higher Education, MHRD, is responsible for the overall development of the basic infrastructure of Higher Education sector, both in terms of policy and planning in India. Under a planned development process, the Department looks after expansion of access and qualitative improvement in the Higher Education, through world class Universities, Colleges and other Institutions

2.1.2 All India Council for Technical Education (AICTE)

The All India Council for Technical Education (AICTE) has been in existence since November 1945 as a national level Apex Advisory Body. AICTE became a statutory body through an act of Parliament 52, in 1987.

AICTE was established with a view to the proper planning and co-ordinated development of the technical education system throughout the country, the promotion of qualitative improvement of such education in relation to planned quantitative growth and the regulation and proper maintenance of norms and standards in the technical education system for matters connected therewith. One of the major functions of AICTE is to lay down norms and standards for courses, curricula, physical and instructional facilities, staff pattern, staff qualifications, quality instructions, assessment and examinations.

2.1.3 National Board of Accreditation (NBA)

The National Board of Accreditation (NBA), India was initially established by AICTE (All India Council of Technical Education) under section 10(u) of AICTE act, in the year 1994, for periodic evaluations of technical institutions & programmes basis according to specified norms and standards as recommended by AICTE council.

NBA in its present form came into existence as an autonomous body with effect from 7th January 2010, with the objective of Assurance of Quality and Relevance of Education, especially of the programmes in professional and technical disciplines, i.e., Engineering and Technology, Management, Architecture, Pharmacy and Hospitality, through the mechanism of accreditation of programs offered by technical institutions.

NBA has introduced a new process, parameters and criteria for accreditation. These are in line with the best international practices and oriented to assess the outcomes of the programme. NBA adopted Outcome Based Education (OBE) model for accreditation of all engineering programs in India from 2013.

2.1.4 Higher and Technical Education, Government of Maharashtra

It is the apex authority responsible for steering and supporting the development and growth of quality Higher and Technical Education that meets educational and social objectives of the state. This department is highly committed towards inclusive education and realizes the importance of quality of education and has undertaken numerous initiatives for achieving highest quality standards in the field of education. Accreditation and Re-accreditation of the Universities and Institutes of higher learning has been made mandatory to ensure the quality of institutions.

2.1.5 Directorate of Technical Education (DTE), Government of Maharashtra

The role of the Directorate is to maintain, enhance the standard, quality of technical education by laying the policies, establishing developing Govt. Institutions, guiding supervising the aided, private institutions, interacting with industry and national level institutions, co-ordinating with other departments of State Government, Government of India Statutory Organisations and to contribute to the development of industry society at large.

2.1.6 Maharashtra State Board of Technical Education (MSBTE)

Maharashtra State Board for Technical Education (MSBTE) was established with the enactment of the Maharashtra State Board of Technical Education Act 1997 to regulate the matters pertaining to diploma level technical education in the state of Maharashtra.

According to act section 34, the autonomous institutions shall be required to obtain equivalence for their courses and programmes from the MSBTE. The MSBTE shall monitor all academic and examination related activities of the Autonomous Institutions such as curriculum, teaching examination scheme, teaching hours, academic schedule, eligibility of candidate to appear for the examination, etc.

2.2 Polytechnic Education System

Polytechnic education in India constitutes an important segment of Technical Education and contributes significantly to the economic development. Aimed at creating a vast amount of technical manpower, the polytechnics have played a vital role in providing skilled manpower at various levels for organized, unorganized and Service Sectors.

The aim of the polytechnic education is to create a pool of skill based manpower to support shop floor and field operations as a middle level link between technicians and engineers. The pass-outs of Diploma level Institutions in Engineering & Technology play an important role in managing shop-floor operations. It is further an established fact that small & medium Industry prefer to employ Diploma Holders because of their special skills in interpreting engineering, drawings, estimating, costing, billing, supervision, measurement, testing, repair & maintenance etc.

Curriculum is an educational programme designed, developed & implemented in formal educational system to achieve pre-determined & pre-stated educational objectives. Every individual social system comes in to existence as a result of need of its output emerged in its environment. Educational objectives of PES can be stated as follows:-

- a) To cater to specific manpower need in overall Technical Manpower Spectrum of industry and society that lies between craftsman on one side and technocrat on other.

- b) To cater the man power need of primary, secondary and tertiary sector of industry.
- c) To cater to individual educational need for development of self, community and society.
- d) To cater to an individual need to update him in tune with advancement in engineering and technology.

Educational objectives stated above talk about manpower with-certain task profile. To develop such task profile in an individual, which consists in general of all duties and associated tasks and sub tasks that an individual is supposed to perform, it is required to organize various experiences in different setups viz. classrooms, laboratories, workshops and fields, through out any educational programme. With such experiences it should be ensured that students acquire requisite knowledge, skills, attitudes and abilities to perform sub tasks and duties and finally job which he is likely to get after passing programme.

Hence, it is essential to design education program taking in to account predetermined objectives in the form of curriculum, then develop requisite resources viz. physical like space, equipment, and furniture etc. human, information and implement it to achieve the educational objectives.

CHAPTER 3

Curriculum Development System

This chapter describes the organization structure, curriculum development system and the various bodies responsible for the development of curriculum of GPN.

3.1 Organizational Structure of GPN

GPN, being part of PES it has been catering needs of individual, community, society and industry since last 102 years. Up to 1995 services being offered by GPN were under different status viz. university, MP DTE and MSBTE.

In 1995 the institute was conferred with autonomous status by Government of Maharashtra as per Government Resolution No. WBP-1093/(2640) (69)VE-5 Dated- 31st March, 1994, in context of academic matter viz. identification of need of new programs, requisite curriculum design, implementation of self-designed curriculum, assessment, evaluation and certification of students. In nutshell accountability regarding academic matters referred above followed by placement of students in world of work is trusted on the institute. Functional organization of students in world of work is entrusted to the institute. Functional organization parallel to hierarchical organization of institute is constituted for running institute under autonomous status effectively and efficiently. Fig. 3.1 shows the organizational structure of GPN.

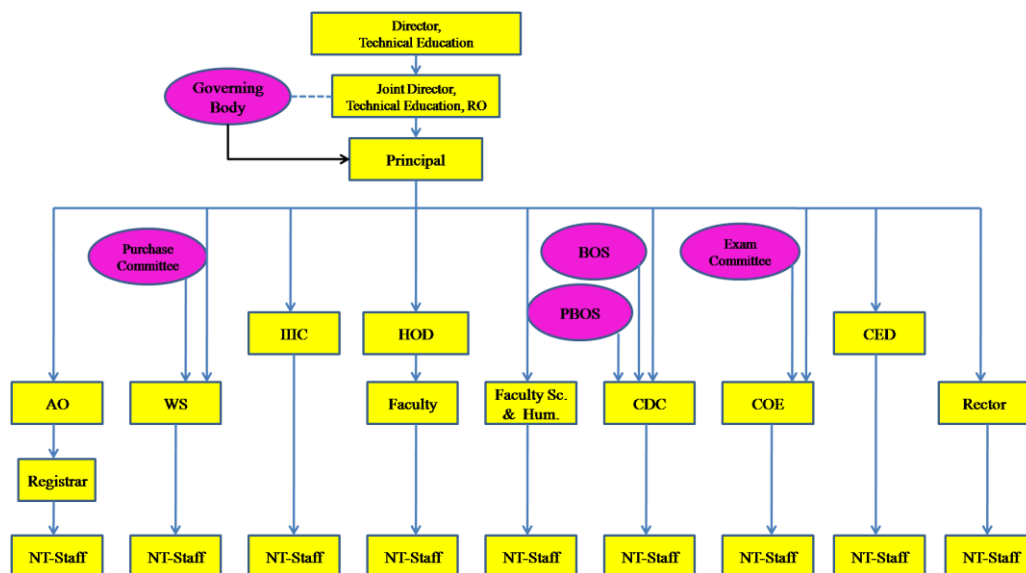


Figure 3.1. Organizational Structure of GPN

3.2 Curriculum Development System

Since, 1995 the institute has been designing/revising and implementing curricula of 11 programmes. This is being done using Curriculum Development System shown in Figure 3.2.

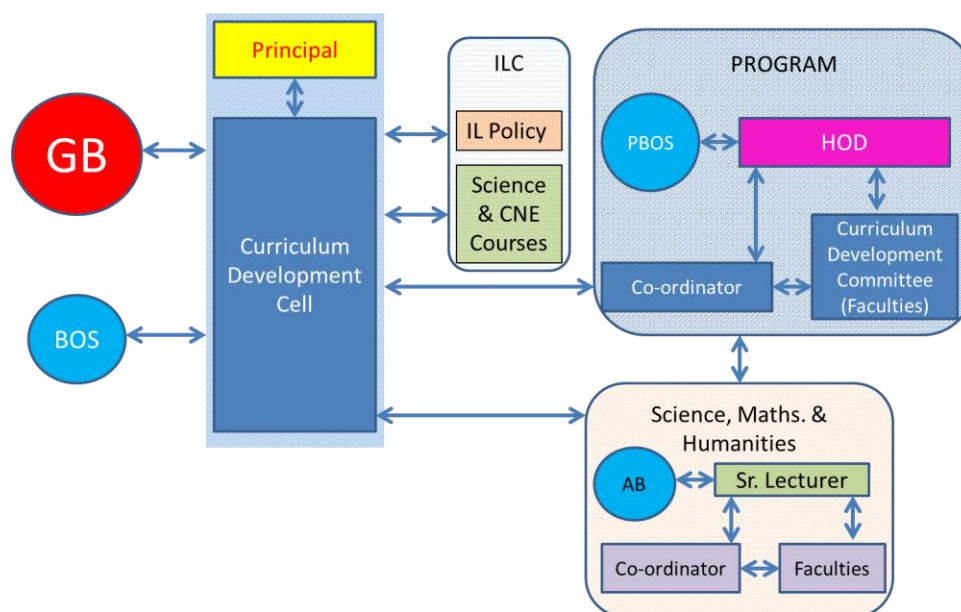


Figure 3.2. Curriculum Development System

Curriculum Development System consists of Programs (Civil, Mechanical, and Electrical etc.), Non Programme Department (Science, Maths, and Humanities), Institute Level Committee (ILC), and Curriculum Developmental Cell (CDC) headed by Principal of the Institute. Institute follows certain process in designing, revising, developing and implementing curriculum and student assessment & evaluation for enhanced students' learning. The constitutional bodies Governing Body (GB), Board of Studies (BOS) and Program wise Board of Studies (PBOS) for programs and non-constitutional body i.e. Advisory Board (AB) for Non Programme Department are responsible for approval of curriculum.

3.2.1 Governing Board (GB)

GB is an apex body. The committee members and roles and responsibilities of GB of GPN are stated below:

- **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.

3.2.2 Board of Studies (BOS)

BOS is an Institute level committee. The committee members and roles and responsibilities of BOS of GPN are stated 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.

3.2.3 Program Wise Board of Studies (PBOS)

PBOS is a program level committee. GPN is having 11 PBOS committees. The committee members and roles and responsibilities of PBOS of program of GPN are stated 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 coursewise.
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.

3.2.4 Advisory Board (AB)

Non Program Department (Science, Maths, and Humanities) are not having PBOS as per the Government Resolution. The AB is constituted in line with the PBOS for Non Program Department. There are 4 AB each for Physics, Chemistry, Mathematics and English Department.

CHAPTER 4

Outcome Based Education Philosophy

Government Polytechnic, Nagpur adopted the OBE approach for curriculum design because, National Board of Accreditation (NBA) focusing on the adoption of OBE approach for all engineering programmes in India from 2013 for accreditation. Programmes to be accredited from 2013 will have to be based on OBE approach. NBA adopted Outcome based Model because, OBE is “Learner Centric” rather than “Teacher Centric”

4.1 Outcome Based Education

Outcome Based Education (OBE) is an education approach that focuses on the graduate attributes or outcomes after completing an academic programme. Outcome based approach means knowing what you want to achieve and then taking the steps to do so.

Some Benefits of OBE are-

1. More directed and coherent curriculum.
2. Graduates (students) will be more “relevant” to industry and other stakeholders.

The framework required for implementation of OBE consists of the following as shown in Figure 4.1 and consists of:

- Outcome Based Curriculum (OBC): What students should able to do?
- Outcome Based Teaching learning (OBTL): Making the students to achieve the outcomes
- Outcome Based Assessment (OBA): How to measure, what the students has achieved?

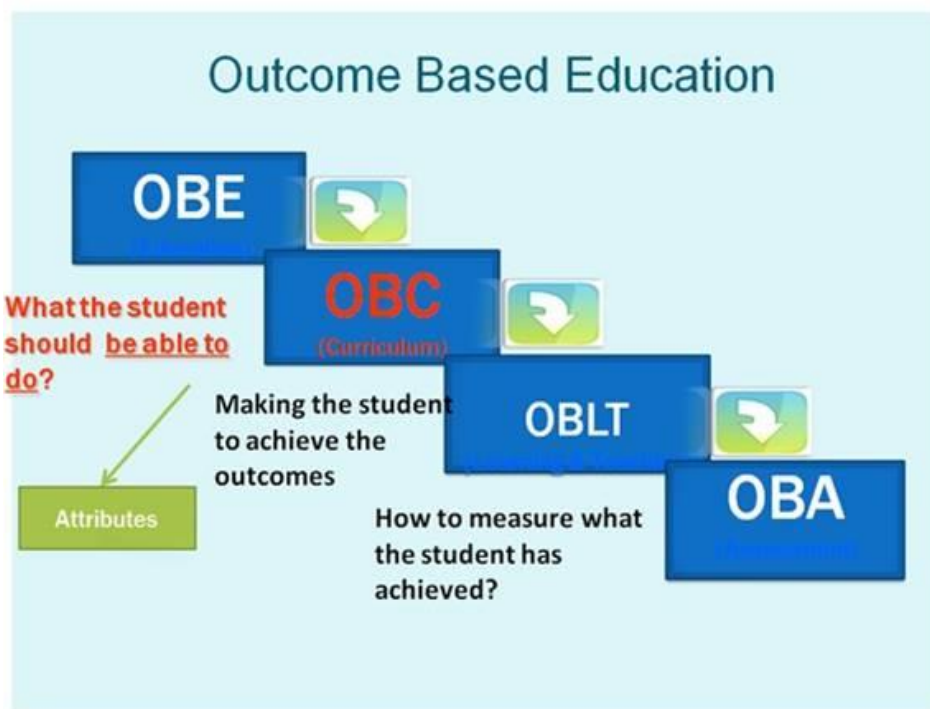


Figure 4.1. Outcome Based Education Framework

4.2 KEY constituents of OBE

Figure 4.2 shows the key constituent of OBE.

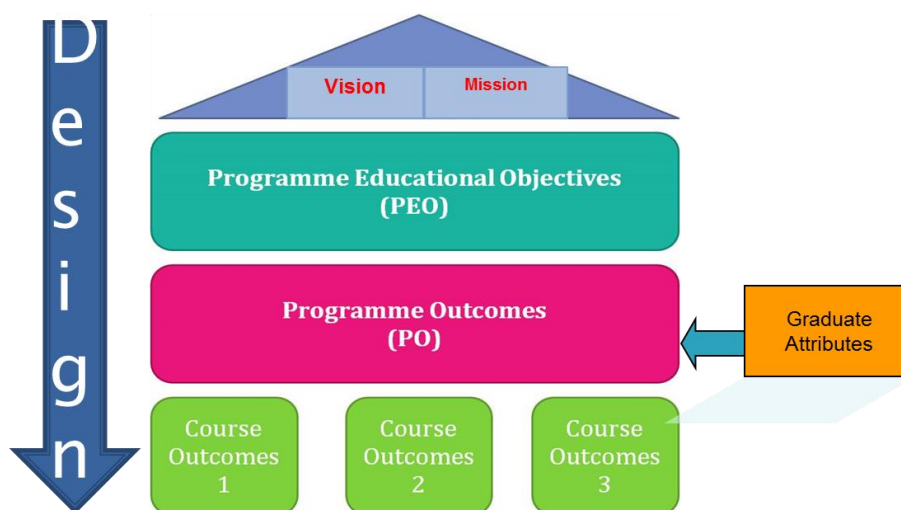


Figure 4.2. Key Constituents of OBE

4.2.1 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.

4.2.2 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.

4.2.3 Graduate Attributes (GA's)

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.

4.2.4 Program Outcomes (PO's)

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) of NBA. 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.

Following are POs (Ten) for all diploma engineering programs as per NBA guidelines-

1. **Basic Knowledge:** Ability to apply knowledge of basic Mathematics, Science and Engineering to solve the engineering problems
2. **Discipline Knowledge:** Ability to discipline specific knowledge to solve core and/or applied engineering problems
3. **Experiments and Practice:** Ability to plan and perform experiments and practices and use the results to solve engineering problems

4. **Engineering tools:** Apply appropriate technologies and tools with an understandings of limitations
5. **The Engineer and Society:** Demonstrate knowledge to assess the societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to engineering practice.
6. **Environment and Sustainability:** Understand the impact of engineering solutions in societal and environmental context, and demonstrate knowledge and need for sustainable development.
7. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
8. **Individual and Team work:** Function effectively as an individual, and as a member or leader in diverse/ multidisciplinary teams.
9. **Communication:** An ability to communicate effectively.
10. **Life-long learning:** Recognize the need for, and have preparation and the ability to engage in independent and life-long learning in context of technological changes.

4.2.5 Program Educational Objectives (PEO's)

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.

4.2.6 Program Specific Outcomes (PSO's)

No definition for PSO's is found in literature. According to Dr. B.L. Gupta, NITTTR, Bhopal, PSO's are the broad statements of Program specific outcomes as per the local needs.

4.2.7 Course Outcomes (CO's)

Course Outcomes (COs) are clear statements of what a student should be able to demonstrate upon completion of a course. They should be assessable and measurable knowledge, skills, abilities or attitudes that students attain by the end of the course. It

is generally a good idea to identify between four and seven. All courses in a particular programme would have their own course outcomes. These course outcomes are designed based on the requirement of the programme outcomes (POs). Each course outcomes are mapped to a relevant PO and they are mapped to the programme educational objectives (PEO). The teaching learning process and assessment methods are to be designed in such a way to achieve the COs. It is important to ensure that the student is able to acquire the knowledge or skill required. Table 4.1 clarifies the difference between Course Objectives Vs Course Outcomes

Table 4.1. Difference between Course Outcomes and Course Objectives.

Course Objectives	Course Outcomes
Describe what a teacher needs to teach, and what needs to be planned to teach.	Describe what students should demonstrate upon the completion of a course.
Example- At the end of the course, students will- Understand the types of wiring system.	Example- At the end of the course, students will be able to- Choose a suitable wiring system for particular installation.

4.2.8 Specific Learning Outcomes (SLO's) or Learning Outcomes (LO's)

Learning outcomes (LO's) or Specific Learning Outcomes (SLO's) are “*statements of what is expected that the student will be able to do as a result of learning the activity*”. (Jenkins and Unwin, 2001); i.e at the end of each unit or chapter. SLO's should also be assessable and measurable knowledge, skills, abilities or attitudes that students attain by the end of the unit

CHAPTER 5

Bloom's Taxonomy

Outcome-based education is an educational model in which curriculum and pedagogy and assessment are all focused on student learning. Learning is a relatively permanent change in behaviour potentiality that results from reinforced practice or experience. A group of educational psychologists led by Benjamin Bloom develops a taxonomy, or classification system, for learning. Some aspects of Bloom's Taxonomy is described below.

5.1 Introduction to Bloom's Taxonomy

Benjamin Bloom (1948) developed classifications of intellectual behaviour and learning in order to identify and measure progressively sophisticated learning. Bloom's taxonomy is especially important in higher education where outcomes need to address the student ability to use information, not just recall and regurgitate concepts. Lower levels of learning are easier to assess but do not adequately display what the student can do with the knowledge. However, learning is not a purely cognitive function; learning occurs differently when it entails performing a skill or re-evaluating behavior. This approach is based on biological structure of human being as shown in figure 5.1.

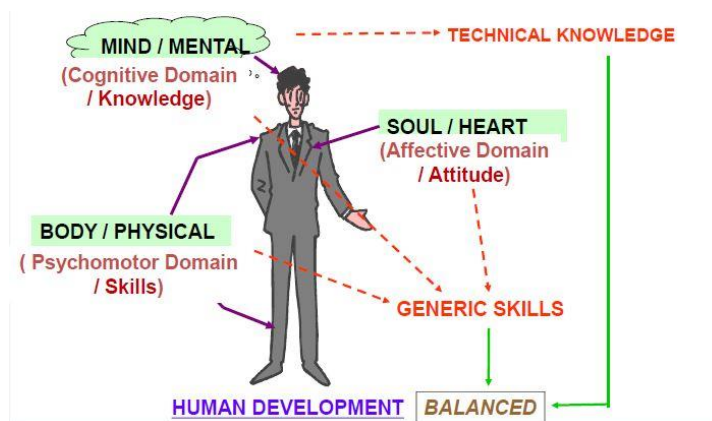


Figure 5.1. Human Being and Domains of Learning

Important elements of this approach which form basics of learning are explained below.

5.2 Domains of Learning

Learning is a process by which students develop relatively permanent change in mental associations through experience. This is how learning is defined by cognitive psychologists. Behavioral; psychologists define learning as a relatively permanent change in behavior. However, learning is not a purely cognitive function; learning occurs differently when it entails performing a skill or re-evaluating behavior.

There are following domains of learning:

- A: Cognitive Domain relates to intellectual skills or abilities
- B: Affective Domain relates to emotions, feelings, likes, dislikes etc.
- C: Psychomotor Domain relates to manipulative skills of hands, legs. Eye-hand coordination

In Engineering & Technology courses, endeavor is made to design curriculum with a focus on development of cognitive skills through classroom teaching, whereas manipulative (psychomotor) skills are developed in workshops, laboratories & seminars where students work individually or in a group. Development of affective skills attitudes and value is supposed to be acquired through projects and co-curricular activities. These are also developed from the work culture or institutions.

How far a student has developed these abilities/skills especially from cognitive and psychomotor domains is assessed on the basis of suitable examinations. When classroom and laboratory teaching is viewed in this light, evaluation becomes an integral part of teaching – learning process.

5.2.1 Cognitive Domain

Dr. Benjamin Bloom (1956) analysed questions asked in various examinations in American situation and proposed a hierarchical arrangement of instructional objectives (Intellectual abilities) tested by these questions.

The lowest level of cognitive learning achieved by a student is demonstrated by the recall of information that the student retrieves from his long term memory. So, the storage and retrieval of specific facts, concepts, principles, laws, definitions, properties, procedures etc. directly from memory was classified as a knowledge level objective. Thus questions

testing memory of students were treated as at the lowest level of the hierarchy of intellectual abilities. The other levels of hierarchy proposed by Dr. Bloom in 1956 relate to the degree of information processing required in the brain needed to provide answer to a question. The various levels in the cognitive hierarchy proposed by Dr. Bloom in 1956 and further revised in 2001 are shown in figure 5.2.

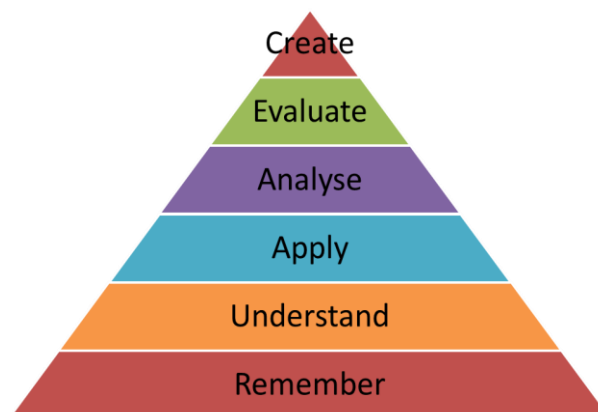


Figure 5.2. Revised cognitive hierarchy Levels

Table 5.1. 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

5.2.2 Psychomotor Domain

The Psychomotor Domain (RH Dave's version, 1970) was established to address skills development relating to the physical dimensions of accomplishing a task. Because, 'motor' skills extend beyond the originally traditionally imagined manual and physical skills, always consider using this domain, even if you think your environment is covered adequately by the Cognitive and Affective Domains. Whatever the situation, it is likely that the Psychomotor Domain is significant.

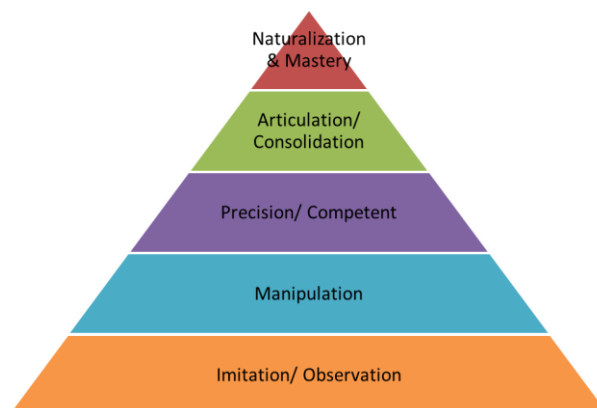


Figure 5.3. Psychomotor hierarchy Levels

Table 5.2. 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

5.2.3 Affective Domain

Affective Domain, was detailed by Bloom, Krathwhol and Masia (1964, *Taxonomy of Educational Objectives: Vol. II, The Affective Domain*.) Bloom's theory advocates this structure and sequence for developing attitude - also now commonly expressed in the modern field of personal development as 'beliefs'. As with the other domains, the Affective Domain detail provides a framework for teaching, training, assessing and evaluating the effectiveness of training and lesson design and delivery, and also the retention by and affect upon the learner or trainee.

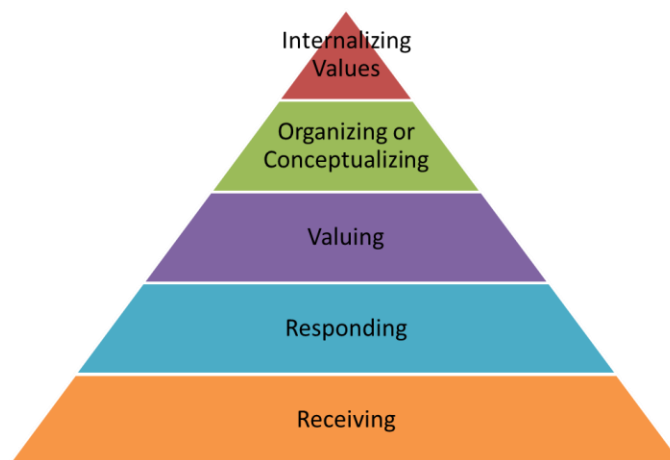


Figure 5.4. Affective Domain hierarchy Levels

Table 5.3. 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,

5.3 Program Outcomes and Domains of Learning

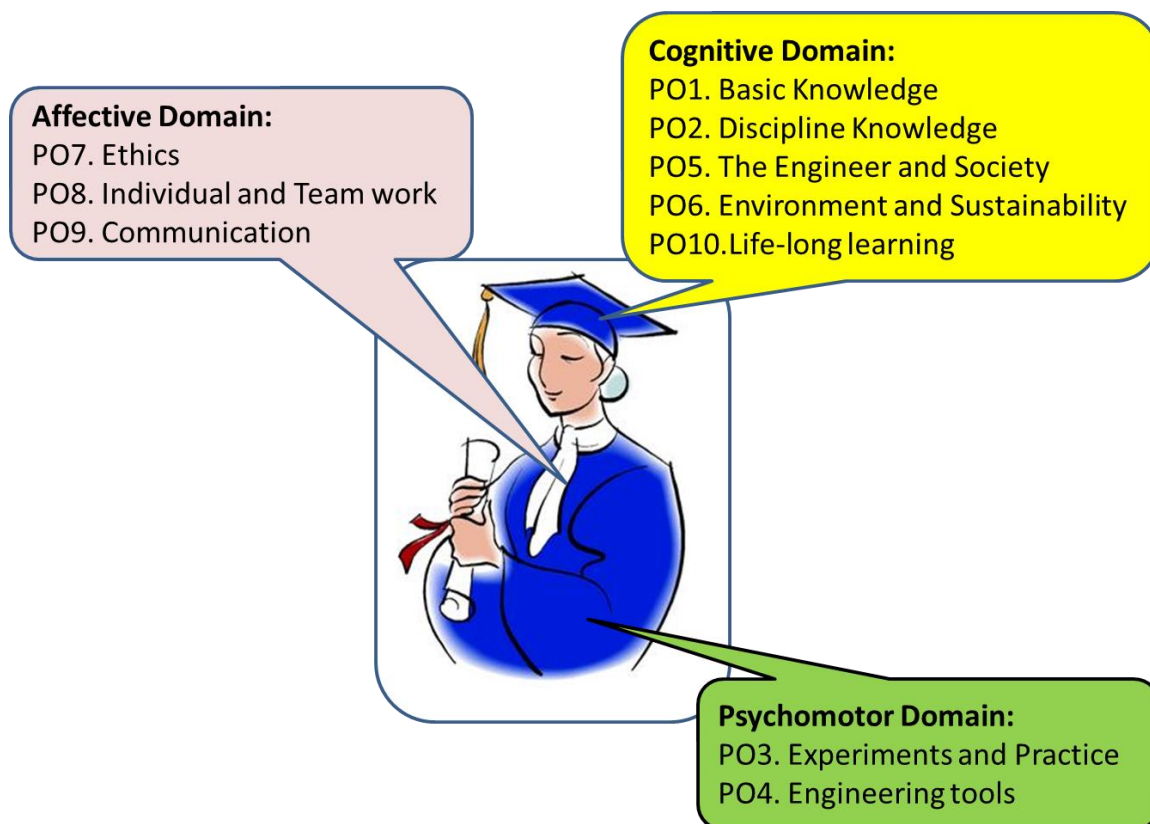


Figure 5.5. Program Outcomes and Domains of Learning

Program Outcomes (POs) framed by NBA for diploma students are the specific characteristics required by the stake holders in the students. There is definite relation between these outcomes with the three different domain of learning, which are described in figure 5.5. These classification plays major role while framing curriculum.

CHAPTER 6

Curriculum Revision Process

Since, autonomous status GPN revised curriculum after every 5 years. 2016 revision is the fifth revision. Concept of Bloom's Taxonomy is included in GPN curriculum since the beginning; however the complete model of OBE is adopted first time in the curriculum revision process. The complete curriculum revision process is described below.

6.1 Change Management

GPN is the diploma level educational institute is having total 12 diploma program, out of which 11 programs are under autonomous status. Curriculum revision of such 11 programs in a short period with the new unknown model is a huge task before CDC. It is natural reaction of human being even in the best circumstances for any change, is to resist.

GPN used ADKAR model for change management. This diagnostic tool helps our organization and our employees understand where they are in the change process. We use this tool to identify gaps in your change management process and to provide effective coaching for our faculties.

The ADKAR model is used to:

- manage faculties resistance
- help faculties transition through the change process
- create a successful action plan for curriculum development
- develop a strategy of curriculum development

6.1.1 ADKAR Model for Change Management

ADKAR has become very popular with managers and project teams because this change management model is easily applied and simple to teach to others, including executive sponsors of change. ADKAR stands for:

- **Awareness** : Awareness of the need for change
- **Desire** : Desire to participate and support the change
- **Knowledge** : Knowledge on how to change
- **Ability** : Ability to implement required skills and behaviors
- **Reinforcement** : Reinforcement to sustain the change

Following change management tools are used in curriculum revision process.

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

Figure 6.1 shows the mapping of these tools with ADKAR.

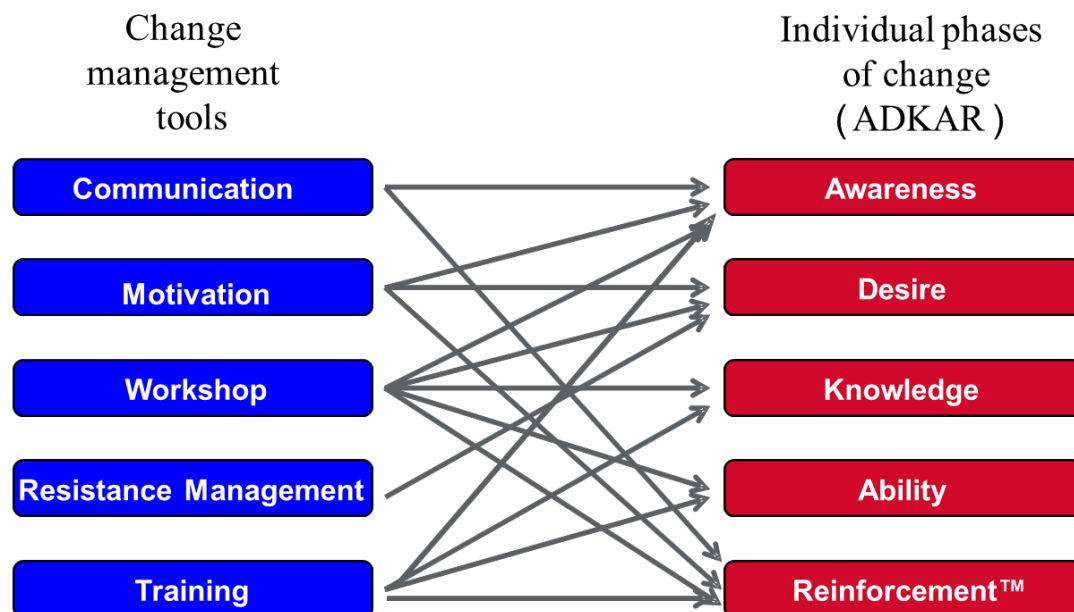


Figure 6.1. Mapping of change management tools with ADKAR

6.1.2 Results of ADKAR Model

As a result of using ADKAR model for change we got following results:

- Date of Starting curriculum Revision process : 23/01/2016
- Date of Completion of curriculum Revision process : 24/11/2016
- Time Period to complete curriculum Revision : 11 Months.
- No. of Programs for curriculum Revision : 11
- No. of Courses for curriculum Revision : 293
- Implementation of OBE curriculum from : July 2016

6.2 Curriculum Revision Process

Following Method is adopted for Development of Curriculum

- Study Outcome Base Education Philosophy
- Analyse OBE Curricula of Diploma in Engineering in India and Autonomous Institute (MS) curricula
- Analyse Model Diploma in Engineering curriculum by AICTE
- Compare 2011 curriculum with MSBTE existing curriculum
- Study NBA/AICTE/MSBTE/NSQF guidelines
- Organize Search Conference for validation of skills
- Collect Feedback (Program-wise) on existing curriculum from stake holders
- Curriculum mapping with POs to identify curriculum gaps
- Decide Institute Level policies
- Develop Model
- Prepare Action Plan for development
- Analyse and Brain storming at program level
- Develop Vision, Mission and PEOs and curriculum at program Level (Framing, Mapping, Editing, Revising)
- Approve from PBOS, BOS and GB.

6.2.1 Study of OBE Philosophy

CDC studies the OBE philosophy, which is described previously in this document. The training of faculties are arranged for awareness of faculties.

6.2.2 Analysis of OBE curricula

Following Boards in India adopted Outcome based curriculum for Diploma in Engineering:

- Gujarat Technological University-2014-15
- Board of Technical Examinations, Bengaluru, Karnataka- 2015-16
- State Board of Technical Education, Kerala state- 2015-16
- MSBTE is going for OBE from- 2017-18

The analysis of above OBE curriculum of each and every program is a huge task; however CDC studied curriculum of Diploma in Electrical Engineering of above said boards and analyze their curriculum based on the following points.

- Credits
- Credits Ratio TH:PR
- Total Courses
- Examination Scheme
- Comparison of Autonomous Curriculum in State

The results are shown in table 6.1 to 6.5

Table 6.1. Credits Comparison

Boards	Theory Periods	Practical Periods	Credits
GTU, Ahmedabad (OBE)	95	87	182
BTE, Bengaluru (OBE)	88	108 (2Pr=1Cr)	142
SBTE, Kerala (OBE)	NA	(2Pr=1Cr)	47 per Year
MSBTE, Mumbai (G scheme)	106	93	199
AICTE Model Curriculum	90	102 (2Pr=1Cr)	145
G. P. Nagpur (2011)	113	87	200

Table 6.2. Credit Ratio TH:PR Comparison

Boards	TH:PR
GTU, Ahmedabad (OBE)	52:48
BTE, Bengaluru (OBE)	62:32
SBTE, Kerala (OBE)	70:30 (I yr)
MSBTE, Mumbai (G scheme)	53:47
AICTE Model Curriculum	64:36
G. P. Nagpur (2011)	57:43

Table 6.3. Courses Comparison

Boards	Theory Courses	Practical Courses
GTU, Ahmedabad (OBE)	28	06
BTE, Bengaluru (OBE)	22	18
SBTE, Kerala (OBE)	NA	NA
MSBTE, Mumbai (G scheme)	31	12
AICTE Model Curriculum	29	16
G. P. Nagpur (2011)	29	12

Table 6.4. Examination Scheme Comparison

Boards	Theory		Practical	
	TEE	CA	TEE	CA
GTU, Ahmadabad (OBE)	70	30	20/40	30/60
BTE, Bengaluru (OBE)	100	25	50	25
SBTE, Kerala (OBE)	100	50	50	50

MSBTE, Mumbai (G scheme)	100	25	50	25/50
AICTE Model Curriculum	70	20*+10**	50	25
G. P. Nagpur (2011)	80	20	25	25/50

*Progressive Test

** Assignments

Table 6.5. Comparison of Autonomous Curricula

Institute	TH	TU	PR	Total	Theory Papers	Practical	Total Courses
G.P. Mumbai	96	12	68	176	25	13	38
VJTI, Mumbai	92	16	86	194	27	19	46
G.P. Aurangabad	103	00	81	184	26	13	39
G.P. Kolhapur	104	00	76	180	31	10	41
G.P. Nasik	111	03	82	196	29	11	40
G.P. Nagpur	113	05	82	200	29	12	41

6.2.3 Comparison with MSBTE Existing Curriculum

As mentioned 2.1.1, autonomous institutions shall be required to obtain equivalence for their courses and programs from the MSBTE, it is essential to compare GPN curriculum with existing curriculum for variation in content, Existing Courses for Revision/Deletion, New Courses proposed, detailed Comparison of Examination Scheme. This task is performed at program level. The analysis of this task is used to decide the course outcomes, course contents as well as to finalize the program structure of revised curriculum. The formats for the same are shown in table 6.6 to 6.9.

Table 6.6. Comparison of Existing Curriculum-2011 with MSBTE-2012 Curriculum

SN	MSBTE Curriculum				Equivalent course in Autonomous Curriculum				Content Variation if any with MSBTE
	Subject Code	Name of Subject	TH Periods	PR Periods	Course Code	Name of course	TH Credits	PR Credits	

Table 6.7. List of Existing Courses for Revision/Deletion etc.

Sr. No.	Course Code	Name of Course	Write-R (Revision) NR (No Revision) D (Deletion)	Reason for R/NR/D	Name of New title if proposed

Table 6.8. List of New Courses proposed

Sr. No.	Name of new courses proposed (if any)	Reason for introduction of New courses

Table 6.9. Comparison of Examination Scheme with MSBTE Curriculum

Sr. No.	Points	MSBTE Curriculum	Autonomous Curriculum	Remarks if any
1	Theory Paper Maximum marks			
2	Practical Maximum marks			
3	Progressive Test Maximum marks			
4	Term work Maximum marks			
5	No. of subject/courses having internal practical exam.			
6	No. of subject/courses having external practical exam			

7	No. of subject/courses having internal oral exam			
8	No. of subject/courses having external oral exam			
9	No. of subject/courses having term work			
10	No. of non-exam subject/courses			
11	Industrial training included in curriculum (Yes/No)			

6.2.4 Study of NBA/AICTE/MSBTE Guidelines

The guidelines given in following documents are studied, and the final conclusions are made to framed curriculum documents.

1. Orientation Workshop on Outcome Based Accreditation NBA training text material- to frame Vision, Mission of the Institute, Vision, Mission, PEOs of the program.
2. AICTE Guidelines- 21st Academic Council Meeting of AICTE on 3rd April, 2013 to decide percentage of various level courses. The abstract of the guidelines is mentioned in the table 6.10.

Table 6.10. Abstract of Guidelines

S. N.	Levels	Percentage	Course Heads
1	General	5 to 10%	Language / Communication skills
			Humanities and Social Science
			Economics & Principle of management
			NSS, NCC, NSO, Rural Development
2	Basic Science	15 to 25%	Computer literacy with numerical analysis
			Mathematics
			Physics
			Chemistry

3	Engineering Sciences and Technical Arts	15 to 25%	Engineering Graphics
			Workshop Practice
			Engineering Mechanics
			Electrical Science I (Basic Electrical Engineering)
			Thermodynamics and Heat Transfer
			Material Science and Engineering
			Electrical Science II (Electronics and Instrumentation)
4	Professional Subjects	55 to 65%	
i)	Professional Core	22.5 to 27.5%	Minimum number of Core courses suggested by experts
ii)	Professional Elective	12.5 to 15%	About 10% Electives should be made available to the students
iii)	Free Elective	7.5 to 10%	Open interdisciplinary electives allow a student to diversify his/her spectrum of knowledge
iv)	Project	5 to 10%	
v)	Seminar & Industrial Training	2.5 to 5%	

3. MSBTE Guidelines MSBTE/D-10/Director/2012/303 Dt.1st October, 2012-

The important guidelines given by MSBE are as follows:

- Credits should not be more than 160 and should be uniform across the program
- Curriculum should be laboratory based and having more practical weight age
- Curriculum should be restricted to five levels
- 4th and 5th level courses are considered for award of diploma
- Practical Examination should be based on performance only.

- Implant training should be made compulsory any time in vacation after first year and separate credits should be given.
- Online examination of courses should be start gradually. To begin with one course per semester.

6.2.5 Search Conference

The search conference is organized at institute level on dated 12/02/2016. The experts from the industries, academic institutions and alumni were present. The main objectives of organization of search conference are as follows:

- Validate generic and technical skills identified by the program.
- Suggest new skills to be developed in a technician pertaining to specific work area by industry/ field experts.
- Collect Feedback on existing curriculum and suggestions on previous received feedback.
- Suggest new course content to be incorporated in curriculum.
- Obtain suggestions on various topics related to program structure.
- Analyze and prepare a final list of generic skills and technical skills and from courses based on validated skills later on.
- Formation of Courses

6.2.6 Curriculum mapping

The 2011 curriculum is mapped to identify Program strengths (attributes that are widely addressed) and Gaps (attributes that are addressed by only a few learning experiences).

The simplest form of curriculum map is a matrix whose rows are the learning experiences (curriculum courses) and columns are the Graduate attributes (or Program Outcomes).

The curriculum courses include General Studies Courses, Basic Science Courses, Engineering Sciences and Technical Arts Courses, Professional Courses (Core, project, seminar etc.), Elective Courses.

To establish the curriculum map, each faculty member reviews his/her courses and identifies the attributes that are addressed in the course based on its content and materials.

A sample curriculum mapping sample is shown in Table 6.10. Program wise curriculum mapping is given in subsequent chapter.

Table 6.11. Curriculum mapping (Sample)

SN	Course code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
			Basic Knowledge	Discipline Knowledge	Experiments and Practice	Engineering tools	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team work	Communication	Life-Long Learning	Maintain Electrical Equipment's	Maintain Electrical Power System
1	EV1101	Environmental science	X	-	-	-	X	X	X	X	X	X	-	-
2	EE1301	Basic Electrical Engineering	X	X	X	X	-	-	X	X	X	X	X	X
3	EE1401	Electrical Circuit and Network	X	X	X	X	-	-	-	X	-	X	X	X
4	EE1402	Electrical Measurement	-	X	X	X	X	-	X	X	-	X	X	X

6.2.7 Institute Level Policies

Institute level policy for curriculum development is decided by the CDC on the basis of followings:

- OBE Model
- Analysis of various curriculum Autonomous Institute/ MSBTE curriculum/ OBE curriculum
- NBA/AICTE/MSBTE Guidelines
- Feed Back from stake holders
- Search Conference Outcomes
- Curriculum Mapping of 2011 curriculum and
- GPN 2011 Curriculum

The following institute level suggestions are forwarded to the various programs for framing program structure.

1. Levels of Courses V

- **Level I- General studies courses- 5 (5 to 10%)**

1. English
2. Communication Skill
3. Environmental science
4. Economics & Management
5. Rural development (Non Theory)

- **Level II- Basic Science Courses- 6 (15 to 25%)**

6. C programming (including introduction to office tools) (Non Theory) (Note: Letter on this course is changed to Computer Applications as suggested in CM/IT PBOS)
7. Physics
8. Chemistry
9. Mathematics-I
10. Mathematics-II
11. Mathematics- III

(Note: The program which does not require mathematics-III course, may opt for more Computer literacy with numerical analysis courses. Letter on three mathematics courses are converted into two mathematics courses, by increasing the credits)

- **Level III Engineering Sciences and Technical arts courses- 7 (15 to 25%) (should be programme specific)**

12. Engineering Graphics (Theory)
13. Workshop Practice (program specific) (Non Theory)
14. Electrical Science I (Basic Electrical Engineering)
15. Electrical Science II (Electronics and Instrumentation)
16. Material Science and Engineering (program specific)

17. Engineering Mechanics

18. Thermodynamics and Heat Transfer (or mechanical related e.g. Elements of Mechanical Engineering for EE or program specific as per the experts suggestions)

- **Level IV- i) Professional Core Courses– 11- 22.5% to 27.5%**

19. to 27- Theory cum Practical Courses

28 to 29 – Practical courses (Non-Theory)

(Note: Letter on number of core courses are increased to 14)

- ii) **Project Courses- 5 to 10%**

30 to 31 – Practical Courses prerequisite for project (Non-Theory) Department specific workshop + program related design laboratory

32. Industrial Project

- iii) **Seminar and Industrial Training Courses- - 2.5 to 5%**

33. Seminar

34. Industrial Training/Practices

- **Level V- Elective Courses– 11- 22.5% to 27.5%**

- i) **Professional Elective Courses- 5/8 - 12.5 to 15%**

35. to 42- Theory cum Practical Courses

(Note: Letter on number of professional electives are changed to 3/6)

- ii) **Free Elective- 7.5 to 10%**

43. Finishing School (Common for all Brach)

44 to 53. Any one Elective Course each from 10 programs

(Note: Letter on number of electives courses are changed to 1/12)

2. **Detailed Curriculum Response**

CDC has suggested the various responses on various criteria based on the above study and are given in table 6.12

Table 6.12. Suggestive Curriculum at a Glance

SN	CRITERION	Suggestive RESPONSE
1	Total No. of Courses in a Program	55*
2	Total courses required.	41
3	No. of courses having theory papers.	29
4	No. of courses having non Theory exam.	12
5	No. of General Studies courses	5
6	No. of Basic Science Courses	6
7	No. of Engineering Science courses	7
8	No. of Professional Core courses	11
9	No. of Professional Elective courses	5/8
10	No. of Professional Free Elective courses	2/10*
11	No. of Project courses	3
12	No. of Seminar courses	2/3
13	Total credits (1 Th Hr = 1Credit & 2 Pr Hr = 1Credit)	150-155
14	Total marks	4600 (approx.)
15	Proportion of Hours (Periods), Th : Pr	50:50 (approx.)
16	Proportion of credits, Th : Pr	65:35 (approx.)
17	Proportion of marks; Th : Pr	50:50 (approx.)
18	Total courses for Award of Class	12
19	Total theory paper courses for Award of Class	10
20	Total marks for Award of Class	1600

6.2.8 Development of Curriculum Revision Model

Top to bottom design approach model of OBE described in Figure 4.2 is found in literature. No other model is found in literature. OBE is not only top to bottom design approach; it is a 360⁰ approach model. Based on this 360⁰ CDC developed our own model based on the study described above. Government Polytechnic, Nagpur model is named as GoPoNa Model. The model is as shown in figure 6.2.

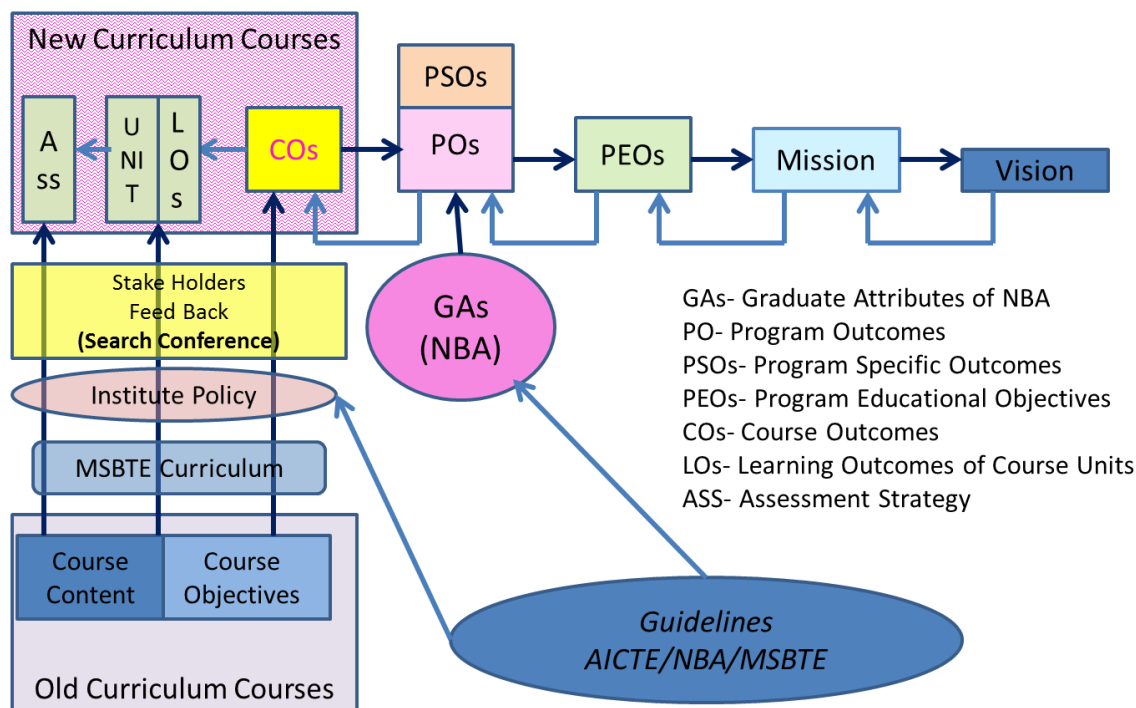


Figure 6.2. GoPoNa Model

GoPoNa Model is based on the OBE philosophy, various guidelines framed by the AICTE/NBA/MSBTE, and Search conference outcomes (feedback from stake holders). As OBE is 360⁰ approach various feedback loops are provided in the model for continuous improvement. The model is self-explanatory.

6.2.9 Preparation of Action Plan

Due to time constraint it is decided that the curriculum development process should be divided in to two phases. In first phase Curriculum of common courses i.e. Level I, II, III

are to be develop. And in second phase program specific courses of level IV and V are to be developed. The action plan is prepared for the both phases and is shown in table 6.13 and table 6.14 respectively.

Table 6.13. First Phase Action Plan

S.N.	Activity	Period/Date of Completion, up to
1	- Formation of PBOS at departmental level - Formation of institute level committee for deciding common policies. - Formation of committee for deciding Basic Engg. , Science and CNE courses policies	31/12/2015
2	Comparison of 2011 curriculum with MSBTE curriculum (Preliminary Task)	02/01/2016
3.	Meeting for deciding common policies of outcome based curriculum at institute level.	19/01/2016
4	Meeting for deciding policies of Basic Engg. , Science and CNE courses.	19/01/2016
5	Workshop for outcome based design procedure	22/01/2016
6	Preparation of Vision, Mission statements, POs and COs at program level	01/02/2016
7	Preparation of program structure based on outcome based education (course titles, scheme etc) by all programs (first draft, based on the information/data received from industries) & submission to I/C CDC.	10/02/2016
8	Checking of first draft of program structure of all program by curriculum revision committee (CDC) and return to respective program suggesting necessary corrections if any.	17/02/2016
9	Preparation of revised draft, if required, of program structure by the program and submission to CDC.	24/02/2016
10	Search conference for Validation of skills, program structure and course content detailing by all programs at department level.	02/03/2016
11	Course Content detailing of I, II & III sem. courses strictly as per Guideline of Curriculum Revision , information obtained from industries, content detailing format , feedback of MSBTE equiv. committee etc.	11/03/2016
12	Revising program structure, course content based on the outcome of search conference(if required)	19/03/2016

13	Arranging Program-wise Board of studies meeting (PBOS) of all program for courses of all levels by respective Program.	31/03/2016
	Suggestions in PBOS if any to be incorporated for getting approval from PBOS.	
14	Submission of curriculum of I, II & III sem. courses (soft copy) by program head/ “coordinator – curriculum” of program, to I/C CDC.	07/04/2016
15	Finalizing/checking of curriculum of I, II & III sem. courses of all program by Curriculum Revision Committee & submission to respective programs.	14/04/2016
16	Presentation of curriculum structure and courses in BOS meetings.	20/04/2016
17	Presentation of curriculum structure and courses in G.B. meetings	27/04/2016

Table 6.14. Second Phase Action Plan

S.N.	Activity	Period/Date of Completion, upto
1	Course Content detailing of III (if any), IV & V Level. courses strictly as per Guideline of Curriculum Revision , information obtained from industries, content detailing format , feedback of MSBTE equiv. committee etc.	06/06/2016 to 07/08/2016
2	Revising program structure, course content based on the outcome of search conference(if required)	14/08/2016
3	Arranging Program-wise Board of studies meeting (PBOS) of all program for courses of all levels by respective Program.	Up to 24/08/2016
4	Suggestions in PBOS if any to be incorporated for getting approval from PBOS.	
5	Submission of curriculum of IV & V level courses (soft copy) by program head/ “coordinator – curriculum” of program, to I/C CDC.	31/08/2016
6	Finalizing/checking of curriculum of IV & V level courses of all program by Curriculum Revision Committee & submission to respective programs.	01/09/2016
7	Presentation of curriculum structure and courses in BOS meetings.	07/09/2016 08/09/2016
8	Presentation of curriculum structure and courses in G.B. meetings	Before Diwali Vacation

6.2.10 Analysis and Brain Storming at Program Level

As per the action plan, OBE philosophy, guidelines and outcomes of search conference faculties in the program develops the program Structure (PS) and curriculum of courses as a group task.

The draft program structure of Electrical Engineering (Described in chapter 7) and draft curriculum of Basic Electrical Engineering is developed (shown in table 6.16) by CDC as a model for development of various programs PS and curricula.

Table 6.15. Program Structure Level I (sample)

PROGRAM STRUCTURE												
Level I: General Studies												
DIPLOMA IN ELECTRICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
				TH	TU	PR		Theory		Practical		Total Marks
								TEE	CA	TEE	CA	
1	EN101E	English	Nil	03	00	02	04	70	30	50 [@]	25	175
2	EN102E	Communication Skills	Nil	03	00	02	04	70	30	50 [@]	25	175
3	MN101E	Industrial Organization & Management	Min.60 credits	04	00	00	04	70	30	Nil	Nil	100
4	EV101E	Environmental Science	Nil	01	01	00	02	70 ^{**}	30	Nil	Nil	100
5	RD101E	Rural Development	Nil	00	00	02	01	Nil	Nil	50 [@]	25	75
Total				11	01	06	15	280	120	150	75	625

- Abbreviations:
TH – Theory ; PR- Practical; TU- Tutorial; TEE- Term End Examination; CA- Continuous Assessment
- *Credit Formula: 1 TH Hr. = 1 Credit; 1 TU Hr. = 1 Credit; 2 PR Hrs. = 1 Credit
- Symbolic Representation
** Online Examination, @ Internal Practical Examination, # External Practical Examination, \$ Award of class course.

6.2.11 Development of Vision, Mission and PEOs and Curriculum

Vision and Mission of the Institute is revised by the CDC in consultation with all the programs, industry experts, academic expert and alumni in search conference. Vision,

Mission, PSOs and PEOs of the programs are developed by program itself in consultation with industry experts, academic expert and alumni in search conference. Vision and Mission of the Institute is approved in BOS and GB and Vision, Mission, PSOs and PEOs of the programs are approved in PBOS, BOS and GB.

6.2.12 Approval from AB, PBOS, BOS and GB

Program Structure, Curriculum of Science, Maths and Humanities departments are approved in AB and program specific courses are approved in PBOS of individual departments, Science, Maths and Humanities courses are also put before the PBOS of each program for approval, the suggestions obtained in PBOS are carried out before put it to BOS and all approved courses are put before BOS for approval. The approved curricula are put before GB for final approval. Table shows the details of PBOS, BOS and GB meetings.

6.3 Curriculum Revision at a Glance

• No. of Programs	:	11
• No. of Courses	:	291
• No. of GB Meetings	:	2
• No. of BOS Meetings	:	3
• No. of PBOS Meetings	:	33
• No. of AB Meetings	:	4
• No. of ILC Meetings	:	5
• No. of SCC Meetings	:	4
• No. of Coordinators Meetings	:	5
• Trainings Workshops	:	3
• Individual Department Trainings	:	13
• Search Conference	:	1
• No. of Faculties Involved	:	108
• No. of outside Experts Involved	:	46
• Days Spent for Curriculum Editing	:	26

CHAPTER 7

Model Course Curriculum

Model Course Curriculum of Basic Electrical Engineering is framed by CDC of GPN and circulates among the programs for development of various curricula. The workshop is arranged to describe the contents in it. The details are described below.

7.1 Basic Information

Following introductory information related to course is given in each curriculum.

PROGRAMME : **DIPLOMA IN ELECTRICAL ENGG.**
LEVEL NAME : **ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES**
COURSE CODE : **EE301E**

The unique method is developed for assigning course code for the various courses, which is described in Figure 7.1.

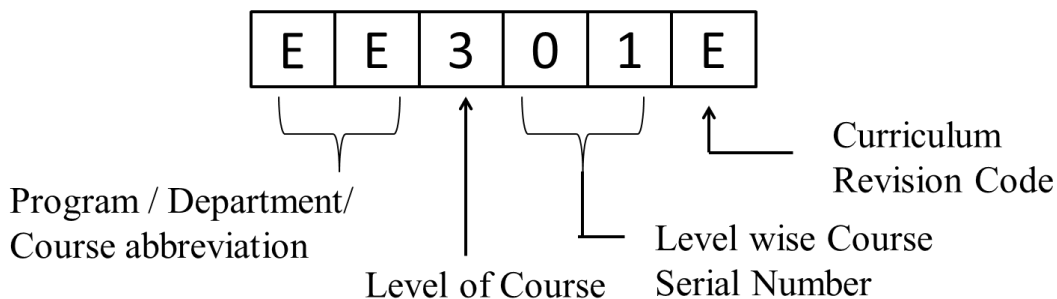


Figure 7.1. Course Code

COURSE TITLE : **BASIC ELECTRICAL ENGINEERING**
PREREQUISITE : **NIL**
TEACHING SCHEME: **TH: 04; TU: 00; PR: 02(CLOCK HRs.)**
TOTAL CREDITS : **05 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)**
TH. TEE : **03 HRs**
PR. TEE : **02 HRs (Internal)**
PT. : **01 HR**

7.2 Rationale

In rationale the importance of the course is described in brief.

7.3 Course Outcomes (COs)

COs are “Building Blocks” of OBE system. COs are measured at the end of the course. They are aligned with one or more POs and are closely related to the assessments. COs are measurable and assessable. Every course is having six COs.

Blooms taxonomy is important in higher education, where outcomes needs to be address the student ability to use information, not just recall, therefore all course outcomes are written in higher levels of learning. COs are based on all domains of learning to fulfill maximum POs and start with the action verb. The example of CO is given below showing domains of learning. CO1, CO2 and CO3 are in cognitive domain. CO4, CO5 and CO6 are in psychomotor domain. CO3 falls also under affective domain.

1. **Apply** electrical safety concept
2. **Use** principle and basic laws in electrical engineering for different applications
3. **Solve** simple electrical circuits.
4. **Connect** electrical measuring instruments in the circuit
5. **Record** the readings of various electrical meters.
6. **Operate** electrical equipment.

7.4 Course Details: Theory

Course content is limited to six units. Each unit is having topic and subtopic. Based on the content Specific Learning Outcomes (SLOs) in cognitive Domain are mentioned. Action verbs of Cognitive Domain in all levels of learning;

1. Knowledge,
2. Comprehension,
3. Application, Analysis, Synthesis, Evaluation.

These SLOs are in line levels of learning domains mentioned in specification table or vice versa. Table 7.1 shows example.

Table 7.1. Course Details Theory (sample)

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1. Electrical Safety	1. Apply electrical safety rules while working 2. Remove the electrocuted person from live conductor 3. Interpret electrical safety signs and symbols 4. Apply different methods of artificial respiration on electrocuted person 5. Select fire-fighting equipment on different types of fires.	1.1 Electrical Safety, Causes of accidents, General safety rules, Concept of electrical shock, Effect of electric shock, Method of removing electrocuted person, Safety signs and symbols. 1.2 Artificial respiration-schaefer's method, silvester's method, mouth to mouth respiration. 1.3 First Aid 1.4 Fire, Causes of Fire, Basic ways of extinguishing the fire Classification of fire, Class A, B,C, D, Fire fighting equipments, fire extinguishers, and their types .	06

7.5 Course Details Practical

All Specific Learning Outcomes (SLOs) are in psychomotor domain to develop the practical skills. Table 7.2 shows example.

Table 7.2. Course Details: Practical (sample)

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify electrical measuring instruments, sources, ICDP/ITDP, switches, loads, wires and execute safety precautions in laboratory.	1. Electrical Safety	4
2	Connect voltmeter, ammeter and wattmeter in electrical circuit.	2. Fundamentals of electricity	2
3	Measure the current, voltage and resistance with the help of multi-meter or tong tester.		2
4	Find unknown resistance using ohms law.		2
5	Find temperature coefficient of materials.		2

Skill test is mandatory to assess the skills acquire during the course work before term end examination.

7.6 Specification Table

Specification table is a blue print for setting question paper. It is useful for designing a valid question paper. In OBE 2016 curriculum; specification table is provided for question paper setting (as well as for student); which shows the level wise cognitive process dimensions. The sample Specification table is shown on table

Table 7.3. Specification Table (sample)

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Electrical Safety	00(02)	04(00)	00(00)	04(02)
02	Fundamentals of Electricity	06(02)	08(08)	06(00)	20(10)
03	DC Circuits	02(00)	04(00)	06(06)	12(06)
04	Electrostatics	02(00)	06(04)	00(00)	08(04)
05	Magnetism and Electromagnetism	06(04)	04(08)	06(00)	16(12)
06	AC Fundamentals	02(00)	08(00)	00(06)	10(06)
	Total	18(08)	34(20)	18 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

It is suggested that for:

- Basic Courses: R=30%; U=50%; A=20%
- Higher Level Courses: R=20%; U=50%; A=30%

7.7 Question Paper Profile (QPP)

Question paper profile (QPP) is the steps to words the step of e-governance. We can generate the question paper using computer program with the help of QPP and question bank on each bit of QPP. QPP is also the ready reckoner to the setter for setting questions on different levels of cognitive domain and topics. QPP reduces the process time of printed Question Paper for Examination.

Table 7.4. Question Paper Profile (sample)

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	1	R	2	5/7
	2	R	2																
02	2	R	4	1	U	4	2	U	4	2	U	4	2	U	4				3/5
03	5	R	4	2	U	4	3	U	4	4	U	4	5	U	4				3/5
04	5	U	4	6	U	4	6	U	4	5	U	4	5	R	4				3/5
05	4	U	6	2	A	6	3	A	6										2/3
06	3	A	6	5	A	6	6	A	6										2/3

2 Marks Bit- 5(2) = 7 Bits

4 Marks Bit- 9(6) = 15 Bits

6 Marks Bit- 4(2) = 6 Bits

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

7.8 Assessment and Evaluation Scheme

A detailed assessment and evaluation scheme is mentioned in curriculum in tabulated form as mentioned in table 7.5, which is self-explanatory.

Table 7.5. Assessment and Evaluation Scheme (Sample)

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Scripts	1, 2, 3
		Class Room Assignments		Assignments	10	--	Assignment Book	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Scripts	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	ST	Students	One skill test at end of term	20	--	Practical Answer Scripts	4,5,6
		Journal Writing		Assignments	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Practical Answer Scripts	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course Survey			End Of The Course	Questionnaires			

7.9 Scheme of Practical Evaluation

A detailed scheme of practical evaluation is mentioned in curriculum having practical examination in tabulated form, which is a guideline for development of rubrics for assessment purpose. A sample scheme of practical evaluation of EE301E is shown in table 7.6.

Table 7.6. Scheme of Practical Evaluation (Sample)

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment's. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs (if any)	10
4	Viva voce	10
	TOTAL	50

7.10 Mapping of Course Outcomes with POs and PSOs

All developed curricula are mapped with POs and PSOs of the program. The POs and PSOs which fulfilled by the curriculum content are identified first. Individual course outcomes written previously are then mapped with the POs and PSOs. A sample mapping of EE301E is shown in table 7.7.

Table 7.7. Mapping of COs with POs and PSOs (Sample)

Course Outcomes (COs)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	3	-	-	-	-	1	-	-	-	3	3
CO2	3	3	-	-	-	-	-	-	-	-	3	3
CO3	3	3	-	-	-	-	-	-	-	-	3	3
CO4	3	3	2	2	-	-	-	2	2	2	3	3
CO5	3	3	2	2	-	-	-	2	2	2	3	3
CO6	3	3	2	2	-	-	-	2	2	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

7.11 Reference & Text Books

A reference and text books required as per the content of curriculum are mentioned as a reference for the student as well as faculties. Only standard books having ISBN numbers are given priority in the document. A sample of EE301E is shown in table 7.8.

Table 7.8. Reference & Text Books (Sample)

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	81-219-1053-6
2.	A Text Book Of Electrical Technology Vol-I	B.L.Theraja, A.K.Theraja, S. Chand & Co Ltd., Reprint,2006	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, Reprint, 2009.	978-81-224-1042-6
5.	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

7.12 E-References

E-references as per the content of curriculum are mentioned as a reference for the student as well as faculties. Standard e-references are given priority in the document. These references are useful for students learning. A sample of EE301E is shown below.

- <http://nptel.ac.in/courses/108108076/1> , assessed on 18th January 2016
- <http://www.electrical4u.com> , assessed on 18th January 2016
- <https://www.youtube.com/watch?v=A9KSGAnjo2U>, assessed on 18th January 2016

7.13 List of Major Equipment's/Instruments with Specification

The list of major equipment's/ instruments required for performing the practical to developed psychomotor skills is mentioned in the document. A sample list of EE301E is shown below.

1. Ammeter MI 0-5-10 A
2. Voltmeter MI 0-150-300 V
3. Wattmeter 0-3000 W
4. Digital Multi-meter
5. Rheostat assorted sizes
6. Variable Inductor

7.14 List of Experts & Teachers who Contributed for Curriculum

The list of experts & teachers who contributed for curriculum is mentioned in the document followed by the signature of chairman PBOS and member secretary of PBOS for the authenticity of the curriculum.

S.N.	Name	Designation	Institute / Industry
1.			
2.			

 Sign. _____
 (Member Secretary PBOS)

 Sign. _____
 (Chairman PBOS)

CHAPTER 8

Curriculum Document

Detailed curriculum document of Diploma in **Metallurgical Engineering** is given below.

8.1 Vision of Institute

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

8.2 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.

8.3 Vision of Program

Vision of the Metallurgical Engineering Program:

To produce excellent, self-motivated, creative and ethical metallurgical technicians for industries and society.

8.4 Mission of Program

Mission of the Metallurgical Engineering Program:

M1: To develop and deliver quality academic programs in Emerging field of Metallurgical Engineering to empower the students to meet industrial needs with environmental concern.

M2: To adopt the best Instructive methods to maximize knowledge transfer.

M3: To provide the best facility, infrastructure and environment to the students and faculty members, creating an ambience conducive for excellence in Metallurgical Engineering education.

M4: To impart quality education to inculcate moral values, professional ethics and Entrepreneurial qualities

8.5 Program Educational Objectives (PEOs)

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

PEO1: To provide a strong background of science and humanities in order to use these tools in Metallurgical Engineering.

PEO2: To develop the ability to demonstrate technical and administrative competence.

PEO3: To develop innovative ideas of recent technology for benefits of society with environmental concern.

PEO4: To attain professional excellence through life-long learning and produce supervisors who ensure ethical and moral behavior.

8.6 Program Outcomes (POs)

PO1: Basic Knowledge: Ability to apply knowledge of basic Mathematics, Science and Engineering to solve the engineering problems

PO2: Discipline Knowledge: Ability to discipline specific knowledge to solve core and/or applied engineering problems

PO3: Experiments and Practice: Ability to plan and perform experiments and practices and use the results to solve engineering problems

PO4: Engineering tools: Apply appropriate technologies and tools with an understandings of limitations

PO5: The Engineer and Society: Demonstrate knowledge to assess the societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to engineering practice.

PO6: Environment and Sustainability: Understand the impact of engineering solutions in societal and environmental context, and demonstrate knowledge and need for sustainable development.

PO7: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO8: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse/ multidisciplinary teams.

PO9: Communication: An ability to communicate effectively.

PO10: Life-long learning: Recognise the need for, and have preparation and the ability to engage in independent and life-long learning in context of technological changes.

8.7 Program Specific Outcomes (PSOs)

PSO1: Select appropriate test method for inspection of castings and other metallurgical products.

PSO2: Engage in preparing charge for producing quality steel.

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

8.8.1 Mapping of Vision and Mission

Table 8.1. Mapping of Vision-Mission

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

8.8.2 Mapping of Mission and PEOs

Table 8.2. Mapping Mission-PEOs

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

8.8.3 Mapping of PEOs and POs- PSOs

Table 8.3. Mapping PEOs-POs & PSOs

PEOs	Program Outcomes (POs)										PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PSO1	PSO2
PEO1	✓											
PEO2		✓	✓	✓				✓				
PEO3		✓	✓	✓				✓		✓	✓	✓
PEO4							✓	✓	✓			✓
PEO5					✓	✓					✓	

8.9 Identified Skills in Search Conference

8.9.1 Technical skills for Metallurgical Engineering Diploma Students

1. Prepare engineering drawings using codes, norms and standards manually as well as through CAD software.
2. Prepare simple jobs correctly according to given specification using various tools, measuring instruments and machines for different operations in fitting, smithy, carpentry, pipefitting and metal joining shop.
3. Use various measuring (linear, area, volume, angular, gear, thread, roughness, straightness, squareness, flatness, roundness, pressure, temperature, flow, etc) and gauging instruments-Analog and digital based.
4. Use destructive and nondestructive testing methods.
5. Use foundry materials and simple equipments to cast ferrous and non ferrous materials using material technology and strength of material.
6. Use arc, gas and spot welding and cutting processes to prepare simple jobs.

- 7 Understand Principles of Metal Working.
- 8 Know the basics of rolling, forging and extrusion.
- 9 Be familiar with the constructional details and types of rolling mills.
- 10 Identify the defects in end rolled, forged and extruded products and apply corrective measures.
- 11 Understand Principles & Procedures of various wire drawing and rod drawing methods.
- 12 Be familiar with Equipment's used in different methods.
- 13 Know the applications & range of products of different forming methods.
- 14 Interpret the defects in end products & apply corrective measures.
- 15 Understand the principles of Iron Making.
- 16 Know the different methods of production of Iron.
- 17 Know the constructional details of Blast Furnace.
- 18 Acquire knowledge regarding raw materials required for iron production.
- 19 Understand the sequence of reactions in Blast Furnace.
- 20 Be familiar with sponge iron production methods.
- 21 Be familiar with various Pyro, Hydro & Electro Metallurgical methods of extraction of Non-ferrous Metals.
- 22 Appreciate the different ore dressing operations involved in extraction of non – ferrous metals.
- 23 Get acquainted with roasting, leaching,, smelting stages involved in extraction.
- 24 Understand the principles involved in extraction of non ferrous metals.
- 25 Know the Indian Position regarding the sources of raw materials & status of Non-Ferrous Industries.
- 26 Be familiar with different macro and micro structures of ferrous and non ferrous metals and alloys and their interpretation.
- 27 Prepare specimen for macro and micro examination.
- 28 Understand the Principle of Heat treatment.
- 29 Acquire knowledge of various Heat treatment processes for ferrous & Non-Ferrous metals & alloys.
- 30 Compare different surface treatment processes
- 31 Understand the importance of special casting.
- 32 Be familiar with various Foundry Practices.
- 33 Know the common defects observed in casting, their causes and remedies.

- 34 Know the various aspects of Metallurgical Design.
- 35 Develop proficiency in Metallurgical Design.
- 36 Understand the Principles of Powder Metallurgy.
- 37 Know the applications of Powder Metallurgy.
- 38 Understand the principle of Ore-Dressing.
- 39 Be conversant with various Mineral Dressing methods.
- 40 Understand the Principles of Ferro alloy production.
- 41 Know the different Methods of Ferro alloy production
- 42 Understand the corrosion.
- 43 Understand the Principles of alloy steel production.
- 44 Know the different Methods of alloy steel production

8.9.2 Generic skills for Metallurgical Engineering Diploma Holder

- 1 Learn skills to develop personal traits.
- 2 Expand the area of learning beyond communication.
- 3. Draw motivation from various sources.
- 4. Learn to draft technical letters.

8.10 2011 Curriculum Mapping with Program Outcomes (POs)

The 2011 curriculum is mapped to identify Program strengths (attributes that are widely addressed) and Gaps (attributes that are addressed by only a few learning experiences). The mapping table is shown below.

Table 8.4. 2011 Curriculum Mapping with POs & PSOs

Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
	Basic Knowledge	Discipline Knowledge	Experiments and Practice	Engineering tools	The Engineer and Society	Environment and	Ethics	Individual and Team work	Communication	Life-Long Learning	Select appropriate test method for	Engage in preparing charge for
EN1101	X	=	X	=	=	=	=	X	X	X	=	=
EN1102	X	=	X	=	=	=	=	X	X	X	=	=
IT1101	X	=	X	X	=	=	=	X	X	X	=	=
ME1101	X	X	X	X	=	=	X	X	X	X	X	=
PH1201	X	=	X	X	=	=	=	X	=	X	=	=
CH1201	X	=	X	=	=	=	=	X	=	X	=	=
MH1201	X	=	X	=	=	=	=	X	=	X	=	=
MH1202	X	=	X	=	=	=	=	X	=	X	=	=
EC1313	X	X	X	X	=	X	=	X	=	X	X	X
EV1101	X	=	=	=	X	X	X	X	X	X	=	=
EE1301	X	=	X	X	=	=	X	X	=	X	=	=
MT1302	X	X	X		-	-	-	X		X	-	-
MT1303	X	X	X		-	-	-	X	-	X	-	-
MT1304	X	X	X		X	X	-	-	-	-	-	-
MT1401	-	X	X		-	X	-	X	-	X	-	-
MT1402	-	X	X		-	-	-		X	X	-	-
MT1403	-	X	X		X	-	-	X		X	X	X
MT1404	-	X	X	X	X	-	-	X		X	X	X
MT1405	-	X	X	X	X	-	-	X		X	-	-
MT1406	-	X	X	-	-	-	-	X		X	-	-
MT1407	-	X	X	-	X	X	-	X		X	-	-
MT1408	-	X	X	-	-	X	-	X		X	-	-
MT1409	-	X	X	X	X	-	-	X		X	X	X
MT1410	-	X	-		-	X	-					
MT1411	-	X	X	-	-	-	-	X		X	-	-
MT1412	-	X	X		-	-	-	X		X	-	-
MT1413	-	X	X	-	-	-	-	X		X	-	-
MT1414	-	X	X	-	X	X	-	X		X	-	-
MT1415	-	X	X	X	X	X	-	X		X	-	-
MT1416	-	X	X	-	-	X	-	X		X	-	-
MT1501	-	X	X	X	-	X	-	X		X	-	
MT1502	-	X	X	X	-	X	X	X		X	-	-
MT1503	-	X	X	X	-	X	X	X		X	X	X

8.10.1 Identified Gaps in 2011 Curriculum

2011 curriculum mapping with Program Outcomes (POs) and Program Specific Outcomes (PSOs) are carried out. It is found that, the content in 2011 curriculum related to following POs are less related to other POs.

1. PO4: Engineering Tools
2. PO5: The Engineer and Society
3. PO6: Environment & Sustainability
4. PO7: Ethics
5. PO9: Communication

Therefore, to fulfill these gaps some common courses and program specific courses are suggested in curriculum

Common Courses:

1. Rural Development
2. Finishing school
3. Industrial Training / Industrial practices
4. Free Electives (Total twelve courses)

Program related courses:

1. Computer Aided Drawing
2. Metallurgical Workshop

8.11 Courses Identification

Courses are formed based on identified skills in search conference, identified gaps in 2011 curriculum, AICTE guidelines and institute policy framed by ILC. The following table shows the identified skills and courses formed based on it.

Table 8.5. Courses Identification from Identified Skills

Identified Skills	Courses
- To lay a strong foundation of English through grammar. - To teach correct structure of word and sentences	English
- To acquire skills to learn efficiently. - To enable the students to have broader vision.	Communication skills

To face problems with confidence.	
- Effective use of office tools for preparing documents ,worksheet & presentation - Effective Use of internet facilities.	C programming
- To get acquainted with the industrial work culture. - To get acquainted with Human Resource Development Activities in Industries. - To get acquainted with the activities of Marketing Management. - To get acquainted with Basics & financial Management. - To get acquainted with industrial acts. - To get acquainted with auditing in Management	Industrial Organization and management
- To present sample case studies of natural disasters - To prepare reports on various issues related to environmental pollution	Environment Studies
- Select proper measuring instruments on the basis of range and its least count. - Calibrate different measuring instrument. - Transform one unit from one system to another system of unit. - Test physical properties for practical application. - Verify the principal and laws.	Engineering Physics
- Develop analytical skills for various analysis - Analyze the water sample (Acidity, alkalinity , hardness ,PH value) - Find the percentage of iron in given ferrous alloy - Prepare Bakelite plastic. - Compare rate of corrosion	Chemistry
- To calculate the unknown quantities - derive, prove the mathematical expression	Engineering Mathematics
To develop logical thinking which is useful in comprehending the principles of all other subjects?	Applied Mathematics
- Drawing - Calculating - Judgment of object	Engineering Graphics
- Handling different machines - Operating different M/Cs - Setting of Job - Marking for preparation of job	Workshop Practice
Calculating stress ,strain, identify Beam structure,	Engineering Mechanics

specify the different forces, mention different trusses	
● Be familiar with Equipment's used in different methods Interpret the results of Proximate Analysis.Be familiar with different Crystal structures ,Planes and directions. Know the applications of thermocouples and Pyrometers. ● Be familiar with various types of furnaces and their applications.Appreciate the applications of refractories, solid ,liquid and gaseous fuels.	Basic Metallurgy
● Be familiar with various Pyro, Hydro & Electro Metallurgical methods of extraction of Non-ferrous Metals. ● Appreciate the different ore dressing operations involved in extraction of non – ferrous metals. ● Get acquainted with roasting, leaching,, smelting stages involved in extraction. ● Understand the principles involved in extraction of non ferrous metals. ● Know the Indian Position regarding the sources of raw materials & status of Non-Ferrous Industries. ● Be familiar with different macro and micro structures of ferrous and non ferrous metals and alloys and their interpretation. ● Prepare specimen for macro and micro examination. ● Be familiar with Equipment's used in different methods. ● Interpret the defects in end products & apply corrective measures	Non Ferrous Metallurgy
● Understand the Principles of Powder Metallurgy. ● Know the applications of Powder Metallurgy. ● Be familiar with Equipment's used in different methods. ● Interpret the defects in end products & apply corrective measures ● Use destructive and nondestructive testing methods	Powder Metallurgy
● Understand the importance of special casting. ● Be familiar with various Foundry Practices. ● Know the common defects observed in casting, their causes and remedies. ● Use destructive and nondestructive testing methods. ● Use foundry materials and simple equipments to cast ferrous and non ferrous materials using material technology and strength of material. ● Be familiar with Equipment's used in different methods. ● Interpret the defects in end products & apply corrective measures. Use destructive and nondestructive testing	Foundry Technology-I

methods.	
• Understand the Principle of Heat treatment. • Acquire knowledge of various Heat treatment processes for ferrous & Non-Ferrous metals & alloys. • Compare different surface treatment processes • Be familiar with Equipment's used in different methods. • Interpret the defects in end products & apply corrective measures. Use destructive and nondestructive testing methods	Heat Treatment
• Understand the principles of Iron Making. • Know the different methods of production of Iron. • Know the constructional details of Blast Furnace. • Acquire knowledge regarding raw materials required for iron production. • Understand the sequence of reactions in Blast Furnace. • Be familiar with sponge iron production methods. • Use destructive and nondestructive testing methods	Steel Making
• Know the various aspects of Metallurgical Design. • Develop proficiency in Metallurgical Design	Met. Design And Drawing
• Understand Principles of Metal Working. • Know the basics of rolling, forging and extrusion. • Be familiar with the constructional details and types of rolling mills. • Identify the defects in end rolled, forged and extruded products and apply corrective measures. • Understand Principles & Procedures of various wire drawing and rod drawing methods. • Be familiar with Equipment's used in different methods. • Know the applications & range of products of different forming methods. • Interpret the defects in end products & apply corrective measures. • Use destructive and nondestructive testing methods.	Mechanical Metallurgy
• Understand the Principles of Ferro alloy production. • Know the different Methods of Ferro alloy production • Understand the corrosion. • Understand the Principles of alloy steel production. • Know the different Methods of alloy steel production • Use destructive and nondestructive testing methods	Alloy Steel
• Prepare engineering drawings using codes, norms and standards manually as well as through CAD software. • Prepare simple jobs correctly according to given specification using various tools, measuring instruments	Welding Technology

and machines for different operations in fitting, smithy, carpentry, pipefitting and metal joining shop. • Use arc, gas and spot welding and cutting processes to prepare simple jobs. • Use destructive and nondestructive testing methods.	
• Understand the importance of special casting. • Use destructive and nondestructive testing methods	Special casting Techniques
• Understand the principle of Ore-Dressing. • Be conversant with various Mineral Dressing methods. • Be familiar with Equipment's used in different methods. • Interpret the defects in end products & apply corrective measures. • Use destructive and non destructive testing methods. • Be familiar with environmental policies and safety rules and	Mineral Dressing
• Identify different parts of testing equipments • Prepare sample for test to be carried out. • measure hardness of various materials • Handle testing equipments. Interpret test result, • Prepare test report..	Testing Of Materials
• Draw phase diagram and Fe- Fe₃C diagram . • Prepare sample for microscopy and macroscopy. • Identify phases present in metals and non metals. • Handle image analyzer software.	Physical Metallurgy
• Acquire skills required for independent thinking & application to a specific problem. • Co-ordinate among themselves working in a group for solving a particular problem. • Develop liaison with relevant industries, institutes & other organizations. • Prepare a Project Report by collecting proper write up materials & giving final shape to a presentable form. • Deliver a seminar on the basis of their collective experiences	Project
• Follow the ethics & Values, Develop an industrial attitude, acquire hospitality, maintain discipline ,Keep cleanliness ,face interview, use logical thinking, manage account & finance ,lead the group, • Think about entrepreneurship,	Finishing School
• Repair electronic devices, maintain automobile equipments, draw the sketches , cook the food ,assemble computer components, testing of faults,	Free Electives

• Replace fuse, solder components, use internet & other modern communication technique , develop habit of yoga & meditation ,maintain physical health, prepare best from waste.	
• Develop energy generation project, Guide about energy conservation ,advice about saniterisation • Demonstrate the use of internet, provide materials, on agriculture technique, try solve their problems, aware them about the new banking technique, report writing.	Rural Development

8.12

Program Structure

The program structure of the Metallurgical Engineering program is developed as described in chapter 6 previously and is given below.

8.12.1 Program Structure Level I: General Studies

Table 8.6. Program Structure Level I: General Studies

DIPLOMA IN METALLURGICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
				TH	TU	PR		Theory		Practical		Total Marks
								TEE	CA	TEE	CA	
1	EN101E	English	Nil	03	00	02	04	70	30	50 [@]	25	175
2	EN102E	Communication Skills	Nil	03	00	02	04	70	30	50 [@]	25	175
3	MN101E	Industrial Management	Min.50 credits	04	00	00	04	70	30	Nil	Nil	100
4	EV101E	Environmental Science	Nil	01	01	00	02	70**	30	Nil	Nil	100
5	RD101E	Rural Development	Nil	00	00	02	01	Nil	Nil	50 [@]	25	75
Total				11	01	06	15	280	120	150	75	625

Abbreviations:

TH – Theory ; PR- Practical; TU- Tutorial; TEE- Term End Examination; CA- Continuous Assessment

Credit Formula: 1 TH Hr. = 1 Credit; 1 TU Hr. = 1 Credit; 2 PR Hrs. = 1 Credit

Symbolic Representations:

** Online Examination,

@ Internal Practical Examination,

External Practical Examination,

\$ Award of class course,

8.12.2

Program Structure Level II: Basic Science Courses

Table 8.7. Program Structure Level II: Basic Science Courses

DIPLOMA IN METALLURGICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
				TH	TU	PR		Theory		Practical		Total Marks
								TEE	CA	TEE	CA	
1	CA201E	Computer Applications	Nil	00	00	04	02	Nil	Nil	50 [@]	25	075
2	PH201E	Engineering Physics	Nil	04	00	02	05	70	30	50 [@]	25	175
3	CH201E	Applied Chemistry	Nil	04	00	02	05	70	30	50 [@]	25	175
4	MH201E	Engineering Mathematics	Nil	04	01	00	05	70	30	Nil	Nil	100
5	MH202E	Applied Mathematics	MH201E	04	01	00	05	70	30	Nil	Nil	100
Total				16	02	08	22	280	120	150	75	625

8.12.3

Program Structure Level III: Engineering Sciences and Technical Arts Courses

Table 8.8. Program Structure Level III: Engineering Sciences and Technical Arts Courses

Level III: Engineering Sciences and Technical Arts Courses

DIPLOMA IN METALLURGICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
				TH	TU	PR		Theory		Practical		Total Marks
								TEE	CA	TEE	CA	
1	ME302E	Engineering Graphics	Nil	02	00	04	04	Nil	Nil	50 [@]	25	75
2	WS301E	Workshop Practice	Nil	00	00	04	02	Nil	Nil	Nil	50	50
3	AM301E	Engineering Mechanics	Nil	03	01	02	05	70	30	50 [@]	25	175
4	EE306E	Electrical Technology	Nil	04	00	02	05	70	30	50 [@]	25	175
5	EC304E	Applied Electronics & Mechatronics	Nil	04	00	02	05	70	30	50 [@]	25	175
6	MT301E	Basic Metallurgy	Nil	04	00	02	05	70 ^{**}	30	50 [@]	25	175
7	MT302E	Metallurgical Thermodynamics	Nil	03	01	00	04	70	30	Nil	Nil	100
Total				20	02	16	30	350	150	250	175	925

8.12.4

Program Structure Level IV: Professional Courses

Table 8.9. Program Structure Level IV: Professional Courses

DIPLOMA IN METALLURGICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
				TH	TU	PR		Theory		Practical		Total Marks
								TEE	CA	TEE	CA	
a) Core Courses												
1	MT 401E	Testing of Materials ^{\$}	Nil	04	00	04	06	70	30	50 [#]	25	175
2	MT 402E	Mechanical Metallurgy ^{\$}	Nil	04	00	04	06	70	30	50 [#]	25	175
3	MT 403E	Iron Making	Nil	03	00	00	03	70	30	Nil	Nil	100
4	MT 404E	Steel Making ^{\$}	Nil	03	00	02	04	70	30	50 [#]	25	175
5	MT 405E	Non Ferrous Metallurgy	Nil	03	00	00	03	70	30	Nil	Nil	100
6	MT 406E	Physical Metallurgy ^{\$}	Nil	04	00	04	06	70	30	50 [#]	25	175
7	MT 407E	Heat Treatment ^{\$}	MT406E	04	00	04	06	70	30	50 [#]	25	175
8	MT 408E	Metallurgical Analysis ^{\$}	Nil	03	00	04	05	70	30	50 [#]	25	175
9	MT 409E	Foundry Technology	Nil	04	00	02	05	70	30	50 [#]	25	175
10	MT 410E	Special Casting Techniques ^{\$}	Nil	04	00	02	05	70	30	50 [#]	25	175
11	MT 411E	Powder Metallurgy	Nil	03	00	02	04	70	30	50 [@]	25	175
12	MT 412E	Mineral Dressing	Nil	03	00	02	04	70	30	50 [@]	25	175
13	MT 413E	Metallurgical Quality Control	Nil	03	00	00	03	70	30	Nil	Nil	100
14	MT 414E	Metallurgical Workshop	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
Sub Total (a)				45	00	34	62	910	390	550	275	2125

8.12.5

Program Structure Level IV: Professional Courses (Project Courses)

Table 8.10. Program Structure Level IV: Professional Courses (Project Courses)

DIPLOMA IN METALLURGICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
				TH	TU	PR		Theory		Practical		Total Marks
								TEE	CA	TEE	CA	
b) Project Courses												
15	ME 415E	Computer Aided Drawing	Nil	00	00	04	02	Nil	Nil	50 [@]	50	100
16	MT 415E	Metallurgical Design and Drawing ^{\$}	Nil	00	00	04	02	Nil	Nil	50 [#]	50	100
17	MT 416E	Industrial Project ^{\$}	Nil	00	00	04	02	Nil	Nil	100 [#]	50	150
Sub Total (b)				00	00	12	06	Nil	Nil	200	150	350
c) Seminar & Industrial Training												
18	SE401E	Seminar	60 credits	00	00	02	01	Nil	Nil	50 [@]	50	100
Any one from following												
19	ID401E	Industrial Training	70 credits	00	00	02	01	Nil	Nil	50 [@]	50	100
	ID402E	Industrial Practices		00	00	02	01	Nil	Nil	50 [@]	50	100
Sub Total (c)				00	00	04	02	Nil	Nil	100	100	200
Total (a) + (b) + (c)				45	00	50	70	910	390	850	525	2625

8.12.6

Program Structure Level V: Elective Courses

Table 8.11. Program Structure Level V: Elective Courses

DIPLOMA IN METALLURGICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
				TH	TU	PR		Theory		Practical		Total Marks
								TEE	CA	TEE	CA	
a) Professional Electives (Any Three)												
1	MT 501E	Welding Technology ^{\$}	Nil	03	00	02	04	70	30	50 [#]	25	175
2	MT 502E	Corrosion Engineering ^{\$}	Nil	03	00	02	04	70	30	50 [#]	25	175
3	MT 503E	Alloy Steel ^{\$}	MT 404E	03	00	02	04	70	30	50 [#]	25	175
4	MT 504E	Selection of Materials ^{\$}	Nil	03	00	02	04	70	30	50 [#]	25	175
5	WS 501E	Manufacturing Processes ^{\$}	Nil	03	00	02	04	70	30	50 [#]	25	175
6	ME 507E	Production Technology ^{\$}	Nil	03	00	02	04	70	30	50 [#]	25	175
Sub Total (a)				09	00	06	12	210	90	150	75	525
b) Free Elective – Non-Technical												
1	FS501E	Finishing School	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
Sub Total (b)				00	00	04	02	Nil	Nil	50	25	75

8.12.7

Program Structure Level V: Elective Courses

Table 8.12. Program Structure Level V: Elective Courses

DIPLOMA IN METALLURGICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
				TH	TU	PR		Theory		Practical		Total Marks
								TEE	CA	TEE	CA	
c) Free Electives Technical (Any one)				% Not offered for Program MT								
1	FE501E	Basic Building Drawings	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
2	FE502E	RAC Maintenance	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
3	FE503E	Electrical Maintenance	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
4	FE504E	Hobby Electronics	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
5	FE505E	Basic Packaging Technology	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
	FE506E	Industrial Metallurgical Practices %	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
6	FE507E	Computer Network	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
7	FE508E	PC Architecture & Maintenance	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
8	FE509E	Fabric Selection and Care	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
9	FE510E	Two and Four Wheeler Technology	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
10	FE511E	Energy Conservation and Management	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
11	FE512E	Learning Ability Development	Nil	00	00	04	02	Nil	Nil	50 [@]	25	75
Sub Total				00	00	04	02	Nil	Nil	50	25	75
Total (a) + (b) + (c)				09	00	14	16	210	90	250	125	675

8.12.8

Program Structure Abstract

Table 8.13. Program Structure Abstract

Abstract

DIPLOMA IN METALLURGICAL ENGINEERING											
Sr. No	Level	Course Title Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
			TH	TU	PR		Theory		Practical		Total Marks
							TEE	CA	TEE	CA	
1	I	General Studies	11	01	06	15	280	120	150	75	625
2	II	Basic Science Courses	16	02	08	22	280	120	150	75	625
3	III	Engineering Sciences and Technical Arts Courses	20	02	16	30	350	150	250	175	925
4	IV	Professional Courses	45	00	50	70	910	390	850	525	2625
5	V	Elective Courses	09	00	14	16	210	90	250	125	675
Total			101	5	94	153	2030	870	1650	975	5475

Above program structure approved in PBOS meeting held on 2nd April, 2016 for implementation from Academic session 2016-17.

8.13 Award of Class Courses

Table 8.14. Award of Class Courses

DIPLOMA IN METALLURGICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
				TH	TU	PR		Theory		Practical		Total Marks
								TEE	CA	TEE	CA	
1	MT 401E	Testing of Materials	Nil	04	00	04	06	70	30	50 [#]	25	175
2	MT 402E	Mechanical Metallurgy	Nil	04	00	04	06	70	30	50 [#]	25	175
3	MT 404E	Steel Making	Nil	03	00	02	04	70	30	50 [#]	25	175
4	MT 406E	Physical Metallurgy	Nil	04	00	04	06	70	30	50 [#]	25	175
5	MT 407E	Heat Treatment	MT406E	04	00	04	06	70	30	50 [#]	25	175
6	MT 408E	Metallurgical Analysis	Nil	03	00	04	05	70	30	50 [#]	25	175
7	MT 410E	Special Casting Techniques	Nil	04	00	02	05	70	30	50 [#]	25	175
8	MT 415E	Metallurgical Design and Drawing	Nil	00	00	04	02	Nil	Nil	50 [#]	50	100
9	MT 416E	Industrial Project	Nil	00	00	04	02	Nil	Nil	100 [#]	50	150
Any Three of the followings												
10	MT 501E	Welding Technology	Nil	03	00	02	04	70	30	50 [#]	25	175
11	MT 502E	Corrosion Engineering	Nil	03	00	02	04	70	30	50 [#]	25	175
12	MT 503E	Alloy Steel	MT 404E	03	00	02	04	70	30	50 [#]	25	175
13	MT 504E	Selection of Materials	Nil	03	00	02	04	70	30	50 [#]	25	175
14	WS 501E	Manufacturing Processes	Nil	03	00	02	04	70	30	50 [#]	25	175
15	ME 507E	Production Technology	Nil	03	00	02	04	70	30	50 [#]	25	175
Total				35	00	38	54	700	300	650	350	2000

8.14 Curriculum at a Glance

Table 8.15. Curriculum at a Glance

SN	CRITERION	RESPONSE
1	Total No. of Courses in a Program	55
2	Total courses required	41
3	No. of courses having Theory papers	29
4	No. of courses having non Theory exam.	12
5	No. of General Studies Courses	5
6	No. of Basic Science Courses	5
7	No. of Engineering Science Courses	7
8	No. of Professional Core Courses	14
9	No. of Professional Elective Courses	3/6
10	No. of Professional Free Elective Courses	2/12
11	No. of Project Courses	3
12	No. of Seminar Courses	2/3
13	Total Credits (1 Th Hr = 1Credit & 2 Pr Hr = 1Credit)	153
14	Total Marks	5475
15	Proportion of Hours (Periods), Th : Pr	53:47 (approx.)
16	Proportion of Credits, Th : Pr	69:31 (approx.)
17	Proportion of Marks; Th : Pr	53:47 (approx.)
18	Total courses for Award of Class	12
19	Total theory paper courses for Award of Class	10
20	Total marks for Award of Class	2000

8.15 Course Flow Diagram

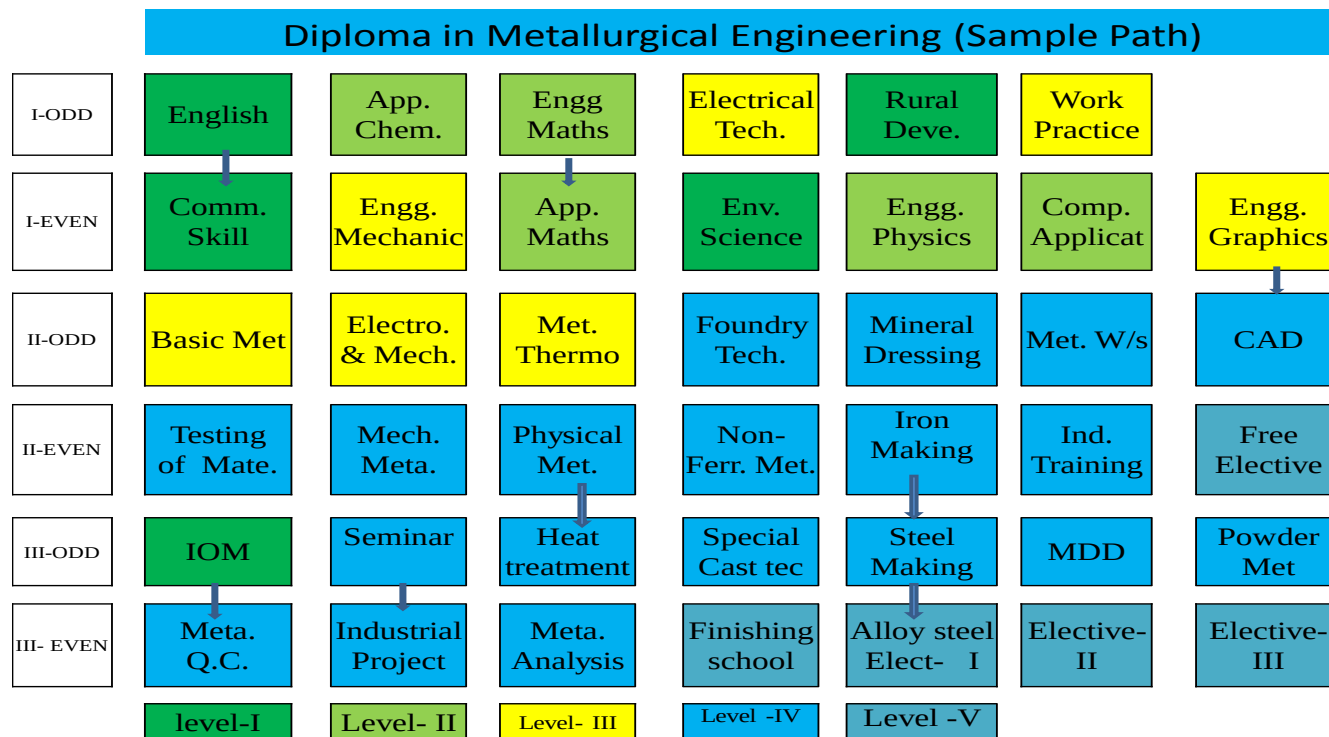


Figure 8.1. Course Flow Diagram

APPENDIX A

Curriculum

LEVEL - I

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE,ME,EE,EC,PK,MT,IT,AE,CM,TX,TR
LEVEL NAME	: GENERAL STUDIES
COURSE CODE	: EN101E
COURSE TITLE	: ENGLISH
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (Internal)
PT.	: 01 HR

❖ RATIONALE:

The basic structure of English through Grammar enhances Holistic development as an individual as well as their role in the world. While teaching this course, complete emphasis will be laid on enhancing expression of ideas in English by the students. Excellence in this language enables a technician to develop his professional career as well as a strong standing in society.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Construct grammatically correct sentences.
2. Express ideas effectively in oral and written form.
3. Enhance comprehending abilities.
4. Develop interest in and appreciate literature.
5. Use social skills and be conversant.
6. Speak sentences with correct intonations.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1. Application of Grammar	1. Identify grammatical rules to form correct sentences. 2. Use correct sentence pattern in writing and speaking. 3. Enrich vocabulary. 4. State and identify various tenses to be used in a situation.	1.1 Articles :Appropriate use of definite and indefinite articles 1.2 Prepositions: To use correct prepositions as per context. 1.3 Phrases: Combining words to form various phrases. 1.4 Tenses: Appropriate uses of tenses in given situations. 1.5 Voice: use of active and passive voice. 1.6 Narration: Conversion of direct and indirect speech.	12
2. Text	1. Present oral summary of topics read or heard. 2. Adjust speed of reading. 3. Follow oral instructions and interpret them to others 4. Present summary of topics read and heard.	2.1 Text: Learning to read fluently and to develop insight through prose and poetry. Selected prose and poetry prescribed in the text. 2.2 Prose: 1. Positive Thinking- By Stephen 2. Vision 2020- Dr. A.P.J. Abdul Kalam. 3.What India Wants: A.Our muddled Generation- DineshKumar. B. Employers want Employees not Exam results –Manish Sabharwal. 4. The Last Cab Ride- Kent Newburn 2.3 Poem: 1.Kalahandi-Jaganath Prasad Das 2.Money Madness-D.H. Lawrence 3. Where the mind is without fear- Rabindranath Tagore. 4. Voice of the unwanted Girl-Sujata Bhatt.	16
3. Success stories And Seen passages for Comprehension.	1. Take down lecture notes while listening. 2. Write single or multiple sentences. 3. Comprehend main ideas and reproduce them. 4. Ask pertinent question as well as to answer them.	3.1 Success stories:(selected Two success stories from text) 1."It happened in India" Kishor Biyani 2. Aditya Kumar Birla. 3.2 Comprehension: (Selected two passages from the text)	06

4. Vocabulary Building	1. Use word formation devices. 2. Use new words in sentences. 3. Read/write new words from various media. 4. Enrich vocabulary through reading.	4.1 Synonyms and Antonyms 4.2 One word substitution. 4.3 Using words and expressions appropriate to audience.(peers, superiors, subordinates and others)	04
5. Conversational Practice.	1. Use correct pronunciations 2. Pronounce the words correctly. 3. Speak sentences with correct intentions. 4. Use correct accent/stress for the words.	Sample situations for conversational practice. 5.1 Introducing yourself and others. 5.2 Meeting and parting. 5.3 Requests 5.4 Inquiries and information. 5.5 Asking, Giving and Refusing Permission. 5.6 Apologizing.	04
6 Writing Techniques.	1. Expand ideas into paragraphs 2. Prepare speeches as per situations 3. Connect multiple sentences.	6.1 Paragraph writing: Elaborate and expand ideas. 6.2 Speech writing: Welcome speech, Farewell speech, Introducing the guests and vote of thanks.	06
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Tense Busters -All levels(To be performed in language lab)	Application of Grammar)	04
2.	Reading and making notes	Prose	02
3.	Summarizing poems	Poetry	02
4.	Reading and making notes	Short stories	02
5	Reading and making notes	Prose	02
6	Comprehending passage	Comprehension passage	02
7	Issues in English(to be performed in language lab)	Vocabulary building	06
8	Formal conversations-Telephonic ,Video conferencing	Conversation practice	02
9	Introducing –self and others	Conversation practice	02
10	Observation of oratory speeches of renowned speakers	Conversation practice	02
11	Preparing speech and presenting	Writing techniques	02
12	Writing a paragraph on given topic	Writing techniques	02
Skill Assessment			02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Application of Grammar	06(04)	06(04)	00(00)	16(12)
02	Text	04(04)	16(04)	06(00)	26(08)
03	Short stories	04(04)	08(04)	00(00)	08(04)
04	Vocabulary Building	04(00)	04(04)	00(00)	08(04)
05	Conversational Practice	00(00)	00(00)	06(06)	06(06)
06	Writing Techniques	00(00)	00(00)	06(06)	06(06)
	Total	18(12)	34(16)	18 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Application

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	U	2	1	U	2	1	U	2	1	U	2	1	U	2	1	U	2	5/7
	1	R	2																
02	2	U	4	2	R	4	2	R	4	2	U	4	2	U	4				3/5
03	3	U	4	3	U	4	2	R	4	2	R	4	3	U	4				3/5
04	4	R	4	4	A	4	1	R	4	1	R	4	1	U	4				3/5
05	5	A	6	5	A	6	5	U	6										2/3
06	6	A	6	6	A	6	6	U	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Performance	05
2	Overall presentation of given assignment	05
3	Viva voce	10
4	Activity	05
	TOTAL	25

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	-	3	-	-	-	-	-	3	3	-	-
2	3	-	3	-	-	-	-	-	3	-	-	-
3	-	-	3	-	-	-	-	-	3	3	-	-
4	-	-	3	-	-	-	-	-	-	-	-	-
5	-	-	3	-	-	-	1	1	3	3	-	-
6	3	-	3	-	-	-	-	1	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1	Positive Thinking	Stephen, Inspirational Stories ,June 2011	-
2	Vision 2020	Dr.A.P.J. Abdul Kalam 'Prism', Macmillan Publication.	1403928282
3	What India Inc-	Dinesh Kumar, Manish Sabharwal, Golden Harvest,	9788125059523
4	The Last Cab Ride	'Life',by Stephen	-
5	Kalahandi	Jaganath Prasad Das, Reflection on vital issues', by P.J.George	9788125041764
6	Money Madness	D.H.Lawrence by P.J.George Orient Blackswan 2010	9788125041764
7	Where the mind is without fear	Rabindranath Tagore Prism, Macmillan Publication	1403928282

8	Voice of the unwanted girl	Sujata Bhatt Prism, Macmillan Publication	1403928282
9	High School English Grammar and Composition	Wren and Martin Revised by Dr.N.D.V. Prasada Rao, S.Chand Publication.	81-219-0009-3
10	Business communication	Urmila Rao Himalaya Publication, 2011	81-8318-438-3
11	Contemporary English Grammar-structure and composition	David Green Revised Edition,2004 Himalaya Publication	033392183-6
12	Interactive English	S.K.Gangal, Revised Edition 1997 Allied Publishers	81-7023-678-9
13	Applied English Grammar and composition.	Dr. P.C. Das, 2013, New Central Book Agency.	978-81-7381-542-3
14	English for Practical Purposes	Z. N. Patil, B.S. Valke	033935098

❖ **E-REFERENCES:**

www.talkenglish.com-grammar , assessed on 12th March, 2016

www.edufind.com-englishgrammar ,assessed on 12th March, 2016

www.perfect-english-grammar.com, assessed on 12th March, 2016

www.yosuccess.com, assessed on 13th March, 2016

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr. Sadiya Raza	Lecturer in English & Coordinator	Government Polytechnic, Nagpur.
2.	Dr. Nutan Chotai	Expert, Head of Dept.	LAD College, Nagpur.
3.	Mrs. K.N. Deshmukh	Expert, Head of Humanities	SDMP, Nagpur.
4.	Dr. Shilpa Sarode	Expert, Asst. Professor	LAD, Nagpur
5.	Mrs. M.M. Machale	Lecturer in English	Government Polytechnic, Nagpur.
6.	Ms. Humeera Quraishi	Visiting Lecturer in English	Government Polytechnic, Nagpur.
7.	Ms. Marlyn Fernandes	Visiting Lecturer in English	Government Polytechnic, Nagpur.
8.	Ms. Nazish Ahmed	Visiting Lecturer in English	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA INCE,ME,EE,EC,PK,MT,IT,AE,CM,TX,TR
LEVEL NAME	: GENERAL STUDIES
COURSE CODE	: EN102E
COURSE TITLE	: COMMUNICATION SKILLS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03 TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM.	: 03 HRs
PR. TEE EXAM	: 02 HRs (Internal)
PT. EXAM	: 01 HR

❖ RATIONALE:

In this present competitive scenario, proficiency in communication skills is one of the basic needs of technical students. A diploma holder is therefore expected to meet the challenges of communicating with his peers, superiors, subordinates and clients. Communication skills will help him towards achievement of perfection.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply concepts of communication in the given situation.
2. Modify language skills.
3. Execute requisite qualities as per industry requirements.
4. Compose official documentation.
5. Participate in and conduct group discussions and meetings effectively
6. Use correct pronunciations and intonations.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1. Communication	1. Identify modern concept of communication. 2. Breaks down barriers to communicate effectively. 3. Modify appropriate body language. 4. Derive confidence while conversing.	1.1 Definition, Process, Types: Verbal-Non Verbal, Formal-Informal, Upward-Downward, Horizontal. 1.2 Barriers of communication: Physical, Mechanical, Psychological, Language, Status . Ways to overcome barriers. 1.3 Selection of proper channels of communication. 1.4 Non-verbal communication in detail: Body language, Eye contact, Dress and appearance, color, sound, Gestures, Postures, Pictorial representations.(Maps, Charts ,Graphs)	14
2. Inculcation of various generic skills.	1. Identify their receptive skills to strengthen their productive skills. 2. Derive listening abilities. 3. Use detailed write-ups 4. Participate in conversations.	2.1 Listening and reading skills- Importance of listening skills, levels of listening, Types of reading, Phonetics, IPA 2.2 Speaking and writing – Importance of Pronunciation, Importance of Debate.	08
3. Areas of self-Development.	1. Identify strengths and weakness. 2. Classify different types of motivation in one's life. 3. Plan presentations properly. 4. Modify leadership qualities.	3.1 Aims of self-development, self-awareness with respect to strength and weakness, How to overcome weakness for acquiring self-confidence. 3.2 Motivation –Introduction, Definition, Types with example. 3.3 Presentation skills – Parameters, Appearance, use of body language, Eye contact, content preparation, Depiction of interest of audience. 3.4 Time management- Importance, Process of time planning. 3.5 Team Building and Leadership qualities.	10
4. Development of	1. Plan group discussion. 2. Relate behavior during and post	4.1 Interview Techniques: Preparation, Behavior during interview, post interview. 4.2 Group discussion: Being the first	06

soft skills.	interview. 3. State and justify one's abilities.	member, how to make a general discussion, to give a concrete shape to discussion, purpose.	
5. Business correspondence	1. Identify various types of letters. 2. List down one's qualities by writing resume. 3. Use various reports to express ideas effectively in English	5.1 Letters: Job application and Resume writing Leave letter, Sales letter, Enquiry letter, order letter, complaint letter. 5.2 Report writing: Progress, Accident, Trouble, Feasibility. 5.3 Notices, circular, Memorandum-mail messages.	10
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practic al's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Master the skill of face -to -face communication	Communication	02
2.	Sharpen one's body language while communicating with the help of Extempore/Impromptu.		02
3.	Demonstrate through role-play skills of a good communicator like RJ, News reader, commentator.		04
4.	Master the art of reading, writing, listening skill(to be performed in Language lab using software)	Inculcation of various Generic skills	06
5	Execute the art of Debate		02
6	Transcribe the given words phonetically		02
7	Master the skill of oral presentation by presenting a topic through PowerPoint presentation.	Areas of self-development.	02
8	Demonstrate leadership qualities		02
9	Manipulate Group Discussion by active participation	Development of soft skills	02
10	Build interview techniques through Mock Interview		02
11	Implement the art of writing E-mails and reports	Business correspondence	02
12.	Implement the art of writing Formal drafting's by preparing resume, letters.		02
Skill Assessment			02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Communication	06(06)	04(04)	06(04)	16(14)
02	Inculcation of various Generic skills among future engineers	02(00)	08(10)	00(06)	10(16)
03	Areas of self Development	06(00)	06(06)	06(00)	18(06)
04	Development of soft skills	02(04)	08(00)	00(00)	10(04)
05	Business Correspondence	00(00)	08(04)	08(00)	16(00)
	Total	20(08)	30(20)	20 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	5	A	2	3	U	2	5/7
	1	R	2																
02	1	R	4	1	R	4	2	U	4	2	U	4	5	U	4				3/5
03	3	R	4	4	R	4	2	U	4	3	U	4	5	U	4				3/5
04	1	U	4	5	U	4	4	U	4	1	A	4	4	U	4				3/5
05	2	A	6	3	A	6	3	U	6										2/3
06	1	A	6	5	A	6	2	U	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Performance	05
2	Overall presentation of given assignment	05
3	Viva voce	10
4	Activity	05
	TOTAL	25

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	2	-	3	-	-	-	-	3	3	3	-	-
2	-	-	3	-	-	-	-	-	3	-	-	-
3	-	-	3	-	-	-	-	3	3	3	-	-
4	2	-	3	-	-	-	-	-	3	3	-	-
5	-	-	3	-	-	-	-	3	3	3	-	-
6	-	-	-	-	-	-	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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 , Himalaya Publication, First Edition, 2009	978-81-8488-596-5
4.	Secret of face to face communication.	Peter Urs, Bender, 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 McGraw Hills,	13978-0-19-566804-9
7	Modern Commercial Correspondence	R.S.Pillai, Bhagwati, S.Chand & Co.	812190519-2

❖ **E-REFERENCES:**

www.mindtools.com.au, assessed on 12th March, 2016

www.interviewbest.com, assessed on 12th March, 2016

www.skillsyouneed.com-presentationskills, assessed on 12th March, 2016

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr. Sadiya Raza	Lecturer in English&Coordinator	Government Polytechnic, Nagpur.
2.	Dr. Nutan Chotai	Expert, Head of Dept.	LAD College, Nagpur.
3.	Mrs. K.N. Deshmukh	Expert, Head of Humanities	SDMP, Nagpur.
4.	Dr. Shilpa Sarode	Expert, Asst.Professor	LAD, Nagpur
5.	Mrs. M.M. Machale	Lecturer in English	Government Polytechnic, Nagpur.
6	Ms. Humeera Quraishi	Visiting Lecturer in English	Government Polytechnic, Nagpur.
7.	Ms. Marlyn Fernandes	Visiting Lecturer in English	. Government Polytechnic, Nagpur.
8.	Ms. Nazish Ahmed	Visiting Lecturer in English	Government Polytechnic, Nagpur.

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GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME/EE/EC/CM/IT/AE/MT/PK/TX
LEVEL NAME	: GENERAL STUDIES
COURSE CODE	: MN101E
COURSE TITLE	: INDUSTRIAL MANAGEMENT
PREREQUISITE	: 50 Credits
TEACHING SCHEME:	TH: 04; TU: 00; PR: 00
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: NIL
PT.	: 01 HR

❖ RATIONALE:

Managing personnel and scarce resources in any organization is one of the primary & most challenging functions in industries. Scientific Management studies have evolved techniques for the same. The success of an enterprise depends upon how effectively the manpower is organized to work. The students of engineering who will be joining as technicians in the industrial organization are expected to have preliminary information about these said procedures

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Illustrate various forms of organization and its necessity and different aspects of entrepreneurship.
2. Analyze different sources of finance for industry to fulfill capital needs.
3. Interpret principles of human resource management, safety engineering and supervisory management along with various industrial acts
4. Illustrate various functions of marketing management and inventory control.
5. Calculate various cost of production, selling price of a product and its depreciation.
6. Analyze concept of TQM and modern techniques of quality control.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Introduction to Management & Entrepreneurship	1. Define Management, Organization, Administration and Entrepreneurship. 2. Compare Management, Organization, Administration. 3. Interpret appropriate type of ownership. 4. Carry out different methods of selection of organization. 5. Define Function of Management. 6. Describe Entrepreneurial qualities/traits. 7. Acquire industrial work culture 8. Describe successful entrepreneurs 9. Select Government subsidies	1.1 Definitions: Management, Organization, Administration and Entrepreneurship. Forms of ownership: Proprietorship, Partnership, Joint stock co. 1.2 Co-operative sector, Public sector, Government Undertaking, Advantages, limitations & Application of each type, comparison between different forms 1.3 Types of Organization: Line, Functional, line & staff organization, Advantages, limitations & Applications of each type, comparison between different types. 1.4 Functions of Management: - Forecasting, Planning, Organizing Directing, Motivating, Controlling, Coordinating, Decision-making, 1.5 Principles of management, Levels of management - Function of each level. 1.6 Entrepreneurship: Concept, Types of Entrepreneur, Characteristics of Entrepreneur, Women entrepreneurship, problem faced by women entrepreneur. 1.7 Case studies on successful entrepreneurs 1.8 Government subsidies for entrepreneur: Expert lecture on it. (No questions should be asked on the subtopic 1.7 & 1.8)	12
2.Financial Management	1. State the need and sources of finance. 2. Define and differentiate Shares and debentures. 3. Construct Break Even point in an Industry. 4. Analyse Break even point 5. Calculate E.O.Q. 6. Compare types of capital. 7. Acquire basics & financial Management techniques.	2.1 Need of Finance and Sources of finance for enterprises -Short term, Medium term and long term sources. 2.2 Shares, debentures, types of shares and Comparison between shares & debentures 2.3 Break Even Analysis- Importance of Breakeven point, E.O.Q. (numerical on EOQ) 2.4 Types of capital: fixed and working capital	10

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
3. Human Resource Management	1. State Concept, aim,& objectives of HRM. Describe Functions of HRM. 2. Interpret the need of welfare & safety, Industrial Hygiene. 3. Define functions of Supervisors. 4. Identify&/choose proper style of supervision. 5. Describe industrial act	3.1 Concept, aim , & objectives of HRM. 3.2 Functions of HRM: planning, organizing, staffing, recruitment, education & training- need, methods of training, , Motivation, controlling, compensation, integration and maintenance. Labour welfare , Industrial relations 3.3 Safety engineering: need, organization, committee, programme, instructions & training. Accidents: causes & prevention. 3.4 Characteristics of supervisors, functions of supervisors and styles of supervision& its advantages and limitations. 3.5 Industrial act: Need, Factory act 1948, ESI act, Workmen compensation act only	10
4. Marketing and inventory management	1. Describe the activities of Marketing Management. 2. State inventory management technique. 3. Use marketing strategies. 4. Select sales promotion and media	4.1 Definition of Market, Functions of Marketing Department 4.2 Marketing strategies, Marketing environment, Consumer behavior, Market research, Market survey, marketing mix. 4.3 Sales forecasting, Sales promotion, advertising, media selection. 4.4 Definition of inventory & inventory control. 4.5 Types of inventory items in industries, ABC and VED analysis only	12
5. Estimation and Costing	1. Define & calculate various cost and expenses involving in Product manufacturing. 2. Calculate the selling price of product. 3. Describe balance sheet. 4. Define& compare depreciation and obsolescence. 5. Describe& Calculating depreciation.	5.1 Product cost determination, Direct Cost and Indirect Cost, Material Cost And Labour Cost, Expenses- Factory and Overheads. 5.2 Determination of Selling Price of product- Profit and Loss Statement, Balance sheet description. 5.3 Depreciation &, Obsolescence- Concept and Comparison. 5.4 Methods of Calculating depreciation- straight line, reducing balance, annuity, sinking fund & sum of the digit methods. (Simple Numericals on subtopic 5.1, 5.2 & 5.4)	10

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
6. Total Quality Management	1. Define terms related to TQM 2. Describe various quality control techniques. 3. Interpret importance of quality circle and ISO 9000 4. Compare ISO9000 and TQM	6.1 Concept and definition of Quality, Quality Control, Quality Conformance and Quality Assurance. 6.2 TQM- Concept and Objectives, Process 6.3 Quality control techniques: Lean Manufacturing -JIT,5”S”, Six sigma, Kaizen, BPR 6.4 Quality Circle and ISO 9000, ISO 14000, ISO 9001: 2015, ISO 14001: 2015, Difference between ISO9000 and TQM,	10
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
Nil			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01.	Management	04(04)	10(04)	00(00)	14(08)
02.	Financial Management	04(00)	04(06)	04(00)	12(06)
03.	Human Resource Management	02(00)	04(06)	06(00)	12(06)
04.	Marketing And Inventory Management	04(04)	06(00)	00(04)	10(08)
05.	Estimation And Costing	06(04)	04(02)	02(00)	12(06)
06.	Total Quality Management	04(04)	06(00)	00(02)	10(06)
	Total	24(16)	34(18)	12 (06)	70(40)

R – Remember U – Understand A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	1	R	2	2	R	2	2	R	2	3	R	2	1	A	2	5/7
	1	R	2																
02	1	U	4	2	A	4	2	U	4	1	A	4	4	A	4				3/5
03	4	R	4	3	U	4	5	R	4	4	U	4	5	U	4				3/5
04	5	A	4	5	U	4	6	R	4	6	U	4	6	A	4				3/5
05	3	A	6	4	U	6	2	U	6										2/3
06	1	U	6	6	U	6	3	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	--	--	--	--
		Journal Writing		Continuous	--	--	--	--
				TOTAL	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
	Nil	

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:****For Mechanical Engineering Program:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	–	–	–	–	–	–	–	–	3	3	–
2	3	–	–	–	–	–	–	–	–	3	3	–
3	3	–	–	–	3	2	3	–	–	3	3	–
4	3	–	–	–	3	–	3	–	–	3	3	–
5	3	–	–	–	3	–	3	–	–	3	3	2
6	3	–	–	–	3	2	3	–	–	3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

For Other than Mechanical Engineering Program:

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	–	–	–	–	–	–	–	–	3	–	–
2	3	–	–	–	–	–	–	–	–	3	–	–
3	3	–	–	–	3	2	3	–	–	3	–	–
4	3	–	–	–	3	–	3	–	–	3	–	–
5	3	–	–	–	3	–	3	–	–	3	–	–
6	3	–	–	–	3	2	3	–	–	3	–	–

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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 Engineering And Management	O.P. Khanna, Dhanpat Rai, New Delhi, 1980	81-885-9777-5
3.	Industrial organization and management	Lawrence L Bethel & James L Riggs, New York, McGraw-Hill [1971], 6 th , 1979	09-322-3849-1
4.	Industrial Management	I.K.Chopde & A.M.Sheikh, S.Chand & Co. Ltd, Delhi, 2 nd , 1999	81-219-1480-9
5.	Industrial engineering: Organization and management	Tara Chand, Publisher: Nem Chand, 5 th , 1982	B0007BSSB0
6.	Engineering Economics	Tara Chand, Publisher: Nem Chand, 14 th , 2014	81-85240-82-5
7.	Entrepreneurial Development	S.S.Khanka, S.Chand & Co. Ltd, Delhi, 1 st , 1999, reprint 2006	81-219-1801-4

❖ **E-REFERENCES:**

- <http://www.free-management-ebooks.com/index.htm> , assessed on 22th March 2016 .
- <https://www.youtube.com/watch?v=oQ1OTaJ9Sfc&list=PLB628C837430CB736&index=3> assessed on 23th March 2016
- <https://www.youtube.com/watch?v=2PkrT1ko3Yk&list=PLB628C837430CB736&index=10> assessed on 24th March 2016
- <http://www.slideworld.com/pptslides.aspx/industrial-management> assessed on 24th March 2016
- http://www.powershow.com/view/e4cd2mMwY/Industrial_Organization_I_powerpoint_ppt_presentation assessed on 25th March 2016

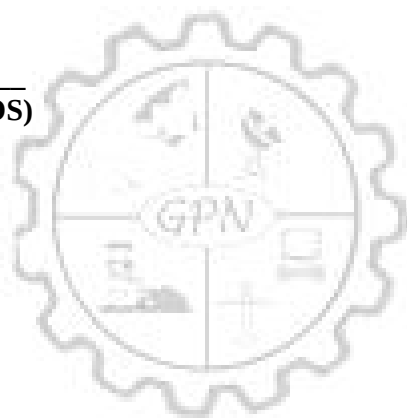
❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

Nil

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Mr. V.S Ikhar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
2.	Mrs. R A Gadekar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
3.	Mr. G. H. Dahole	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4.	Er. A.M.Onkar	Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
5.	Shri. G.F.Potbhare	Principal	NIT, Polytechnic, Nagpur
6.	Dr.S.S.Baraskar	Lecturer in Mechanical Engineering	Govt. Polytechnic, Arvi

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/CM/IT/AE/PK/MT/TX/TR
LEVEL NAME	: GENERAL STUDIES
COURSE CODE	: EV101E
COURSE TITLE	: ENVIRONMENTAL SCIENCE
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 01; TU: 01; PR: 00 (CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 01 Hr. (Objective Type Online Examination)
PR. TEE	: NIL
PT.	: 15 MINUTES (Objective Type offline Examination)

❖ RATIONALE:

The world today is facing the biggest challenge of survival. Degradation of ecosystem, depletion of natural resources, increasing levels of pollution, poses major threat to the survival of mankind. The need of the hour, therefore, is to concentrate on the area of environmental science, which shall provide an insight into various environment related issues.

Environmental science is an interdisciplinary academic field that integrates physical and biological sciences, with the study of the environment. It provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems & gives an insight into solutions of Environmental problems

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Define the terms related to Environmental Studies.
2. Identify natural resources and resolve problems associated with them.
3. Identify alternate energy resources and use them efficiently during their engineering practices.
4. Develop habits which will cause less harm to environment
5. Analyze key issues about environment and create public awareness about those environmental issues.
6. Follow environmental ethics as lifelong learning.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs .
1. Earth Systems and Resources	1. Name the historical events of earthquakes, volcanoes, Tsunami, cyclone & landslides in the world. 2. Identify problems associated with soil, water 3. Define weather and climate. 4. Analyze the global water problems.	1.1 Earth Science: Concepts of Geologic time scale; earthquakes, volcanoes , Tsunami , cyclone & landslides 1.2 The Atmosphere: Weather and climate; the Coriolis Effect 1.3 Global Water Resources and Use: Present scenario, surface and groundwater issues; global problems; and its conservation. 1.4 Soil : soil erosion and other soil problems; methods of soil conservation	02
2. Concept of Biodiversity	1. Define Biodiversity 2. List Levels of biodiversity 3. Define and list the biodiversity hotspots 4. List the endangered species 5. Prepare a report on value of Biodiversity 6. Suggest methods /steps for Biodiversity conservation	2.1 Definition of Biodiversity 2.2 Levels of biodiversity 2.3 Value of biodiversity 2.4 Threats to biodiversity, loss of biodiversity (biodiversity hotspots) 2.5 Conservation of biodiversity (modern methods of biodiversity conservation)	02
3. Energy Resources and Consumption	1. Match the energy forms projects 2. List various forms of energy 3. State advantages and disadvantages of forms of energy 4. Select appropriate solutions of Efficient Use energy 5. Utilize techniques for energy consumption to reduce impact on environment.	3.1 Energy Consumption history 3.2 Present global energy use, Future energy needs 3.3 Energy forms:(conventional and non conventional) 3.4 Energy Conservation 3.5 Renewable Energy: Solar energy; solar electricity; biomass; wind energy; ocean waves and tidal energy; geothermal	03
4. Pollution	1. Define pollution and pollutants 2. List the types of pollutants. 3. Identify the Pollutants and their sources 4. Develop habits to reduce pollution 5. State the standard / limiting/ controlling values	4.1 Definition of pollution. 4.2 Air pollution: Definition, Classification, sources, effects, Prevention and ambient air quality standards. 4.3 Water Pollution: Definition, Classification, sources effects, Prevention And WHO and BIS water quality standards.	04

	of various types of pollution.	4.4 Soil Pollution/land pollution: Definition, sources, effects, prevention 4.5 Noise Pollution: Definition, sources, effects, prevention. 4.6 Biomedical Waste and E-Waste -- Origin, Effects and control Measures. 4.7 CPCB and MPCB norms and roles and responsibilities.	
5 Social Issues and Environment	1. Define sustainable development 2. Evaluate sources of Green house effect, acid rains, Global warming 3. List the incidences of Nuclear Accidents,	5.1 Concept of development, sustainable development 5.2 Watershed management , rain water harvesting 5.3 Global Warming, greenhouse effect; ozone depletion, relevant laws and treaties 5.4 Nuclear Accidents and Holocaust: Basic concepts and their effect on climate, , relevant laws and treaties	03
6. Environmental Education	1. Differentiate between formal and non formal education 2. List the various acts and their provisions 3. Develop awareness about environment.	6.1 Formal and non-formal education 6.2 Role of Govt. and Non-Govt. Organization 6.3 Indian constitutional provisions regarding the environment. Brief description of the following acts and their provisions: Environmental Protection Act and Prevention of Water, air and noise Pollution Act. 6.4. Concept EIA and environmental Ethics	03
Total Hrs.			16

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Prepare report on Loss of biodiversity, its conservation and also describe biodiversity hotspots.	Concept Of Biodiversity	4
2	Prepare report on use of various renewable energy sources.	Energy Resources And Consumption	4
3	Group discussion and Assignment on article collection from news papers, magazines and internet on local environmental pollution.	Pollution	4
4	Prepare report on case study of Industrial/Nuclear/any other Disaster in India.	Social Issues And Environment	4

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Earth Systems And Resources	02(00)	04(00)	02(00)	08(00)
02	Concept Of Biodiversity	04(00)	08(00)	02(00)	14(00)
03	Energy Resources And Consumption	04(00)	08(00)	04(06)	16(00)
04	Pollution	04(00)	10(04)	06(00)	20(04)
05	Social Issues And Environment	02(00)	04(00)	00(00)	16(12)
06	Environmental Education	02(00)	02(00)	02(00)	06(00)
	Total	18(00)	36(00)	16 (00)	70 (00)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Bit 7		
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M
01 To 35	1	R	2	2	R	2	3	R	2	4	R	2	1	U	2	2	R	2	1	U	2
	3	U	2	2	A	2	1	A	2	2	U	2	3	R	2	4	U	2	2	U	2
	4	A	2	4	U	2	4	U	2	5	R	2	2	U	2	3	U	2	4	R	2
	2	U	2	3	U	2	5	R	2	4	U	2	3	U	2	5	U	2	3	A	2
	4	U	2	3	A	2	4	A	2	6	R	2	6	U	2	6	U	2	4	A	2

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Online Examination Report	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	--	--	--	--
		Journal Writing		Continuous	--	--	--	--
				TOTAL	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

Nil

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	--	--	--	3	3	3	3	--	3	-	-
2	3	--	--	--	--	3	--	--	--	3	-	-
3	3	--	--	--	3	3	--	--	--	3	-	-
4	3	--	--	--	3	3	3	3	--	3	-	-
5	--	--	--	--	3	3	3	3	2	3	-	-
6	--	--	--	--	3	--	3	3	2	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Environmental studies	Oxford University Press, New Delhi. 2011	0-19-807228-2
2.	Environmental Science	Y.K. Singh, New Age International, New Delhi	8122418481, 9788122418484
3.	A Text Book Of Environmental Science	Arvind Kumar, APH Publishing, New Delhi	817648590X, 9788176485906
4.	Environmental Engg	A Kamla & D.L.Kanth Rao, Tata Mc Graw-Hill, New Delhi	0-07-451708-2
5.	A Textbook of Environmental Studies	Shashi Chawla, Tata Mc Graw-Hill, New Delhi	9781259006388

❖ **E-REFERENCES:**

1. https://en.wikipedia.org/wiki/Lists_of_nuclear_disasters_and_radioactive_incident_s, accessed on 20 January 2016
2. www.legalserviceindia.com/articles/noip.htm accessed on 18 March 2016
3. <https://prezi.com/8mnz--ldkybc/apes-unit-1-earth-systems-resources/> accessed on 23 March 2016
4. <http://www.conserve-energy-future.com/AlternativeEnergySources.php>, 18 March 2016

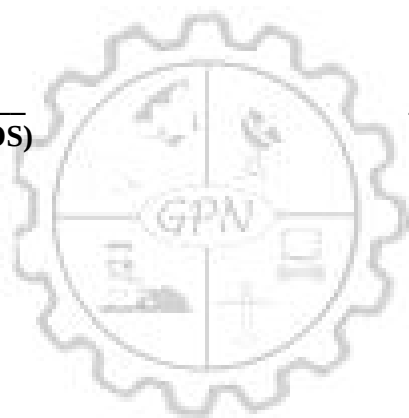
❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

Nil

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr. S J Patil	Head of Civil Engineering, (I Shift)	Government Polytechnic, Nagpur.
2	R N Giradkar	Head of Civil Engineering, (II Shift)	Government Polytechnic, Nagpur.
3	N. U Sulbhewar	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
4	B. R. Ambade	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
5	D. A. Khandare	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
6	Mr. M. R. Shelote	Consultant Engineer	M R Associates, Nagpur
7	Dr. R. N. Khapre	Associate Professor	Ramdeobaba College of Engineering and Management, Nagpur
8	Mr. A. J. Fulzele	Assistant Secretary (Tech.)	MSBTE, RO, Nagpur

(Member Secretary PBOS)



(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/CM/IT/AE/PK/MT/TX/TR
LEVEL NAME	: GENERAL STUDIES
COURSE CODE	: RD101E
COURSE TITLE	: RURAL DEVELOPMENT
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 01(1TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT.	: NIL

❖ RATIONALE:

India is a rural developing country. About 70 percent of the total inhabitants are living in rural area. The development of India as a whole cannot be possible without development of the rural areas. The Central and state Governments tried to develop rural area through various welfare, health, economic, and social schemes. But it is the moral duty of each urban person to think about the development of rural area.

Young students are said to be new Nation. Therefore, this subject has been introduced so that the students should aware about the rural scenario in India. They should think and work for the overall rural development as per the development indicators prescribed at International level. They should write, and work for the Rural – Urban Linkage to upgrade the rural level.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Interpret Indian development indicators with International level.
2. Use and record questionnaire for rural survey.
3. Apply engineering knowledge for rural economy.
4. Suggest suitable scheme for rural development.
5. Prepare sustainable development plan for rural development.
6. Create suitable environment in rural area for development of every individual.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Write report of Development, Indicators of development, Rank of India in various development indexes (Individual task). Report includes: • Development, Modern Concepts, Indicators of development, • Importance, Scope and Objectives of RD. • Agriculture development, Agricultural allied development, Social and Human Development. • Rank of India in Human development index, Water and Sanitation Index, Shelter index, Education to all indexes, Health and wellness index.	Overview of Rural Development	04
2	Write report related to particular village (Group of 10 students). Survey, observe and evaluate Educational issues, Occupational issues, Agricultural issues, irrigation issues, migration issues, landless issues, Water supply and sanitation issues, Health issues, Poverty issues, Nutrition issues, Unemployment issues, Economy issues, Market for agriculture products issues, in Rural Development. Report includes: • Social structure of Rural India, Educational issues, Occupational issues, Agricultural issues, irrigation issues, migration issues, landless issues, Water supply and sanitation issues, Health issues, Poverty issues, Nutrition issues, Unemployment issues, Economy issues, Market for agriculture products issues, etc	Issues of Rural Development	06
3	Write report related to particular village (Group of 10 students). Survey, observe, evaluate and propagate Rural Development programmes (Sarva Shiksha Mission, Jal Swarajya Scheme, Water shed Management, Gobar Gas Scheme, Water Harvesting, MNREGA etc.) Run by Central and State Govt, according to directive principles in Indian Constitution. Report includes: • Constitutional provisions for Rural Development, Directive Principles. • Schemes of Central and State Govt. for Rural Development. • Role of GOs and NGOs. • Empowerment –Social, Educational, Economic, Women and Human. • Private Public Partnership (PPP), its advantages and disadvantages.	Constitutional Provisions and Programs for Rural Development	06

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
4	Write report related to particular village (Group of 10 students). Survey, observe and propagate Modern Technology (Rural Housing, Non Conventional Energy, Rural Water Supply and Sanitation, Agricultural allied industries etc.) in Rural Development. Report includes: • Low cost housing. • Rural water supply and sanitation, • Water conservation and Water shed management, • Non-conventional energy. • Computer application and Management Information system, Info – literacy, Global village • Solid waste management.	Technology for Rural Development	06
5	Write report related to particular village (Group of 10 students). Survey issues and challenges in Rural Development programs and suggest Rural – Urban link for social change in rural development and Nation Building. Report includes: • Basic micro-economic theories and concepts, Growth, Income, Employment, Finance. • Rural resources – Land, Forest, Water, Human, Capital and Market. • Rural Economy - Agriculture Reforms, Rural Finance, Rural Urban linkage. • Understanding BUDGET of Central and State Govt. • Corporate Social Responsibilities. • SEZ, Advantages and disadvantages on rural development.	Economical Developments	06
6	Present a report on Rural Development experiences of the same village, challenges, opportunities, suggestions. Presentation includes: • Success stories of rural development in India, Asia and other countries.	Rural Development Success Stories	04
Total			32

Note – The students shall select any one village and perform all practical based on experiences in that village.

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	--	--	--	--
		Journal Writing		Continuous	25	10	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Writing skills, Data collection from internet, Writing references, etc.	05
2	Survey skills, Preparation of questionnaire, Gathering information through interviews, etc.	10
3	Knowledge of rural development schemes, its salient features, its role in rural development, etc.	10
4	Knowledge of modern technology, Tech terms, its need in rural area, rural development through technology, etc.	10
5	Rural urban linkage, sustainable human development, global village, etc.	05
6	Presentation and viva-voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	3	-	-	-	-	-	1	-	3	-	-
2	3	3	-	3	-	-	-	3	3	3	-	-
3	3	3	-	3	-	-	2	3	3	3	-	-
4	3	3	2	3	3	-	3	3	3	3	-	-
5	3	3	2	3	3	2	1	3	3	3	-	-
6	3	3	2	3	1	-	1	-	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Micro Enterprise & Rural Development In India,	Subrata Kumar Ray, Neha Publishers & Distributors.	9788183875752
2.	Rural Development Indian Context,	Expert Panel Of GPH, Publisher: GPH.	9789382688976
3.	Rural Development Planning And Management,	Expert Panel Of GPH, Publisher: GPH	9789382688990
4.	RURAL DEVELOPMENT, Concept and Recent Approaches, ,	A. Thomas William and A.J. Christopher, Edition – 2011.	9788131602652,
5.	Rural Development & Policies	Dr. B.D. Sharma,	9789381385418

6	Empowering Rural Development Through Panchayats.	Dr. H.K. Lal, Publisher: Neha Publishers & Distributors	9788174456250
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❖ **E-REFERENCES:**

- www.un.org/esa/agenda21/natlinfo/countr/israel/ruraldevelopment.pdf , assessed on 5th March 2016
- rural.nic.in/sites/downloads/NewReleases/Greening_RD_Report.pdf , assessed on 5th March 2016
- planningcommission.nic.in/plans/stateplan/sdr_punjab/sdrpun_ch5.pdf, assessed on 5th March 2016
- jica-ri.jica.go.jp/IFIC_and_JBICI-Studies/english/.../pdf/chapter4.pdf. assessed on 5th March 2016
- www.fao.org/3/a-ah885e.pdf, assessed on 5th March 2016
- [yojana.gov.in/CMS/\(S\(y4dqrc55g1m1qhnd4soqih45\)\)/pdf/.../January.pdf](http://yojana.gov.in/CMS/(S(y4dqrc55g1m1qhnd4soqih45))/pdf/.../January.pdf), assessed on 5th March 2016
- <https://www.youtube.com/watch?v=LXgyAfnBgWo>, assessed on 5th March 2016
- <https://www.youtube.com/watch?v=jCpEh78M4xE> assessed on 5th March 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

Not Applicable

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr. S.J. Patil	Head of Civil Engineering	Government Polytechnic, Nagpur.
2.	Mr. B. R. Ambade	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
3.	Mr. T. K. Rangari	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
4.	Ms. D. A. Khandare	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
5.	M. R. Shelote	Consultant	M.R. Associates, Nagpur
6.	Dr. R. N. Khapre	Associate Professor	RCOEN, Nagpur
7.	A. J. Fulzele	Assistant Secretary (Tech)	MSBTE, RO, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

LEVEL - II

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN CE/ME/EE/EC/AE/MT/PK/TX
LEVEL NAME : BASIC SCIENCE COURSES
COURSE CODE : CA201E
COURSE TITLE : COMPUTER APPLICATIONS
PREREQUISITE : NIL
TEACHING SCHEME : TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS : 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE : NIL
PR. TEE : 02 HRs (Internal)
PT. : NIL

❖ RATIONALE:

Engineering students should know the basics of handling the computers. This course describes the basics of word processing, table handling, and power point presentations for the understanding of elementary knowledge related to IT applications. It also describes basics of problem solving using C language, for the understanding of elementary knowledge related to logic development. It is very useful course for understanding the higher level knowledge in the field of IT applications and software engineering.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Use various formatting tools available in word processor.
2. Handle spread sheets.
3. Prepare presentation.
4. Draw block diagrams, figures.
5. Use LATEX for writing project report
6. Create static website using HTML

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	• Create new document , open existing document and perform various operations on text like Font setting , delete, select, insert, copy- paste, cut- paste, find and replace.	WORD PROCESSING	2
2	• Perform various page setup operations like paragraph setting, page margin, size, orientation, watermark, page borders.		2
3	• Insert and remove Picture/ Image, Tables, Hyperlink, page break, Headers-Footers, bulleted lists in document.		2
4	• Perform Mail merge operation.		2
5	• Open blank /existing worksheet and perform operations like select, delete, insert, copy- paste, cut- paste, find & replace text / data in cell and range of cells. • Perform various formatting operations like, Data Alignment, Wrap text, merge / unmerge cells, change column width, row height, setting page margin, size, orientation, print area.	SPREADSHEET	2
6	• Insert and remove Picture/ Image, Hyperlink, page break, Headers-Footers, in worksheet. Insert and remove cells, rows, columns. Draw various types of graphs / charts.		2
7	• Perform various Functions like sum, average, count, countif, countblank, min, max, upper, lower, len, trim, left, right, mid, date, day, today, month, year, abs, int, exp, floor, sign, sum, sumif, sqrt and formulae like calculating simple interest, compound interest etc. on data in a worksheet.		4
8	• Sort data in ascending and descending order, on one and more than one field. • Apply Filter and obtain desired information.		2
9	• Create new presentation, add /delete slides, insert / delete tables, word Art, header/footer ,slide number, cliparts, images in slide, hyperlink.	PRESENTATION	2
10	• Apply various slide transition methods; apply animation effect, setup slide show, for selected slides.		2
11	• Draw diagrams in a slide, using various available shapes, insert / modify/ delete charts in slide.	PRESENTATION	2
12	• Draw block diagrams, circuit diagrams etc. • Save diagrams in jpg/ TIFF formats • Insert saved diagrams in documents	DRAWING TOOL	4

13	• Open LATEX document • Write simple mathematical equations in LATEX document • Insert figures and tables in in LATEX document • Generate the reports using templates	LATEX	4
14	• Create HTML document by using different tags, elements and attributes (any four) • Create HTML document by using various formatting tags (text level and paragraph level). (any four) • Design webpage using nesting list. (using OL, UL and DL)	HTML	4
15	• Add images, tables and text links in created document. • Insert multimedia in webpage using various techniques		4
16	• Set various attributes of tables. • Set various attributes of images. • Create hyperlink to text, image, table content and email.		4
17	• Create HTML document by using frame and frameset tags (any two)		2
18	• Create HTML document by using frame and frameset tags along with various attributes.		2
19	• Create HTML document by using form and its elements (any two)		2
20	• Create login form and set password.		2
21	• Create static website using all above HTML facilities. (MINI PROJECT)		8
Skill Assessment			4
Total Hrs			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Nil

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Nil

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Activities	20
2	Performance	20
3	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	-	3	3	-	-	-	3	3	3	-	-
2	3	-	3	3	-	-	-	3	3	3	-	-
3	3	-	3	3	-	-	-	3	3	3	-	-
4	3	-	3	3	-	-	-	3	3	3	-	-
5	3	-	3	3	-	-	-	3	3	3	-	-
6	3	-	3	3	-	-	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	World wide web designing with HTML	C. Xavir	13: 9780074639719
2.	HTML5 for Publishers	Sanders Kleinfeld	10/ASIN: B005ISQ7JM
3.	HTML5 for Web Designers	Jeremy Keith	10/ASIN: 0984442502

❖ **E-REFERENCES:**

<http://www.w3schools.org.in>, accessed on 11th April, 2016
<https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf> accessed on 11th April, 2016
<https://www.latex-tutorial.com/tutorials/> accessed on 11th April, 2016
<http://www1.maths.leeds.ac.uk/LaTeX/TableHelp1.pdf> accessed on 11th April, 2016
http://www.tutorialspoint.com/html/html_frames.htm accessed on 21st April, 2016
showmedo.com/videotutorials/openoffice accessed on 29th April, 2016
www.tutorialsforopenoffice.org accessed on 29th April, 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Computer (Dual CORE and above)
2. Network printer.
3. Office Suite.
4. LATEX.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Mr. S.P. Lambhade	Head of Computer Engineering	Government Polytechnic, Nagpur.
2.	Dr. Mrs. A.R. Mahajan	Head of Information Technology	Government Polytechnic, Nagpur.
3.	V.A. Raje	Lecturer in Computer Engineering	Government Polytechnic, Nagpur.
4.	Dr. A.R. Mahajan	Head of Information Technology	Government Polytechnic, Nagpur.
5.	L.D. Vilhekar	Lecturer in Information Technology	Government Polytechnic, Nagpur.
6	Shri. Atul Upadhyay	CEO	Vista Computers , Ram Nagar, Nagpur
7	Shri. N. V. Chaudhari	Asst. Professor (CSE)	DBACEO, Wanadongri, Nagpur
6	Shri. Manoj Jethawa	HOD Computer Science	Shri Datta Meghe Polytechnic, Nagpur

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/IT/CM /MT/PK/AE/TX
LEVEL NAME	: BASIC SCIENCE COURSES
COURSE CODE	: PH201E
COURSE TITLE	: ENGINEERING PHYSICS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 04; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (Internal)
PT.	: 01 HR

❖ RATIONALE:

Engineering physics is an essential part of the educational system and of an advanced society, therefore this course essentially required for engineering courses. The different streams of physics provides fundamental facts, principals and laws are very helpful in having better understanding of the other technology courses which contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries. Physics is an exciting intellectual adventure that inspires young people and expands the frontiers of our knowledge about Nature.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply the principal and laws of Physics on physically observable things to their respective disciplines.
2. Illustrate broad ideas about different physical phenomena.
3. Apply fundamental physics in various Engineering fields.
4. Select proper measuring instruments on the basis of range and least count to measure the physical quantities.
5. Calibrate different measuring instruments.
6. Handle instruments carefully to avoid any type of devastation.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. General Properties of solids	1. Relate Deformation in bodies by the action of external forces. 2. Identify least count and range of instruments. 3. State hook's law of elasticity. 4. Define different terms related to elasticity. 5. Differentiate accuracy and precision. 6. Describe the types of modules of elasticity. 7. Illustrate the Searle's apparatus. 8. Solve the numerical based on Elasticity.	1.1 Elasticity, Plasticity, Rigidity. Deformation in bodies by the action of external forces, Stress and Strain with their types, Elastic Limit, Hook's Law, yield point, factor of safety, breaking stress, ultimate stress. Applications of elasticity. Types of modulus of Elasticity with relation between them. 1.2 Searle's method to find out Young's modulus of elasticity. Least count and range of instruments: Vernier caliper, outside micrometer screw gauge, Travelling microscope. (Numerical based on above)	06
2. General Properties of liquids	1. Define the terms related with general properties of liquid. 2. State the factors affecting surface tension and viscosity. 3. Select the laws of viscosity to find the coefficient of viscosity of freely falling body. 4. Classify the types of flow of liquid with significance of Reynold's number. 5. Illustrate the phenomenon of Capillarity and angle of contact of liquid and glass. 6. Solve the numerical based on general properties of matter.	2.1 Surface Tension, Factors affecting surface tension, Molecular force, cohesive and adhesive force, Angle of contact with its significance and capillary action (no derivation), Effect of impurity and temperature on surface tension. Application. (Numerical based on above) 2.2 Viscous force, Definition of viscosity, Newton's law of viscosity, Reynolds's number and its significance, critical velocity, streamline flow, turbulent flow, Stoke's law, statement and formula (no derivation), Coefficient of viscosity and S.I. unit. Application. (Numerical based on above)	08
3. Transmission of heat and Gas laws	1. List the modes of transmission of heat. 2. Define the terms related to expansion of solid due to heat. 3. State the laws related to gas and specific heat. 4. Describe Mayor's relation. 5. Apply the adiabatic and isothermal expansion for bulk modulus of elasticity. 6. Solve the numerical related to gas laws and heat.	3.1 Heat: Three modes of transmission of heat- conduction, convention, radiation. Good and bad conductor of heat with examples, Law of thermal conductivity and S.I. units, Coefficient of linear, aerial and cubical expansion, relation between them (no derivation). (Numerical based on above) 3.2 Boyles law, Charle's law, Gay Lussac's law, absolute zero temperature, Kelvin scale of temperature, General gas equation (statement only), two specific heats	10

		of gases, relation between them, Mayer's relation. . Isothermal process and adiabatic process(Numerical based on above)	
4. Wave motion and Acoustics	1. Define different terms related to Acoustics. 2. Reproduce the formula for velocity of sound with end correction. 3. Classify the different types of wave by their characteristics. 4. Recognize sound absorbing textile material. 5. Describe the phenomenon of resonance with examples. 6. Describe the Doppler effect and Sabine's formula. 7. Implement the conditions for good acoustics in auditorium. 8. Solve the numerical related to wave motion and acoustics.	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. forced and free vibration, definition of resonance with example, procedure to find resonance with the help of tuning fork. Formula for velocity of sound with end correction, various factors which depends on it.(Numerical based on above) 4.2Introduction to Doppler Effect and its applications. Echo, Reverberation, Reverberation Time. Absorption coefficient of material, Sabine's formula for reverberation time, Factors affecting the Reverberation of time and acoustics of building. Sound absorbing materials. (Numerical based on above)	14
5. Modern Physics	1. Define the terms related to topics in modern physics. 2. List the properties applications of LASER. 3. State the characteristics of photo electric effect. 4. State the applications related to X-ray, LASER, and photo cell. 5. Implement the photoelectric effect to develop photocell. 6. Illustrate the construction and working of Ruby LASER 7. Describe the production of X-rays. 8. Solve the numerical base on Photo-electricity and X-rays.	5.1 Photon, properties of photons, Planck's hypothesis, Threshold frequency, threshold wavelength and work function, Photoelectric effect with characteristics properties. Principle, Construction and working of Photoelectric cell with applications. Einstein's photoelectric equation. (Numerical based on above) 5.2 Properties of laser, Types of laser, absorption, spontaneous and stimulated emission. Definition of Pumping and its type, Population inversion, Metastable state. Ruby laser: Principle, construction and working. Applications of LASER in Engineering and biomedical Engineering. 5.3Introduction to X-rays, Properties of X-rays, production of X-ray using Coolidge tube. Formula for Minimum wavelength of X-rays, Applications of X-rays in Engineering, medical and scientific field.(Numerical based on above)	18

6. Optical Fiber and Nanotechnology	1. Define the terms related to Optical fiber and nanotechnology. 2. Draw the diagram for inner structure of optical fiber. 3. State the applications of Optical fiber and nanotechnology. 4. Clarify the properties of nanoparticles are different than other particles. 5. Describe the principle of optical fiber. 6. Solve the numerical based on optical fiber.	6.1 Optical fiber, Material of Optical fiber. Structure of optical fiber and its types. Principle of Optical fiber-total internal reflection. Acceptance angle, Numerical aperture. Applications of Optical Fiber.(Numerical problems) 6.2 Definition of nanoscale, nanometer, nanoparticle, nanostructured materials with examples, Application of nanotechnology in Engineering and Technology, medical, cosmetics, environmental, space and defense.	08
Total Hrs.			64



B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Pract-icals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify the various instruments used in Physics laboratory and follow precautionary measures.	General Properties of solids	2
2	Determine least count and range of Vernier Caliper, Outside micrometer screw gauge and calculate its zero error.		2
3	Calculate the diameter of a small spherical body by Outside micrometer screw gauge.		2
4	Measure the outer diameter of a cylindrical body by Vernier Caliper.		2
5	Calculate the value of Young's modulus of elasticity of given wire and identify the type of material from standard value.		2
6	Find rise of liquid in capillary tube and compute surface tension of liquid.	General Properties of liquids	2
7	Compose the relation between terminal velocity and radius of spherical body with different materials passing through the liquid.		2
8	Find the most viscous fluid from given fluids by calculating coefficient of viscosity.		2
9	Analyze the effect of volume on pressure at constant temperature.	Transmission of heat and gas laws	2
10	Calculate mechanical equivalent of heat, J by electrical method.		2
11	Determine inner diameter of resonance tube using Vernier Caliper.	Wave Motion and Acoustics	2
12	Find the velocity of sound with the help of resonance tube. OR Determine the unknown frequency of tuning fork by sonometer.		2
13	Measure the angle of divergence of Laser.	Modern Physics	2
14	Find total internal reflection of light by pin method. OR Calculate the surface area (SA), volume (V) and SA/V of an object and measure dimensions required for it.	Optical Fiber and Nanotechnology	2
Skill Assessment			4
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	General Properties of solids	06(00)	00(04)	00(00)	06(04)
02	General Properties of liquids	02(00)	08(06)	00(00)	10(06)
03	Transmission of heat and gas laws	02(00)	04(04)	06(04)	12(08)
04	Wave Motion and Acoustics	04(04)	04(02)	06(00)	14(06)
05	Modern Physics	02(04)	10(04)	06(00)	18(08)
06	Optical fiber and Nanotechnology	02(02)	08(00)	00(06)	10(08)
	Total	18(10)	34(20)	18(10)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	5	R	2	6	R	2	6	R	2	5/7
	4	U	2																
02	1	R	4	2	U	4	2	U	4	1	U	4	3	U	4				3/5
03	3	U	4	4	R	4	4	U	4	4	R	4	3	A	4				3/5
04	6	U	4	5	U	4	6	U	4	5	R	4	5	U	4				3/5
05	5	A	6	4	A	6	2	U	6										2/3
06	5	U	6	3	A	6	6	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing circuit diagram/figure, selection of equipment's.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs (if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	-	-	-	-	-	-	-	-	2	-	-
2	3	-	-	-	-	-	-	-	-	2	-	-
3	3	-	-	-	-	-	-	-	-	2	-	-
4	3	-	2	2	-	-	-	2	-	2	-	-
5	3	-	2	2	-	-	-	2	-	2	-	-
6	3	-	2	2	-	-	-	2	-	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Modern Physics	B.L. Thereja, S.Chand & Company Ltd 5 th Edition, 2014	13:978-8-12-190163-5
2.	Engineering Physics	V.Rajendran, The McGraw Hill Education Pvt. Ltd, 1 st Edition, 2010	13: 978-0-07-107014-0
3.	Conceptual Physics	P.G.Hewitt, San Francisco Addison Wesley- 10 th Edition, 2006	13: 9780321909107
4.	Engineering Physics	R.K.Gaur And S.L.Gupta, Dhanpatrai Publication New Delhi, 1987	97-8-18-992822-3

❖ **E-REFERENCES:**

<https://www.youtube.com/watch?v=7vT-988yH3M> , assessed on 5th march 2016
https://www.youtube.com/watch?v=XMWcQ4Fn_3I , assessed on 4th march 2016
<https://www.youtube.com/watch?v=6L3Y6UnWe6M> , assessed of 5th march 2016
https://www.youtube.com/watch?v=KjUIKF6_4LI , assessed on 2nd march 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS 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 pattern 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. sonometer teak wood with length 1m.
7. Tuning fork -256, 320, 384, 428, 480, 512 Hz.
8. Boyle's apparatus iron base double steel rod, 25 ml fitted with leveling screw on base
9. Stoke's apparatus with glass tube 50 cm.
10. Stop watch GEM 1/10 sec.
11. Ammeter (DC, 0-5 Amp)
12. Millimeter (DC, 0-1 Amp. G.E. type D 50)
13. Voltmeter (DC, 0-3V)
14. Rheostat single tube of 6.5 cm dia., 30 cm length, 5 Amp, 18 ohm, provided with Bakelite slider with phosphor, bronze contacts.
15. Joule's calorimeter with mass 198 cal/gms.
16. Laser

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	M. K. Malke	I/C Physics Department	Government Polytechnic, Nagpur.
2.	Dr. K. S. Moon	Associate Professor	Dharampeth M P Deo Memorial Science College, Nagpur
3.	Mrs. Farheen Baig	Assistant Professor	Priyadarshini College of Engineering, Nagpur
4.	Mrs. M.B. Mahaley	HOD, Physics Department	SDMP, Nagpur
5.	Dr. S. B. Raut	Lecturer	Government Polytechnic, Nagpur.
6	Mrs. S.B. Adulkar	Lecturer	Government Polytechnic, Nagpur.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME/AE/MT/PK
LEVEL NAME	: BASIC SCIENCE COURSES
COURSE CODE	: CH 201E
COURSE TITLE	: APPLIED CHEMISTRY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 04; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR., 2 PR CREDIT = 1 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (Internal)
PT.	: 01 HR

❖ RATIONALE:

Chemistry is the basic science which is essential to all engineering courses. For an engineer, the usage of equipments and instruments would require knowledge of chemical substances, their composition and properties. 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.

Study of Applied chemistry is essential to mechanical engineering course group. It provides knowledge about the appropriate use of engineering materials, their protection, study of extraction of iron, study of different fuels and their usage and lubrication process in different working conditions of machines. This will be gateway for development of reasoning capacity of students and understanding new technology as well.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Use principles and basic laws of chemistry in engineering field.
2. Select and apply knowledge of metal and nonmetallic materials in field of engineering and Technology.
3. Select proper fuel and lubricants on the basis of properties and application.
4. Record readings of experiments.
5. Conclude result of practical on the basis of ultimate stakeholders or society.
6. Safely handle chemicals and equipments which are correlate with safety of others and environmental protection

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1 Chemical Bonding	1. Define terms related to Atomic structure. 2. State postulates of Bohr's Theory. 3. Draw schematic diagram of atom. 4. State all steps of formation of molecules. 5. Review the filling up orbital by Aufbau principle and Hund's rule.	Atomic Structure: 1.1 Definition of Atom, Fundamental Particles of Atom – their Mass, Charge, Location. 1.2 Postulates of Bohr's Theory 1.3. Definition, Shape of the orbitals & distinction between Orbits & Orbitals. 1.4 Hund's Rule, Filling Up of the Orbitals by Aufbau's Principle (till Atomic no. 30). Valence: 1.5 Definition & types of valence (Electrovalence & Covalence). 1.6 Octet Rule, Duplet Rule. 1.7 Formation of Electrovalent e.g. NaCl, CaCl ₂ , MgO, AlCl ₃ . 1.8 Formation of Covalent Compounds CO ₂ , H ₂ O, NH ₃ , C ₂ H ₂ . 1.9 Distinction between electrovalent & covalent compounds.	10
2. Metallurgy and Alloys	1. Describe the process of extraction of iron from its ore. 2. State different processes of Heat treatment. 3. Select effects of alloying elements on properties of steels. 4. State importance and purposes of heat treatment of steel.	Metallurgy 2.1 Definitions of metallurgy, ores of iron. 2.2 Extraction of pig iron by smelting in Blast furnace with chemical reactions in different zones. Product of Blast furnace 2.3 Composition, properties and applications of pig iron, slag and flue gases. 2.4 Properties and applications of commercial forms of iron-pig iron, cast iron, wrought iron Steels 2.5 Definition of steel. Classification of plain carbon-low carbon, medium carbon, high carbon steel with their properties and application. Alloy steel 2.6 Effect of alloying element C, Ni, CO, V, Mo, W, Cr on properties of steel, 2.7 Composition, properties and application of heat resisting steel, Nicrome, magnetic steel (alnico), 18-8 stainless steel, 18-4-1 high speed steel. Heat treatment of Steels 2.8 Definition and purposes of –Hardening, Tempering, annealing, and Normalizing.	12
3. Non-Metallic Engineering Materials	1. Distinguish between thermo softening and thermosetting plastics. 2. List the properties of Rubber.	Polymers (Plastics, Rubber) 3.1 Definition and types of Plastic, thermo softening and thermosetting plastics. Properties, properties and uses of plastic. 3.2 Formation of Plastic by Addition &	08

	3. State the applications of thermal insulators, Thermocole and Glass wool. 4. Describe applications of Polyethylene & Bakelite plastic	Condensation process (by giving e.g. of Polyethylene & Bakelite plastic Respectively) 3.3Rubber: Types of Rubber. 3.4Natural Rubber: Its Processing, Drawbacks of Natural Rubber, Vulcanization of Rubber with Chemical Reaction. 3.5 Synthetic Rubber: Definition, difference between natural and synthetic rubber, 3.6 Properties of synthetic rubber such as elasticity, tack, abrasion resistant, their definition and related applications. 3.7 Insulating material Definition & Characteristics of Thermal insulators. Preparation, Properties & Applications of Thermocole & glass wool.	
4. Energy	1. State characteristics of a good fuel. 2. State significance of proximate analysis of a fuel. 3. Describe the process fraction distillation of crude petroleum. 4. State significance of Biogas, LPG and CNG. 5. Compare different types of fuel- solid, liquid and gaseous.	Energy 4.1 Definitions of a fuel, calorific value and ignition temperature, 4.2 Characteristics of a good fuel, Classification of fuels with suitable examples, advantages and disadvantages of solid fuels, liquids fuels and gaseous fuels. Classifications of fuel : 4.3 Solid fuels: analysis of solid fuels- Proximate analysis for determination of moisture, volatile matter, ash and fixed carbon, significance of Proximate analysis, 4.4 determination of gross calorific value by using Bomb calorimeter. 4.5 Liquid fuels—Origin, fractional distillation of crude petroleum, boiling range, composition and applications of petroleum fractions obtained. 4.6 Composition, properties applications of- Biodiesel. Gaseous fuels 4.7Composition,properties,applications of Biogas, LPG, CNG	16
5. Lubricants	1. State functions of lubricants 2. Describe the mechanism of lubrication. 3. State characteristics of Lubricants. 4. Select proper lubricant on the basis of different types of machines.	5.1 Definition, Types of Lubricants, Functions of Lubricants. 5.2 Types of lubrication. Fluid film lubrication, Boundary lubrication and Extreme pressure lubrication. 5.3 Characteristics of Lubricants- Viscosity, oiliness ,viscosity Index, oiliness , Volatility, cloud and pour point, Flash and fire point, Neutralization number, emulsification. 5.4 Selection of Lubricant for various types of machines such as I.C engine, steam engine	10

		cylinder Gear system, cutting tools delicate and simple machines, tractors and rollers.	
6. Corrosion	1. State mechanism of atmospheric corrosion and immersed corrosion. 2. Describe different methods of protection of metal from corrosion. 3. Select proper protection method for different types of material from corrosion.	6.1 Definition of corrosion, Types of corrosion, mechanism of Atmospheric or chemical corrosion .Effect of oxide film on atmospheric corrosion. Factor effecting atmospheric corrosion. 6.2 Immersed Corrosion or Electrochemical Corrosion, definition, types and mechanism(Hydrogen evolution and oxygen absorption) 6.3 Factors Affecting Electrochemical Corrosion 6.4 Protection of Metals by Purification of Metals, Alloy Formation, Cathode Protection, 6.5 Controlling the External Conditions 6.6 Application of Protective Coatings like metal coating by - Galvanizing, Tinning, Sherardizing Metal Spraying, Metal Cladding, Cementation or Diffusion Method. 6.7 Application of non metallic coatings: paint- definition, characteristics, constituents of paint and their functions.	08
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Pract-icals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Explore the chemistry laboratory.	Chemical Bonding	02
2	Determine the percentage of Iron in given steel sample by redox titration. OR Determine the percentage of copper in given alloy sample.	Metallurgy and Alloys	02
3	Find the relation between loss in weight of aluminium strip in acidic and alkaline medium and rate of corrosion.	Corrosion	02
4	Determine the strength of given hydrochloric acid solution by titrating it against sodium hydroxide solution.		02
5	Determine thinner content in oil paint.		02
6	Determine the percentage of moisture content in the given coal sample.	Energy	02
7	Determine the percentage of ash content in the given coal sample by proximate analysis.		02
8	Determine coefficient of viscosity using Ostwald's Viscometer	Lubricants	02
9	Determine acid value of lubricant by KOH OR Determine flash point of lubricant by use of flash point apparatus.		02
10	Prepare Phenol formaldehyde resin used in manufacturing of Bakelite Plastic.	Non-Metallic Engineering Materials	02
11	Analyse basic and Acidic Radicals of known salt solution-1 (Confirmatory Test) using qualitative analysis method.	Chemical Bonding	02
12	Analyse basic and Acidic Radicals of known salt solution-2 (Confirmatory Test) using qualitative analysis method.		02
13	Analyse basic and Acidic Radicals of known salt solution-3 (Confirmatory Test) using qualitative analysis method.		02
14	Analyse basic and Acidic Radicals of known salt solution-4 (Confirmatory Test) using qualitative analysis method.		02
Skill Assessment			4
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Chemical Bonding	06(04)	04(04)	00(00)	10(08)
2	Metallurgy and Alloy	02(00)	04(06)	06(00)	12(06)
3	Non-Metallic Engineering Material	06(00)	04(04)	00(00)	10(04)
4	Energy	02(04)	10(02)	06(04)	18(10)
5	Lubricant	02(00)	08(00)	00(00)	10(06)
6	Corrosion	00(02)	04(04)	06(00)	10(06)
	Total	18(10)	34(20)	18(10)	70(40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	4	U	2	5/7
	6	R	2																
02	1	R	4	1	U	4	2	U	4	1	R	4	1	U	4				3/5
03	3	R	4	3	U	4	4	U	4	3	U	4	4	R	4				3/5
04	5	U	4	5	U	4	6	U	4	4	A	4	6	U	4				3/5
05	2	A	6	4	A	6	2	U	6										2/3
06	4	U	6	6	A	6	5	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Writing chemical reactions, handling the equipment, writing procedure etc.	10
2	Performance	20
3	Calculation, result, drawing graphs(if any)	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	-	-	-	-	-	-	-	-	-	-	-
2	3	2	-	-	-	-	-	-	-	-	-	-
3	3	2	-	-	-	-	-	-	-	-	-	-
4	3	-	3	-	-	-	-	3	-	3	-	-
5	3	-	2	-	-	-	-	2	-	2	-	-
6	3	-	1	-	-	2	-	1	-	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1	Engineering Chemistry	Jain and Jain , Dhanpat Rai publishing company(P) ltd.16 th Edition reprint 2015	978-93-437-07-3
2	A Text book of Engineering Chemistry	S. S. Dara ,S. Chand Publication,15 th Edition	9788121903592
3	Engineering Chemistry	R. Sivakumar , N. Sivakumar and Tata McGraw-Hill, 10 th Edition	9780745-328896
4	Polytechnic Chemistry	Vedprakash Mehta ,Jain brothers, 6 th Edition	13-9788183600134
5	Industrial Chemistry	B.K.Sharma, Goel Publication, 8 th Edition	8187224002, 9788187224006

❖ **E-REFERENCES:**

http://www.substech.com/dokuwiki/doku.php?id=full_index_of_articles_on_fluids-,

assessed on 2 Feb. 2016

<http://www.asetute.com.au/corrosion.html>, assessed on 4 Feb. 2016

http://www.sherardizing.com/resources/files/9_Sherardizing_Corrosion.pdf, assessed on 4 Feb. 2016

<http://www.galvanizeit.org/aga/animation>, assessed on 6 Feb. 2016

http://www.ehow.com/list_6725219_different-types-metal-cladding.html, assessed on 8 Feb 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS 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. Muffle furnace(temp. measure up to 1500⁰ c)
9. Oven (temp measure up to 500⁰ c)

❖ **LIST OF EXPERS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

Sr. No	Name	Designation	Institute/Industry
1.	Dr. P.J. Sondawale	I/C chemistry Department	Government Polytechnic, Nagpur
2.	Dr. Mudrika I. Ahmed	Lecturer in chemistry	Government Polytechnic, Nagpur
3.	Dr. M. S. Rathod	Lecturer in chemistry	Government Polytechnic, Nagpur
4.	Dr. S. A. Petkar	Lecturer in chemistry	Government Polytechnic, Nagpur
5.	Mr. S.R. Gaidhar	Lecturer in chemistry	Government Polytechnic, Gadchiroli
6.	Dr. S. Z. Jadhav	Professor in chemistry	Institute of Science, Nagpur
7.	Dr. K. A. Nandekar	Lecturer in chemistry	G.H.Raisoni Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/AU/PK/MT/EE/EC/IT/CM/TX
LEVEL NAME	: BASIC SCIENCE COURSES
COURSE CODE	: MH201E
COURSE TITLE	: ENGINEERING MATHEMATICS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH:04; TU: 01; PR:00 (CLOCK HRs.)
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: NIL
PT.	: 01 HR

❖ **RATIONALE:**

The subject is classified under basic sciences and intends to teach students basic facts, concepts and principles of Mathematics as a tool to analyze Engineering problems. Mathematics lay- down the foundation for understanding core Technology subjects.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Develop logical thinking which is useful in comprehending the principles of all other subjects.
2. Use concept of allied angle, compound angle, multiple, and sub multiple angle to solve engineering problems.
3. Use measures of central tendency and measures of dispersion in decision making.
4. Apply matrix method to solve simultaneous equations in two and three variables.
5. Develop intellectual skill by using mathematical concept.
6. Apply laws of logarithm to solve engineering problems.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1. Logarithm	1. Identify natural and common logarithm 2. Apply laws of logarithm in solving examples	1.1 Definition of logarithm 1.2 Definition of natural & common logarithm 1.3 Laws of logarithm & change of base formula	04
2. Partial fractions	1. Define rational function, proper and improper fraction. 2. Factorize quadratic and cubic polynomial 3. Resolve proper and improper fraction into partial fraction.	2.1 Definition of rational function , proper ,improper fraction and partial fraction 2.2 Resolving proper fraction into partial fraction. 2.2.1 Denominator containing non repeated linear factors 2.2.2 Denominator containing repeated linear factors 2.2.3 Denominator containing irreducible non repeated quadratic factors 2.3 Resolving improper fraction into partial fraction.	06
3. Determinant and Matrix	1. Memorize expansion formula of determinant of order 2 and 3. 2. Find the value of determinant of order 2 and 3. 3. Define various types of matrices. 4. Perform all algebraic operations on matrices. 5. Solve simultaneous equations in two and three variables	3.1 Definition of determinant , order of determinant 3.1.1 Expansion of determinant of order 2 and 3 3.2 Definition of matrix 3.2.1 Types of matrices 3.2.2 Algebra of matrices 3.2.3 Transpose of matrix , ad-joint of matrix and inverse of matrix 3.2.4 Solution of system of linear equations two and three variables by inverse matrix method	14
4. Trigonometry	1. Define allied angle and compound angle. 2. State the formula of multiple angle (2θ and 3θ) sub-multiple angle ($\frac{\theta}{2}$). 3. Verify trigonometric identities. 4. Solve examples using allied angle, compound angle, multiple	4.1 Trigonometric ratios of any angle 4.2 Fundamental identities 4.3 Trigonometric ratios of allied angles 4.4 Trigonometric ratios of compound angles 4.5 Trigonometric ratios of multiple and sub-multiple angles 4.6 Factorization and de-factorization formulae	22

	and sub-multiple angle formula. 5. Solve examples using factorization and de-factorization formula.		
5. Inverse trigonometric functions	1. Define inverse trigonometric functions. 2. Find principle values of inverse trigonometric functions 3. Solve examples of inverse trigonometric functions.	5.1 Definition of inverse trigonometric functions 5.2 Principle values of inverse trigonometric functions 5.3 Relation between inverse trigonometric functions	06
6. Statistics	1. Define mean of data. 2. Memorize formula of mean, combined mean, mean deviation and standard deviation. 3. Find mean and combined mean. 4. Find the range, mean deviation, standard deviation and variance. 5. Find coefficient of variation and compare the consistency	6.1 Measures of central tendency (mean only) 6.2 Combined mean 6.3 Measures of dispersion 6.4 Range, mean deviation, standard deviation 6.5 Variance and coefficient of variation 6.6 Comparison of two sets of observations	12
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Solve examples using laws of logarithm	Logarithm	01
2	Find partial fraction of proper fraction.	Partial fraction	01
3	Find partial fraction of improper fraction.		01
4	Expand determinant of order 2 and 3.	Determinant and Matrix	01
5	Perform all algebraic operations on matrices		01
6	Find transpose , ad-joint and inverse of matrix		01
7	Solve simultaneous equations in two and three variables		01
8	Verify trigonometric identities.	Trigonometry	01
9	Use allied angle and compound formulae		01
10	Use multiple and sub-multiple angle formulae		01
11	Apply factorization formula to solve examples.		01
12	Apply de-factorization formula to solve examples.		01
13	Find principle values of inverse trigonometric functions and verify formulae	Inverse trigonometric functions	01
14	Find mean of any data and combined mean oftwo sets ofdata.	Statistics	01
15	Find the range, mean deviation, standard deviation and variance.		01
16	Find coefficient of variation and compare the consistency		01
Total Hrs.			16

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Logarithm	00(02)	04(00)	00(00)	04(02)
02	Partial fraction	00(00)	08(06)	00(00)	08(06)
03	Determinant and Matrix	02(00)	08(04)	06(04)	16(08)
04	Trigonometry	06(00)	14(08)	04(04)	24(12)
05	Inverse trigonometric functions	02(00)	04(04)	00(00)	06(04)
06	Statistics	00(02)	12(00)	00(06)	12(08)
	Total	10(04)	50(22)	10(14)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	3	R	2	4	R	2	4	R	2	4	R	2	5	R	2	1	R	2	5/7
	6	R	2																
02	1	U	4	2	U	4	2	U	4	3	U	4	3	A	4				3/5
03	3	U	4	3	U	4	4	U	4	4	U	4	4	A	4				3/5
04	4	U	4	5	U	4	4	A	4	5	U	4	4	U	4				3/5
05	6	U	6	4	U	6	2	U	6										2/3
06	6	U	6	3	A	6	6	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	--	--	--	--
		Journal Writing		Continuous	--	--	--	--
				TOTAL	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
	NIL	

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	3	2	-	-	-	2	3	-	3	-	-
2	3	3	2	3	-	-	2	3	-	3	-	-
3	3	3	2	3	-	-	2	3	-	3	-	-
4	3	3	2	3	-	-	2	3	-	3	-	-
5	3	3	2	-	-	-	2	3	-	3	-	-
6	3	3	2	3	-	-	2	3	-	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Higher Algebra	Hall & Knight, Publisher: Arihant, 5 th Edition 2015	9352030605
2	Plane Trigonometry	S L Loney, Publisher: Arihant, 5 th Edition 2015	9352030540
3.	Basic Statistics	B L Agarwal, Publisher: Anshan	1848290675
4.	Engineering Mathematics	S.S .Shastry, Prentice Hall Of India, 4 th Edition 2008	978-81-203-3616-2
5.	Fundamental of Statistics	S C Gupta, Himalaya Publishing House, 7 th Edition 2015	9789350517697

❖ **E-REFERENCES:**

<https://www.khanacademy.org/math/algebra>, assessed on March 3, 2016

<https://www.khanacademy.org/math/trigonometry>, assessed on March 3, 2016

<https://www.youtube.com/watch?v=BiLIcCtXmm0>, assessed on March 3, 2016

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Mr. S.M. Sayyed	I/C Mathematics Dept.	Govt. Polytechnic Nagpur
2.	Mr. P.T. Khobragade	Lecturer	Govt. Polytechnic Nagpur
3.	Mr. G.R. Dewalkar	Lecturer	Govt. Polytechnic Nagpur
4.	Dr. K. C. Deshmukh	Professor	R. T. M. Nagpur University
5.	Dr. P. B. Bahatkar	Professor	Y. C. C. E. Nagpur
6	Mr. Nasir Khan	Lecturer	Anjuman Polytechnic Nagpur

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/AU/PK/MT
LEVEL NAME	: BASIC SCIENCE COURSES
COURSE CODE	: MH202E
COURSE TITLE	: APPLIED MATHEMATICS
PREREQUISITE	: MH201E
TEACHING SCHEME	: TH: 04 ; TU:01; PR:00 (CLOCK HRs.)
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR.)
TH. TEE EXAM.	: 03 HRs
PR. TEE EXAM	: NIL
PT. EXAM	: 01 HR

❖ RATIONALE:

Mathematics is the backbone of Technical courses, Understanding of engineering concepts require logical approach and thinking. The course is extension of Engineering Mathematics of first semester and stepping 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 subjects.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply mathematical term, concept, principles and different methods for studying engineering subjects.
2. Apply mathematical methods to solve technical problems.
3. Execute management plans with precision.
4. Use mathematical techniques necessary for daily practical problems.
5. Apply concept of extrema in finding maximum profit of production and minimum cost or material needed for production of an article.
6. Apply various numerical method to solve algebraic and simultaneous equations.

❖ COURSE DETAILS:

A. THEORY:

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Functions and Limits	1. Identify various types of functions. 2. Define odd and even function. 3. Find value of any given function. 4. Find limits for all different functions.	1.1 Definition of function, value of a function. 1.2 Types of functions. 1.3 Concept of limit. 1.4 Algebra of limits. 1.5 Limits of algebraic functions. 1.6 Limits of trigonometric functions. 1.7 Limits of exponential & logarithmic functions.	10
2. Derivatives and Applications of derivative	1. State limit definition of derivative. 2. Perform all algebraic operations on derivatives. 3. Find slope, Equation of tangent and normal line of the given curve. 4. Solve examples of maxima and minima.	2.1 Definition of derivative, Notations. 2.2 Derivative of standard functions. 2.3 Rules for differentiation (without proof) 2.4 Derivative of composite functions. 2.5 Derivative of inverse trigonometric functions. 2.6 Derivative of implicit functions. 2.7 Logarithmic differentiation. 2.8 Derivative of parametric functions. 2.9 Second order differentiation. 2.10 Applications: Equation of tangent and normal; Maxima and minima.	16
3. Integration, Definite integration and Applications	1. State Integration by parts theorem. 2. Integrate function using different method. 3. Solve examples of definite integral using properties. 4. Find area using integration method.	3.1 Definition of integration as anti-derivative. 3.2 Integration of standard functions. 3.3 Rules for integration. 3.4 Integration by substitution. 3.5 Integration of rational functions. 3.6 Integration by trigonometric transformation. 3.7 Integration by parts. 3.8 Integration by partial fraction. 3.9 Definition of definite integral. 3.10 Properties of definite integral. 3.11 Applications: Area under the curve, Area bounded by two curves.	16
4. Differential equations	1. State order and degree of D.E. 2. Solve differential equations of first order and first degree. 3. Solve different engineering problems using differential equations.	4.1 Definition of differential equation. 4.2 Order and degree of differential equation. 4.3 Methods of solving differential equations of first order and first degree. 4.4 Variable separable method, reducible to variable separable. 4.5 Homogenous differential equation, exact differential equation. 4.6 Linear and Bernoulli equations.	08

5. Numerical methods	1. Identify the interval of root of algebraic equation. 2. Find the approximate root of algebraic equation. 3. Solve the system of simultaneous equations containing 3 unknowns	5.1 Solution of algebraic equation. 5.1.1 Bisection method. 5.1.2 Regula-Falsi method. 5.1.3 Newton-Raphson method. 5.2 Solution of Simultaneous equations containing 3 unknowns. 5.2.1 Gauss elimination method. 5.2.2 Iterative methods: Gauss-Seidal & Jacobi's method.	14
Total Hrs.			64

B LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Find value of any given function.	1. Functions and Limits	01
2	Find limits algebraic functions.		01
3	Find limits trigonometric, exponential functions.		01
4	Solve examples on derivative using algebraic operations.	2. Derivatives and Applications of derivative	01
5	To find dy/dx of implicit functions.		01
6	To find dy/dx of parametric functions and inverse inverse trigonometric functions.		01
7	Find equation of tangent and normal and solve maxima and minima problems.		01
8	Solve examples using rules of integration and substitution method	3. Integration, Definite integration and Applications	01
9	Solve examples using integration by parts and partial method		01
10	Solve examples using integration by parts and partial fraction method.		01
11	Evaluate definite integral using properties.		01
12	Find area using integration		
13	Solve D.E. using variable separable method and reducible to variable separable.	4. Differential equations	01
14	Solve homogenous, linear and Bernoulli D.E.		01
15	Find the approximate root of algebraic equation.	5. Numerical methods	01
16	Solve the system of simultaneous equations		01
Total Hrs.			16

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Functions and Limits	04(00)	08(08)	00(00)	12(08)
02	Derivatives and Applications of derivative	04(00)	08(04)	06(06)	18(10)
03	Integration, Definite integration and Applications	02(00)	08(08)	06(00)	16(08)
04	Differential equations	00(04)	08(00)	00(00)	08(04)
05	Numerical methods	04(00)	12(04)	00(06)	16(10)
	Total	14(04)	44(24)	12 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	1	R	2	2	R	2	2	R	2	3	R	2	4	R	2	5/7
	4	R	2																
02	1	U	4	1	U	4	2	U	4	1	U	4	1	U	4				3/5
03	2	U	4	3	U	4	3	U	4	2	U	4	3	U	4				3/5
04	4	U	4	4	U	4	5	R	4	3	U	4	5	U	4				3/5
05	2	A	6	3	A	6	2	A	6										2/3
06	5	U	6	5	U	6	5	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	--	--	--	--
		Journal Writing		Continuous	--	--	--	--
				TOTAL	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
NIL		

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	3	2	-	-	-	2	3	-	3	-	-
2	3	3	2	3	-	-	2	3	-	3	-	-
3	3	3	2	3	-	-	2	3	-	3	-	-
4	3	3	2	3	-	-	2	3	-	3	-	-
5	3	3	2	-	-	-	2	3	-	3	-	-
6	3	3	2	3	-	-	2	3	-	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Engineering Mathematics-1	P N Wartikar, Pune Vidyarthi Griha Prakashan	4567155742
2.	Calculus of one variable	IA Maron, Publisher: Arihant, 5 th edition 2015	9352030559
3.	Engineering Mathematics	S.S .Shastri, Prentice Hall Of India, 4 th edition 2008	9788120336162
4.	Engineering Mathematics	D.T.Gaikawad, S Chand Publication, 1 st edition 2010	8121933560
5.	Higher Engineering Mathematics	B S Grewal, Publisher: S Chand, 43 rd edition 2014	9788174091955

❖ **E-REFERENCES:**

http://www-math.mit.edu/~djg/calculus_beginners/, assessed on March 3, 2016

<https://en.wikibooks.org/wiki/Calculus>, assessed on March 3, 2016

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Mr. M. SAYYED	I/C HOD, MATHS DEPTT.	GOVT. POLYTECHNIC NAGPUR
2.	Mr. T. KHOBRAGADE	LECTURER	GOVT. POLYTECHNIC NAGPUR
3.	Mr. R. DEWALKAR	LECTURER	GOVT. POLYTECHNIC NAGPUR
4.	Dr. K. C. DESHMUKH	PROFESSOR	R. T. M. NAGPUR UNIVERSITY
5.	Dr. P. B. BAHATKAR	PROFESSOR	Y. C. C. E. NAGPUR
6	Mr. NASIR KHAN	LECTURER	ANJUMAN POLYTECHNIC NAGPUR

(Member Secretary PBOS)



(Chairman PBOS)

LEVEL - III

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN EE/EC/CM/IT/MT/TX
LEVEL NAME	: ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES
COURSE CODE	: ME302E
COURSE TITLE	: ENGINEERING GRAPHICS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 02; TU: 00; PR: 04 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT. EXAM	: NIL

❖ **RATIONALE:**

Engineering graphics is the language of engineers. It describes the fundamentals, facts, concepts, principles and techniques of Engineering Graphics. The course illustrates techniques of drawing in an engineering field. The concepts of graphical language are used in expressing the ideas, conveying the instructions, which are used in carrying out the jobs on the sites, shop floor etc. 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.

COURSE OUTCOMES:

After completing this course students will be able to–

1. Draw geometrical figures, curves, sketches etc.
2. Construct the views of an object by using principles of orthographic projection.
3. Visualize three dimensional objects and draw isometric projections.
4. Apply various drawing codes, conventions and symbols as per IS SP-46
5. Interpret various engineering curves
6. Draw free hand sketches of mechanical elements

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Principles of drawing	1. Use of instruments for drawing, scales, lines and their applications. 2. Use of IS SP-46. 3. Loci of points from given data.	1.1 Use of different drawing instruments and equipment 1.2 Types of letters and numbers (single stroke vertical and numbers only) 1.3 Conventions of lines, 1.4 Dimensioning technique as per IS: SP -46 1.5 Scales (reduced, enlarged and full size)- Plain scale, diagonal scale. 1.6 Redrawing 1.7 Loci of points	05
2. Engineering curves.	1. Draw conic sections. 2. Draw involute, cycloid and state their applications 3. Draw helix, spiral from given data.	2.1 To draw an ellipse by- i) Arcs of circles method ii) Concentric circles method 2.2 To draw parabola- I) Rectangle method 2.3 To draw hyperbola by- I) Passing through a given point with reference to given asymptotes 2.4 To draw involutes of circle and polygon of maximum six sides 2.5 To draw cycloid, epi-cycloid and hypo-cycloid	08
3. Orthographic projections.	1. Visualize, interpret and draw orthographic views from given pictorial views. 2. Use of IS SP-46 for dimensioning technique.	3.1 Introduction to orthographic projections 3.2 First angle and Third angle method of projections 3.3 Conversion of simple pictorial views into orthographic views and dimensioning techniques as per IS SP-46	07
4. Isometric projections	1. Visualize, interpret and draw Isometric views from given orthographic views	4.1 Isometric scales 4.2 Isometric views of simple object (plane surfaces, slanting surfaces, and Rectangular, V, Trapezoidal slots)	07

5. Free hand sketches	1. Prepare proportionate freehand sketches of given machine elements 2. Describe functions and use of machine element.	5.1 Types of threads profile – Vee and square, acme, buttress, seller, BA threads, knuckle threads. Types of screws 5.2 Bolts – square and hexagonal bolts, eye bolt 5.3 Types of nuts : square, hexagonal, wing 5.4 Foundation bolts: Eye foundation bolt, Rag foundation bolt, Lewis foundation bolt 5.5 Single and double Riveted Lap and Butt joints	05
Total Hrs.			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Draw types of lines, lettering, numbers are to be drawn on sketch book only and one problem from each subtopics 1.5 ,1.6 and 1.7 of chapter 1 (01 Sheet)	1.Principles of drawing	12
2	Draw Engineering Curves, one problem from each subtopic of chapter 2. (01 Sheet)	2. Engineering Curves	12
3	Draw two problem using first angle method of projection (01 Sheet)	3 Orthographic Projections	14
4	Draw one problem with plane surfaces & other with slot, slanting surfaces (using natural scale and isometric scale) (01 Sheet)	4. Isometric Projections	14
5	Draw Free Hand Sketches – any ten sketches covering all the topics under chapter 6 (01 Sheet)	5. Free Hand Sketches	12
Total Hrs.			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Nil

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Nil

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics, Assessment Sheets &b Drawing Sheets	4,5,6
		Drawing Portfolio		Continuous	05	--	Drawing Portfolio	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Drawing Answer Sheets	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing of scale, redrawing, and loci of point, line work, neatness ,cleanliness and accuracy	10
2	Drawing two Engineering Curves, line work, neatness ,cleanliness and accuracy	10
3	Drawing of orthographic projections , line work neatness ,cleanliness and accuracy	10
4	Drawing of isometric projections, line work neatness ,cleanliness and accuracy	10
5	Drawing of Free Hand Sketches , line work neatness ,cleanliness and accuracy	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	–	–	–	–	–	3	3	–	3	–	–
2	3	–	3	3	–	–	3	3	3	3	–	–
3	3	–	3	3	–	–	3	3	3	3	–	–
4	3	–	3	3	–	–	–	3	–	3	–	–
5	3	–	3	3	–	–	–	3	3	3	–	–
6	3	–	3	3	–	–	–	3	3	3	–	–

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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	81-7061-091-2
2.	Engineering Drawing	N.D. Bhatt Charotar Publishing house 2010	978-93-80358-17-8
3.	Machine Drawing	N.D. Bhatt &V. M Panchal, Charotar Publishing house, 2010	978-93-80358-11-6
4	Engineering Drawing	D.A. Jolhe Tata McGrawHill Edu.2010	978-0-07-064837-1

5.	Engineering Drawing	R. K. Dhawan , S..Chand & co. 2001	81-219-1431-0
6	Engineering Drawing	P. J Shah. S.Chand&co.2008	81-219-2964-4

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=TJ4jGyD-WCw>, assessed on 25th March 2016
- https://www.youtube.com/watch?v=dmt6_n7Sgcg, assessed on 25th March 2016
- https://www.youtube.com/watch?v=_MQScnLXL0M, assessed on 26th March 2016
- <https://www.youtube.com/watch?v=3WXPanCq9LI>, assessed on 26th March 2016
- <https://www.youtube.com/watch?v=fvjk7PlxAuo>, assessed on 27th March 2016
- <http://www.me.umn.edu/courses/me2011/handouts/engg%20graphics.pdf> , assessed on 27th March 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

- 1) Drawing Board with drawing instruments
- 2) Mini-drafter

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Mr. O. V. Sarode	I/C, Head of Mechanical Engineering	Government Polytechnic, Nagpur.
2.	Mr. M.G. Thote	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
3.	Mr. G.H. Dahole	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4	Er. Ritesh Jain	Deputy Manager	Mahindra and Mahindra Ltd. Nagpur
5	Er. A.M.Onkar	Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Mr. G.F.Potbhare	Principal	NIT, Polytechnic, Nagpur
7	Dr. S.S.Baraskar	Lecturer in Mechanical Engineering	Govt. Polytechnic, Arvi

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN CE/ME/EE/EC/AE/PK/MT/TX
LEVEL NAME : ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES
COURSE CODE : WS301E
COURSE TITLE : WORKSHOP PRACTICE
PREREQUISITE : NIL
TEACHING SCHEME : TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS : 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE : Nil
PR. TEE EXAM : Nil
PT. EXAM : Nil

❖ RATIONALE:

Workshop Practice is an engineering science course. The knowledge of this course is essential for technician industry to perform his/her duties. Working in workshop develops the attitude of groups working and safety awareness. This course provides industrial environment in the educational institute.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Adapt safety precautions in workshop
2. Read and interpret job drawing
3. Use hand tools for various operations
4. Apply basic techniques in manufacturing processes
5. Operate different equipments/machineries used in basic shops
6. Perform jobs according to drawing

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Observe the demonstration of hand tools, machine Tools and equipments used in Carpentry Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Carpentry	2
2.	Prepare utility job involving related carpentry operations. (Job to be prepared by group of 2 to 4 students depending on volume of work)		8
3.	Observe the demonstration of hand tools, machine Tools and equipments used in Welding Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Welding	2
4.	Prepare utility job involving related Welding operations. (Job to be prepared by group of 2 to 4 students depending on volume of work)		8
5.	Observe the demonstration of hand tools, machine Tools and equipments used in Fitting Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Fitting	2
6.	Prepare One individual job involving related Fitting operations.		8
7.	Observe the demonstration of hand tools, machine Tools and equipments used in Smithy Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Smithy	2
8.	Prepare One individual job involving related Smithy operations.		8
9.	Observe the demonstration of hand tools, machine Tools and equipments used in Plumbing Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Plumbing	2
10.	Prepare One individual job involving related Plumbing operations.		8
11.	Observe the demonstration of hand tools, machine Tools and equipments used in Sheet Metal Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Sheet Metal	2
12.	Prepare utility job involving related Sheet Metal Shop operations. (Job to be prepared by group of 2 to 4 students depending on volume of work)		8
Skill Assessment			4
Total Hrs.			64

Note: Jobs should be Programme specific.

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Nil

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Nil

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	40	--	Jobs, Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Record		Continuous	10	--	Journals	1, 2, 3, 4,5,6
				TOTAL	50	20		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF JOB EVALUATION:**

S.N.	Description	Max. Marks
1	Job Drawing	5
2	Handling Tools, machineries and its operations	10
3	Dimension Accuracy	20
4	Overall finishing of Job	5
Total		40

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:****For Mechanical Engineering:**

Course Outcomes (COs)	Program Outcomes (POs)										PSO	PSO
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	-	3	3	-	-	3	3	-	3	3	-
2	3	-	3	3	-	-	-	3	3	3	3	-
3	3	-	3	3	-	-	-	3	3	3	3	-
4	3	-	3	3	-	-	-	3	-	3	3	-
5	3	-	3	3	-	-	3	3	-	3	3	-
6	3	-	3	3	-	-	3	3	3	3	3	-

For Other Programs:

Course Outcomes (COs)	Program Outcomes (POs)										PSO	PSO
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	-	3	3	-	-	3	3	-	3	-	-
2	3	-	3	3	-	-	-	3	3	3	-	-
3	3	-	3	3	-	-	-	3	3	3	-	-
4	3	-	3	3	-	-	-	3	-	3	-	-
5	3	-	3	3	-	-	3	3	-	3	-	-
6	3	-	3	3	-	-	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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 ; 2006, 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	81-219-3092-8
4.	Workshop Practice Manual For Engineering Diploma & ITI Students	R K Hegde, Sapna Book House, 2012	13: 9798128005830

❖ **E-REFERENCES:**

<http://books.google.co.in/books/isbn=9380026757> , assessed on 17th March 2016

<http://www.asnu.com.au/profile/our-process.aspx> , assessed on 17th March 2016

<https://www.youtube.com/watch?v=swnEQ17cQW>, assessed on 17th March 2016

<https://www.youtube.com/watch?v=c-FN4M77qyA>, assessed on 17th March 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Welding Transformer (Air Cooled) Single Phase
2. Welding Transformer (Oil Cooled) Three Phase
3. Gas Welding Set
4. Bench Drilling Machine
5. Hydraulic Power Saw Machine
6. Bench Grinder
7. Bench Vise
8. Wood Turning Lathe Machine
9. Circular Saw Machine
10. Portable Wood Cutting Machine
11. Portable Drilling Machine
12. Carpentry Vice
13. Pipe Bending Machine
14. Pipe Vice
15. Pipe Cutter
16. Black smith Hearth
17. Anvil
18. Swage Block
19. Sheet Bending Machine
20. Sheet Cutting Machine
21. Brazing Equipment
22. All Hand Tools and Measuring Tools use in Carpentry Shop, Fitting Shop, Welding Shop, Plumbing Shop, Smithy Shop and Sheet Metal Shop,

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	D. C. Satadeve	Workshop Superintendant	Government Polytechnic, Nagpur.
2.	Dr. S. W. Rajurkar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
3.	Er. A.M.Onkar	Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
4.	Shri. G.F.Potbhare	Principal	NIT, Polytechnic, Nagpur
5.	Dr.S.S.Baraskar	Lecturer in Mechanical Engineering	Govt. Polytechnic, Arvi

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/CM/IT/AE/PK/MT
LEVEL NAME	: ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES
COURSE CODE	: AM301E
COURSE TITLE	: ENGINEERING MECHANICS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 01; PR: 02
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (Internal)
PT.	: 01 HR

RATIONALE:

Study of this course develops understanding of effect of force on a body. It helps in analytical and graphical solutions to problem related to forces acting on body. It also helps in understanding concept and application of Equilibrium, friction, centroid and center of gravity. Study of simple machines gives idea about input, output, efficiency and friction of machine. Study of this course is very useful at higher level like strength of materials, Mechanics of structure etc. It helps in forming base for understanding all the courses, which are related to engineering mechanics.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply concept of engineering mechanics in engineering field.
2. Analyze effect of force, friction, centroid and centre of gravity.
3. Solve problems related to force, equilibrium of forces, friction, centre of gravity and simple lifting machines.
4. Prove simple laws of equilibrium of forces.
5. Compute efficiency of different machines.
6. Draw the graphs between load and efforts, load and efficiency.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Introduction of Engineering Mechanics	1.Define terms related to Engineering Mechanics 2. State the units of different scalar and vector quantity.	1.1Definition of engineering mechanics, necessity and Classification of engineering mechanics. 1.2 Definitions: Space, time, particle, body, rigid body, mass, weight, scalar and vector quantity. 1.3Units of measurement (SI units): Fundamental units and derived units.	02
2.Simple lifting Machine	1. Define terms related to simple lifting Machine 2.Describe different types of simple lifting machine 3.State velocity ratio of machines 4. Solve problem related to simple lifting machine	2.1Concept of simple lifting machine, uses of machine, definition of load, effort, mechanical advantage, velocity ratio, efficiency of Machines, reversible and non-reversible machines.. 2.2Ideal machine, friction in machine, law of machine, maximum Mechanical advantage and efficiency. 2.3Velocity ratios of simple axle and wheel, differential axle wheel, Single purchase & double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block, two sheaves and three sheaves pulley block, worm and worm wheel	08
3.Forces	1.Define Terms Related to Force 2. Define terms related to moments 3. Define terms related to graphic statics 4. State Principal of Transmissibility of Force 5. State Law of parallelogram of forces 6. Describe Resolution & Composition of forces 7. Solve problems on forces.	3.1 Concept of force, definition of force, unit of force, effects of force, Characteristics of force. 3.2System of forces. Principle of transmissibility of force. 3.3 Composition of forces & Resolution of forces (Two dimensional), Orthogonal and Non Orthogonal components of a force. Resultant force. Resultant of concurrent, non- concurrent and parallel forces, Law of parallelogram of forces: limitations and its applications 3.4 Definition of moment, sign convention of moments, types of moments. Law of moment, definition of couple, types of couple, properties of couple, Varignon's theorem of moments and its applications 3.5 Introduction to graphic statics, graphical representation of force, Bow's notation, Space diagram, force diagram, polar diagram & funicular polygon.	12

4. Equilibrium	1. Define terms related to Equilibrium 2. State analytical conditions of equilibrium. 2. State Lami's theorem 3. Define terms related to Beam 4. Solve Problems related to Lami's theorem and beam reaction.	4.1 Definition of equilibrium, analytical conditions of equilibrium, free body diagram 4.2 Lami's Theorem: limitations and its applications. (Simple problems, no problems on spheres put in container). 4.3 Equilibrium of concurrent, non-concurrent and parallel forces. Definition of Beam, span, types of beams, types of supports, types of loading: point load and UDL. Analytical method to calculate reactions at support for point load and UDL on simply supported and overhanging beams	10
5. Centroid & Centre of gravity	1. Define centroid and center of gravity 2. State centroids of plain regular figures. 3. Locate centroid of two different geometric areas 4. Solve problems related to compound figures. 5. State the centre of gravity solid bodies 6. Locate c.g of two different solid bodies 7. Solve problems related to compound figures	5.1 Definition of centroid and centre of gravity, difference between centroid and centre of gravity. Locating centroids of regular figures such as triangle, rectangle, circle, semi circle, quarter circle. (No Derivations). 5.2 Locating centroid of compound figures, having combination of two different geometric areas only. 5.3 Centre of gravity of solid bodies like cylinder, cone, sphere and hemisphere. 5.4 Locating centre of gravity of compound bodies having combination of only two different geometric shapes	08
6. Friction	1. Define terms related to friction 2. State laws of friction 3. Apply concept of friction 4. Solve problems related to friction	6.1 Concept of friction and its importance in engineering, types of friction, laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. 6.2 Equilibrium of bodies on level surface subjected to force parallel and inclined to plane & inclined plane subjected to force parallel to the plane. (No ladder friction).	08
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Find the M.A., V.R., Efficiency of and law of machine for simple /Differential Axle and Wheel	Simple lifting Machine	2
2	Find the M.A., V.R., Efficiency and law of machine for Simple Screw Jack		2
3	Find the M.A., V.R., Efficiency and law of machine for Two Sheave Or three sheave Pulley Block		2
4	Find the M.A., V.R., Efficiency and law of machine for Single purchase Crab Or Double purchase Crab		2
5	Find the M.A., V.R., Efficiency and law of machine for Worm and Worm Wheel		2
6	Find unknown force using law of polygon of forces.	Forces	2
7	Find forces in the members of jib crane by using triangle law of forces.		2
8	Determine resultant of co-planer concurrent forces by graphical method. (Any two problems)		4
9	Determine resultant of co-planer non Concurrent Forces by graphical method. (Any two problems)		4
10	Find angle between three concurrent forces using Lami's Theorem.	Equilibrium	2
11	Find equilibrium of parallel forces using beam reaction apparatus.		2
12	Determine beam reaction for Vertical Point Load and UDL. (Any two problems)		2
13	Compare co-efficient of Friction between different surfaces such as Wood and wood, Wood and glass, Wood and metal.	Friction	2
Skill Assessment			2
Total Hrs.			32
Tutorials			
1	Forces, Equilibrium, simple lifting machine		08
2	Friction, Centroid and centre of gravity		08
Total Hrs.			16

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	04(02)	00(00)	00(00)	04(02)
02	Simple Lifting Machine	02(00)	08(04)	00(04)	10(08)
03	Forces	02(00)	12(04)	06(06)	18(10)
04	Equilibrium	02(00)	08(00)	00(06)	10(06)
05	Centroid And Centre Of Gravity	00(00)	04(04)	06(00)	10(06)
06	Friction	00(02)	04(08)	12(00)	16(06)
	Total	10(04)	36(20)	24 (16)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	1	R	2	2	R	2	3	R	2	4	R	2	1	R	2	5/7
	6	R	2																
02	2	U	4	2	U	4	4	U	4	2	U	4	2	A	4				3/5
03	3	U	4	3	U	4	3	U	4	3	U	4	5	U	4				3/5
04	4	U	4	5	U	4	6	U	4	6	U	4	6	U	4				3/5
05	3	A	6	5	A	6	3	A	6										2/3
06	6	A	6	6	A	6	4	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
	Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6
End Of Course		End Of The Course	Questionnaires					

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing figure of simple lifting machine and force diagram, selection of equipment's. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	PSO 1	PSO 2
1	3	-	-	-	-	-	-	-	-	-	-	-
2	3	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-
4	3	-	3	3	-	-	3	3	-	-	-	-
5	3	-	3	3	-	-	3	3	-	-	-	-
6	3	-	3	3	-	-	3	3	-	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Applied Mechanics	R.S. Khurmi, S.Chand & Co. New Delhi, 2014	10:8121916437 13:9788121916431
2.	Engineering Mechanics	Sunil Deo, Label Book Publishers New Delhi, 2014	10:9381595550 13:978-9381595558
3.	Engineering Mechanics	Basu, Tata Mcgraw Hills, 2013	10:125906266X 13:978-1259062667
4.	Engineering Mechanics	S Ramamrutham, S Chand & Co. New Delhi, 2008	8187433515 9788187433514
5.	Static and Straight of Materials	U.C. Zindal Asian Book Pvt. Ltd New Delhi, 2008	10:8184120737 13:9788184120730

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=-JG9IEqRzQ4>, assessed on 28th March 2016
- <https://www.youtube.com/watch?v=4Vlhh6sGkrI>, assessed on 30th March 2016
- <https://www.youtube.com/watch?v=EcPGKLUe04I>, assessed on 30th March 2016
- <https://www.youtube.com/watch?v=ndT35aqDfAQ>, assessed on 30th March 2016
- <https://www.youtube.com/watch?v=W9UDs-kSR0g>, assessed on 30th March 2016
- <https://www.youtube.com/watch?v=kuAfu0fZOLw>, assessed on 30th March 2016
- <https://www.youtube.com/watch?v=PO5EL9TB-v4>, assessed on 30th March 2016
- <https://www.youtube.com/watch?v=Bx-mMA6k8u4>, assessed on 30th March 2016
- <https://www.youtube.com/watch?v=9XtGJXVnQxk>, assessed on 30th March 2016
- <https://www.youtube.com/watch?v=k37FJHbSQA8>, assessed on 30th March 2016
- https://www.youtube.com/watch?v=6_D6jjQcAFU, assessed on 30th March 2016
- <https://www.youtube.com/watch?v=AOkeQMMsSrc>, assessed on 30th March 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

- | | |
|---|----|
| 1. simple /Differential Axle and Wheel | 01 |
| 2. Simple Screw Jack | 01 |
| 3. Two Sheave Or three sheave Pulley Block | 01 |
| 4. Single purchase Crab Or Double purchase Crab | 01 |
| 5. Worm and Worm Wheel | 01 |
| 6. Force table apparatus for law of polygon of forces. | 01 |
| 7. Jib crane by using triangle law of forces. | 01 |
| 8. Lami's Theorem. Force table apparatus | 01 |
| 9. Co-efficient of Friction between different surfaces ,
such as Wood and wood, Wood and glass,
Wood and metal. | 01 |

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Y. K. Chandarana	HOD, Applied Mechanics	Govt. Polytechnic, Nagpur
2.	H. S. Chepey	HOD, Civil Engineering	A.S. T. S., Wardha
3.	A. P. Waghmare	Lecturer in Applied Mechanics	Govt. Polytechnic, Nagpur
4.	R. D. Mendhe	Lecturer in Applied Mechanics	Govt. Polytechnic, Amravati
5.	R. N. Nibudey	Lecturer in Applied Mechanics	Govt. Polytechnic, Gondia
6.	M. R. Shelote	Consultant	M.R. Associates, Nagpur
7.	Dr. R. N. Khapre	Associate Professor	RCOEN, Nagpur
8.	A. J. Fulzele	Assistant Secretary (Tech)	MSBTE, RO, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGINEERING
LEVEL NAME	: ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES
COURSE CODE	: EE 306E
COURSE TITLE	: ELECTRICAL TECHNOLOGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 04; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (Internal)
PT.	: 01 HR

❖ RATIONALE:

Metallurgical 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. This course describes the design concept of furnace heating element so as student will able to design by themselves and use it for self-employment. It is very useful course for understanding the higher level knowledge.

❖ COURSE OUTCOMES:

After completing this course students will be able to–.

1. Interpret electrical circuit diagram & wiring layout diagrams.
2. Apply principle and basic laws in electrical engineering for metallurgical application
3. Select electrical furnaces, their operation & control
4. Connect electrical measuring instruments in circuit.
5. Record the readings of various electrical meters.
6. Rectify electrical faults in furnaces.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Electrical Safety	1. Recall electrical safety rules. 2. Remove the electrocuted person from live conductor 3. Interpret electrical safety signs and symbols 4. Carry out different methods of artificial respiration on electrocuted person 5. Use fire-fighting equipment on different types of fires. 6. Classify various types of earthing. 7. State the need of earthing.	1.1 Electrical Safety, Causes of accidents, General safety rules, Concept of electrical shock, Effect of electric shock, Method of removing electrocuted person, Safety signs and symbols. 1.2 Artificial respiration-Schaefer's method, Silvestre's method, mouth to mouth respiration. 1.3 First Aid 1.4 Fire, Causes of Fire, Basic ways of extinguishing the fire Classification of fire, Class A, B, C, D, Fire fighting equipments, fire extinguishers, and their types. 1.5 Earthing-Necessity of earthing, methods of reducing earth resistance.	6
2. Fundamentals of electricity	1. Define the various electrical parameters 2. Select the different types of materials for particular applications. 3. State various laws and its applications. 4. Calculate the temperature coefficient of resistance of conductor.	2.1 Concept of electric charge, current, voltage drop, EMF, potential difference, Direction of current and their SI units. 2.2 Various effect of electric current- heating effect and magnetic effect, Applications of Heating Effect of Electric Current, Joule's law (numerical based on it) 2.3 Resistance, unit of resistance, Law of resistance (Factors affecting resistance), Effect of temperature on resistance, temperature coefficient of resistance, Ohms law. (Numerical problems based on 2.3) 2.4 Conductors, insulators, semiconductors used in electrical system. 2.5 Concept of generation of single phase AC power. Definition of cycle, time period, frequency, amplitude, RMS value, power factor, lagging and leading	12

		concept. 2.6 Work, power, energy definition and their SI units, Relation between H.P and watts, Kwh and Kcal.	
3.Electric heating	1. Select electrical furnaces, their operation & control 2. State industrial heating processes. 3. Design the heating element. 4. Control the temperature of furnace.	3.1 Electric heating- Introduction, advantages, modes of transfer of heat, classification of electric heating methods. 3.2 Resistance heating- Principle, direct & indirect resistance heating, resistance furnace, heating materials, desirable properties, causes of failure of heating element, materials used for making heating elements, design of heating element (Numerical based on heating element design) temperature control of resistance furnace, 3.3 Arc furnace- Principle, types, basic circuit of electrical arc furnace, construction, main components, advantages. 3.4 Induction heating- Principle, core type and coreless induction furnace, advantages. 3.5 Dielectric heating- Principle, advantages, applications.	16
4. Transformer	1. State Law of electromagnetic induction 2. Solve problems related to transformer. 3. Describe the concept of transformation ratio, KVA rating of transformer, 4. Classify the different types of transformer. 5. Compare shell type and core type transformer	4.1 Single phase Transformer – Introduction, Principle of operation, 4.2 types of transformer, shell type and core type, their construction, comparison, and applications 4.3 EMF equation (No derivation), transformation ratio, KVA rating of transformer, (Simple Numerical problem based on emf equation and transformation ratio only).	10

5. Drives	1. Classify different types of AC & DC motors. 2. Select the particular motor for particular application in metallurgical process. 3. Describe construction and principle of AC machines.	5.1 Broad classification of A.C & D.C motor. 5.2 DC Motor- General working principle, types, application. 5.3 AC Motor-Three phase induction motors, types, working principle, application and selection for different applications 5.4 Single-phase induction motors-principle of operation, their types, connection diagrams, applications, and reversible direction	12
6. Wiring	1. Identify different types of wiring accessories. 2. Select different accessories for particular type of installation. 3. Classify different types of wires. 4. Predict the faults in installation. 5. Use Megger for measurement of insulation resistance of electrical installation.	6.1 Wiring accessories- test lamp, switches, Fuses, ICDP, ICDB, ICTP, MCB, ELCB, their selection, rating and application. 6.2 Wires – types, Specification and selection for particular use. 6.3 Wiring connections of single-phase and three-phase energy meter with load and supply 6.4 Use of megger as insulation resistance tester.	8
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Use firefighting equipment on fire and execute safety precautions in laboratory	Electrical safety	2
2	Connect voltmeter, ammeter and wattmeter in electrical circuit for measurement of electrical quantity.	Fundamentals of electricity	2
3	Use test lamps for testing single-phase and three – phase supply. Use of test lamp for earth continuity. Use of tester on single-phase supply		2
4	Perform different test on electric motor such as continuity test, earth fault test, insulation resistance test using Megger.		2
5	Measure different parameters by using tong tester and multimeter.		2
6	Observe the heating effect of electric current on conducting material using Joules law.		2
7	Prepare a heating coil of furnace.	Electric Heating	2
8	Rectify the faults in electric furnace.		2
9	Find the transformation ratio of single phase transformer.	Transformer	2
10	Start single-phase capacitor start induction motor and to reverse the direction of rotation.	Drives	4
11	Start three-phase induction motor using starters and to reverse the direction of rotation.		2
12	Identify different electrical accessories like switches, socket outlets, ELCB, MCB, ICTP, ICDP, fuses etc.	Wiring	2
13	Connect single phase and three-phase energy meter in the electrical circuit.		2
14	Use megger for finding faults in electric furnace		2
		Skill Assessment	2
		Total Hrs	32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Electrical Safety	06(00)	04(06)	00(00)	10(06)
02	Fundamentals of electricity	06(02)	10(00)	00(06)	16(08)
03	Electric Heating	02(04)	08(04)	06(00)	16(08)
04	Transformer	02(02)	04(04)	06(00)	12(06)
05	Drives	04(00)	04(08)	00(00)	08(08)
06	Wiring	02(04)	06(00)	00(00)	08(04)
	Total	22(12)	36(22)	12(06)	70(40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	6	R	2	2	R	2	5/7
	4	R	2																
02	1	U	4	1	R	4	2	U	4	3	R	4	3	U	4				3/5
03	2	R	4	3	U	4	3	U	4	4	U	4	5	U	4				3/5
04	5	R	4	4	U	4	5	U	4	5	U	4	6	R	4				3/5
05	2	U	6	3	A	6	1	U	6										2/3
06	4	A	6	6	U	6	2	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing circuit diagram/ selection of equipment's/ writing procedure etc.	10
2	Performance	20
3	Calculation/Result/ Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	-	-	-	-	-	1	-	-		-	-
2	3	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-
4	3	-	2	2	-	-	-	2	-	2	-	-
5	3	-	2	2	-	-	-	2	-	2	-	-
6	3	-	2	2	-	-	-	2	-	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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	81-219-1053-6
2.	A Text Book Of Electrical Technology Vol-I	B. L. Theraja, A. K. Theraja, S. Chand & Co Ltd., Reprint, 2006	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, Reprint, 2009.	978-81-224-1042-6
5.	A Text Book on laboratory courses in Electrical Engineering	S. G. Tarrekar and P. K. Kharbanda, S. Chand & Company Ltd., Third, 1990	13: 978-8121901048

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/108108076/1> , assessed on 18th January 2016
- <http://www.electrical4u.com> , assessed on 18th January 2016
- <https://www.youtube.com/watch?v=A9KSGAnjo2U>, assessed on 18th January 2016

- www.learnerstv.com/Free-engineering-Video-lectures-ltv059-Page1.htm assessed on 28th Feb 2016
- www.studyaaar.com/index.../11-basic-electrical-a-electronics-engineerin assessed on 28th Feb 2016
- www.faadooengineers.com/.../448-BASIC-ELECTRICAL-ENGINEERIN assessed on 28th Feb 2016.
- <https://www.scribd.com/.../Lecture-Notes-Basic-Electrical-and-Electronic> assessed on 28th Feb 2016

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1. Ammeter MI 0-5-10 A
2. Voltmeter MI 0-150-300 V
3. Wattmeter 0-3000 W
4. Digital Multi-meter
5. Rheostat assorted sizes
6. Variable Inductor
7. Megger 500V/1000V Hand driven.
8. Tong tester.

❖ LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Dr. C. S. Thorat	Principal	Government Polytechnic, Nagpur.
1.	Mrs K. M. Gaidhane	I/C, Head of Electrical Engineering	Government Polytechnic, Nagpur.
2.	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
3.	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4.	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5.	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. H. N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	A.P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. R. Y. Ghormade	HOD, Electrical Engineering	Dharampeth Polytechnic, Nagpur
11	Mr. B. P. Bale	Dy. Engineer.	MSDCL, Nagpur
12	Dr. S. S. Bharatkar	Lecturer in Electrical Engineering	Government Polytechnic, Amravati

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG
LEVEL NAME	: ENGINEERING SCIENCE AND TECHNICAL ART COURSES
COURSE CODE	: EC304E
COURSE TITLE	: ELECTRONICS AND MECHATRONICS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH:04; TU:00;PR:02(CLOCK Hrs.)
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRS
PR. TEE	: 02 HRS (Internal)
PT	: 01 HR

❖ **RATIONALE:**

Modern equipments have electronic devices. Understanding the principles of electronic devices is therefore essential for diploma technicians. This course contemplates identification and testing of components, their principles of working of various electronic devices and signal conditioning. This subject also introduces the concepts of mechatronics and PLC.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Identify and test different electronic components.
2. Describe the working principles of electronic devices.
3. Distinguish various elements in analog and digital electronics.
4. Elaborate application of electronics in mechanical field for measurement and control.
5. Illustrate working of different types of transducers and their applications.
6. Describe the concept of mechatronics and PLC.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1 Solid State Devices and Diode Circuits	1. Draw symbols of various components. 2. Describe the working principle of electronic components. 3. Enlist the applications of electronic devices. 4. Sketch the circuit diagram with relevant waveforms for rectifiers and filters. 5. Identify specific electronic component in a circuit. 6. Compare different rectifiers. 7. Compare different filters.	1.1 <u>Solid State Devices:</u> Schematic symbols, applications and specifications of – Resistors, Inductors, Capacitors, Schematic symbols, Working principle and applications of – PN junction diode(V-I Characteristics), Zener Diode(V-I Characteristics), BJT(only types), FET, UJT(V-I Characteristics), SCR(V-I Characteristics), Photo-devices – LED Displays – 7-segment Display, LCD, Optocouplers (No Constructional details) 1.2 <u>Diode Circuits:</u> Circuit Diagram, Working Principle & Waveforms for – Half wave Rectifier, Full wave Rectifier, Centre tap and Bridge Rectifier 1.3 Comparison of all above 1.4 Filter Circuits and their applications – C, LC, CLC	06
2 Basics of Digital Circuits	1. Draw the symbol for various logic gates. 2. Convert numbers in different number systems. 3. Write the truth table for various logic gates. 4. Compare microprocessor and microcontroller. 5. Define various terms related to microprocessors. 6. Enlist the features of microprocessors. 7. Enlist the features of microcontrollers.	2.1 <u>Number Systems:</u> Decimal Number System, Binary Number System, Conversion of Decimal to Binary and vice versa 2.2 <u>Logic Gates:</u> Basic Gates: AND, OR, NOT, Universal Gates: NAND, NOR, Exclusive Gates: XOR, XNOR 2.3 <u>Microprocessors & Microcontrollers</u> 2.3.1 Terminology of microprocessors Bit, Byte, Word, Nibble, Bus, Register, ALU, Program, Assembly Language, Compiler, Assembler, Flowchart, 2.4 Terminology of microcontrollers 2.5 Features of 8085 and 8051 2.6 Comparison of microprocessor and microcontroller 2.7 Applications of microprocessor and microcontroller	08

3 Sensors & Transducers	1. Define transducers. 2. Classify different types of transducers. 3. Select a particular transducer depending on the need of situation. 4. Measure a particular physical quantity by specific transducers.	3.1 Definition of transducer and sensor 3.2 Classification – Active/Passive, Primary/Secondary, Electrical, Mechanical, Optical and their examples 3.3 Selection Criteria for transducers Principle of working and list the applications of 3.4 Displacement transducers - LVDT, RVDT 3.5 Strain Gauge, Load cell, Cantilever arm 3.6 Pressure Sensors - Bourdon Tube 3.7 Principle of working and list the applications of Temperature Sensors - Thermocouple, RTD, Thermistors, Photo sensors –Photodiode, Phototransistor, LDR, LED 3.8 Types of Switches –SPST, SPDT, DPST, DPDT, Toggle switch, Push button switch 3.9 Principle of working and list applications of Relays – Electromagnetic, Dry reed 3.10 Proximity Sensors and their applications – Capacitive, Inductive 3.11 Encoders – Rotary Encoder	12
4 Signal Conditioning	1. State the need of signal conditioning. 2. Describe the use of op-amp in signal conditioning process. 3. Select a particular op-amp based circuit depending on application. 4. Illustrate the process of analogue to digital signal conversion and vice-versa. 5. Describe the process of square wave generation. 6. Use a particular timer as per the requirement.	4.1 Necessity of signal conditioning 4.2 Block diagram of AC and DC signal conditioning 4.3 Block diagram, Working and applications of Operational amplifier IC741 • Virtual ground concept, • Inverting, Non inverting amplifier, • Integrator, Differentiator, 4.4 AC and DC bridges, Wheatstone bridge 4.5 Data Converters: Block diagram and working of successive approximation ADC, R-2R DAC 4.6 Timers: Block Diagram of IC555, Applications of timer as Astable Multivibrator(AMV), Monostable Multivibrator(MMV), Bistable Multivibrator(BMV), Comparison of AMV, MMV, BMV	10

5 Control Systems & Fundamentals of Mechatronics	- Describe the basic control system. - Differentiate between different control systems. - Select a particular control system as per the need. - Describe the function of a servomotor. - Describe the function of a position control systems. - State the meaning, need and basic concept of mechatronics - Enlist the features of real time mechatronics. - State the advantages, disadvantages of mechatronics.	5.1 Definitions of Control system 5.2 Classification of control system 5.3 Block diagram of control system 5.4 Operating Principle of open loop & closed loop control systems 5.5 Advantages, disadvantages of open loop and closed loop control systems 5.6 Transfer function of open loop and closed loop control system 5.7 Principle of Servomechanisms, Transfer function of AC and DC servomotor 5.8 Armature controlled and field controlled synchros, Synchros error detector with waveforms 5.9 Concept of mechatronics 5.10 Basic elements of mechatronics 5.11 Overview of mechatronics design 5.12 Process modelling and simulation 5.13 Prototyping and deployment	15
6 Programmable Logic Controller (PLC)	- Describe the basic PLC architecture. - Explain the working of PLC. - Identify various components of a PLC. - Write simple ladder programs. - Execute different instructions in PLC.	6.1 Introduction to PLC 6.2 General block diagram of hardware of PLC & Internal architecture of PLC 6.3 Concept of ladder logic – Input & Output Instructions 6.4 Scan time, rungs, branching of rung, relays 6.5 NO/NC contacts, sourcing & sinking 6.6 PLC Instructions – Logical – AND, OR, NOT, NAND, NOR, XOR 6.7 PLC Instructions – Latching – latch, unlatch, binary Input/ output bit 6.8 PLC Instructions – Timers – TON, TOF, RTO, RES 6.9 PLC Instructions – Counter – CTU, CTD, RES 6.10 PLC Instructions – Comparators – LIM, EQU, NEQ, LES, LEQ, GRT, GEQ 6.11 Compute – ADD, SUB, MUL, DIV, SQRT,	13
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Operate a regulated power supply to set a constant voltage and current. - Use coarse and fine control knobs for precise voltage adjustment. Operate a function generator to generate different types of waveforms over a wide range of frequencies. - Use the function select knob to generate a particular waveform. - Use the DC offset knob to adjust the DC shift in a signal. - Use the amplitude variable knob to adjust the amplitude of signal generated.	General Electronic Measurement techniques	2
2	Operate a Cathode Ray Oscilloscope to observe the output of a circuit. - Use Volt/div and time/div knobs for amplitude and frequency measurement - Use a particular channel in a dual trace oscilloscope. - Use Intensity and Focus front panel controls Operate a digital multimeter to measure AC and DC voltage, AC and DC current, and resistance. - Test resistors, diodes and transistors. - Test continuity in a circuit		4
3	Identify different passive electronic components and solid state devices. - Draw the symbols for above devices - Identify their terminals and packages - Test above devices	Solid State devices and diode circuits	2
4	Assemble the circuit for half wave, full wave and bridge rectifiers and draw the waveforms at different points in the circuit.		4
5	Verify the truth table for various logic gates.	Basics of Digital Circuits	2
6	Measure linear displacement using LVDT.	Sensors & Transducers	2
7	Measure temperature using thermistor and thermocouple.		2
8	Assemble AMV using IC555	Signal Conditioning	2
9	Assemble inverting and non-inverting amplifier using op-amp.		2
10	Prepare a report on technical and commercial specifications of different modules of PLC available in market.	Programmable Logic Controller	2
11	Develop simple ladder programs for PLC		4
12	Development and testing of ladder logic for TON, TOF and RES instructions of PLC.		2
Skill Assessment			2
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Solid State Devices and Diode Circuits	02(00)	08(04)	00(04)	10(08)
02	Basics of Digital Circuits	04(00)	04(04)	04(04)	12(08)
03	Sensors & Transducers	02(02)	08(04)	04(00)	14(06)
04	Signal Conditioning	02(00)	08(00)	00(06)	10(06)
05	Control Systems & Fundamentals of Mechatronics	00(02)	06(04)	06(00)	12(06)
06	Programmable Logic Controller	00(00)	06(00)	06(06)	12(06)
	TOTAL	10(04)	40(16)	16(20)	70(40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	2	R	2	3	R	2	4	R	2	3	R	2	5/7
	5	R	2																
02	1	U	4	1	U	4	2	U	4	1	A	4	2	U	4				3/5
03	2	A	4	3	U	4	3	U	4	2	A	4	3	U	4				3/5
04	3	A	4	4	U	4	4	U	4	1	U	4	5	U	4				3/5
05	5	U	6	5	A	6	4	A	6										2/3
06	6	U	6	6	A	6	6	A	6										2/3

T = Unit/ Topic Number

L = Level of Question

M= Marks

R – Remember

U – Understand

A- Analyse/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment's. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	-	-	-	-	-	3	-	-	3	-	-
2	3	-	-	-	-	-	3	-	-	3	-	-
3	3	-	-	-	-	-	3	-	-	3	-	-
4	-	-	2	2	-	-	3	2	-	3	-	-
5	3	-	2	2	-	-	3	2	-	3	-	-
6	-	-	2	2	-	-	3	2	-	3	-	-

1 – Slight (Low) 2 – Moderate (Medium) 3 – Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Textbook of Applied Electronics	R. S. Sedha, Revised Edition, S. Chand Limited, 2008	8121927838, 9788121927833
2.	Modern Digital Electronics	R. P. Jain, Tata McGraw-Hill Education, 2010, Fourth Edition.	0070669112, 9780070669116
3.	Microprocessor Architecture, Programming, and Applications with the 8085	Ramesh S. Gaonkar, 3rd Edition, Prentice Hall, 1996	0131988557, 9780131988552
4.	A Course in Electrical and Electronics Measurement and Instrumentation	A.K. Sawhney, Dhanpat Rai Publication, 10th Edition, 1994	8177001000, 9788177001006
5.	Control System Engineering	U.A. Bakshi, V. U. Bakshi, Technical Publications, 2008	8184314639, 9788184314632
6	Mechatronics	W. Bolton, Pearson Education India	8131762572, 9788131762578
7	Introduction to programmable Logic Controllers	Gary Dunning, Rockwell lab Manual for Dunning's Intro to Programmable logic Controllers, 2005	1401884261

8	Programmable logic Controllers	Bolton, 2006	0750681128
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❖ **E-REFERENCES:**

- ❖ www.learnelectronicsonline.com , assessed on 4th May 2016
- ❖ www.instructables.com/id/Basic-Electronics, assessed on 4th May 2016
- ❖ Learnabout-electronics.Org, assessed on 4th May 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Voltmeter MI 0-150-300 V
2. Digital Multi-meter
3. CRO
4. Function Generator
5. Regulated Power Supply
6. PLC Trainer

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Shri S. S. Tadas	HOD, Electronics	Government Polytechnic., Nagpur
2	Mrs. M. N. Bawane	Lecturer in Electronics	Government Polytechnic., Nagpur
3	Mrs. H. R. Bhusari	Lecturer in Electronics	Government Polytechnic., Nagpur
4	Mr. D. A. Brahmanekar	Lecturer in Electronics	Government Polytechnic., Nagpur
5	Ms. Giri K. G.	Lecturer in Electronics	Government Polytechnic., Nagpur
6	Mr. Sandeep Darwhekar	Director	Beta Computronics Pvt. Ltd., Nagpur
7	Mrs. Gazala Ali	HOD, Electronics	Anjuman Polytechnic, Nagpur
8	Mr. S. M. Kale	Lecturer in Electronics	Government Polytechnic., Gadchiroli

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: BASIC TECHNOLOGY COURSES
COURSE CODE	: MT301E
COURSE TITLE	: BASIC METALLURGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 04; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HRs.)
TH. TEE	: 01 HR. (Objective Type Online Examination)
PR. TEE	: 02 HRs (Internal)
PT.	: 15 Minutes (Objective Type offline Examination)

❖ RATIONALE:

Basic Metallurgy mainly deals with basic topics required for the understanding of metallurgical subject. This course is a collection of widely different basic topic such as pyrometry, fuels, refractories, conceptual understanding of structure of solid material, their properties and uses.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

- 1 Draw different planes and direction for crystal structures
- 2 Calculate packing factors for crystal structures.
- 3 Test refractories for various required properties
- 4 Perform proximate analysis of solid fuels
- 5 Operate Furnaces for various metallurgical applications
- 6 Determine Calorific value of Various fuels

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Nature of solids	1. Summarize different states of matter, 2. Identify various crystal structures 3. Formulate no of atoms per unit cell for different crystal structure 4. Draw miller indices for planes and directions for given crystal structure 5. Interpret imperfections in crystal structure. 6. Solve Numerical based on miller indices for planes and directions. 7. Draw structures of Silicates and carbon 8. Describe Allotropy with suitable example 9. Discuss various imperfections in crystals	1.1 States of matter 1.2 Types of Crystal structures- simple cubic structure, BCC, FCC, HCP, number of atoms per unit cell, packing factors, co-ordination numbers. 1.3 atomic structure of metals 1.4 Allotropy-definition, examples 1.5 Miller indices for planes and directions 1.6 Imperfections in crystals- point, line, surface, etc 1.7 Structures of silicates, carbon and glasses. Polymeric structures 1.8 Numerical based on miller indices for planes and directions.	09
2 Pyrometry :	1. Define Thermometry and pyrometry 2. State principles of thermometry- Seebeck effect, Peltiers and Thompson effect 3. State black-body-radiation laws and its applications. 4. Calculate the temperature coefficient of resistance 5. Describe Calibration of thermocouples and Temperature controllers 6. Select pyrometers various for different applications 7. Classify thermocouples 8. Write compositions and temperature ranges for various thermocouples	2.1. Thermometry and pyrometry, High temperature scales 2.3 Primary and secondary standards 2.4 Principles of thermometry- Seebeck effect, Peltiers and Thompson effect. 2.5 Thermocouples: composition, temperature ranges, environmental conditions, preparation and calibration of thermocouples and Temperature controllers 2.6 Pyrometers: black-body-radiation laws, Emissivity. 2.7 Optical, Radiation and Resistance pyrometers levels at various stages in power system. 2.8 Applications of different pyrometers	13
3.Refractory materials:	1. Classify Refractories 2. State steps involved in manufacturing of refractory 3. Describe Properties, composition, applications of special refractories 4. Select suitable tests for refractories 5. Write properties and	3.1 Refractory – definition, general properties of refractories. 3.2 Classifications of refractory and general steps involved in manufacturing of refractory. 3.3 Properties, composition and applications of fire clay, silica, magnetite, chromite, carbon. 3.4 Properties, composition and	10

	compositions of different refractories 6. Describe Insulating materials and their applications	applications of special refractories like insulating materials, fused silica, alumina and zirconia. 3.5 Tests on refractories: to measure its Strength, porosity, refractoriness	
4solid fuels	1 Classify Fuels 2 State properties of Indian coal. 3 Describe bi-products of coke ovens 4 Compare Proximate and ultimate analysis of coal 5 State uses of pulverized and briquetted coal or coke 6 Describe Bi-Products of coke oven 7 Write properties of Indian Coke 8 Describe Carbonizaton of coal	4.1 Definition and Classification of fuels 4.2 Occurrence of coal with reference to Indian conditions 4.3 Classification of coals, properties of Indian coal. 4.5 Coking and non- coking coal, Proximate and ultimate analysis of coal. 4.6 Carbonization of coal- low temperature and high temperature 4.7 Properties and tests of Indian coke 4.8 Bi-products of coke ovens 4.9 Uses of pulverized and briquetted coal or coke	09
5. Liquid and gaseous fuels	1 Illustrate important properties and uses of Liquid fuels. 2 State composition, properties and uses of Gaseous fuels 3 Compare different fuels 4 Describe production of producer gas and water gas 5 Discuss Liquefied petroleum gas 6 Describe Refining of crude petroleum oil	5.1 Liquid fuels - important properties and uses of Liquid fuels. 5.2 Crude petroleum oil and their refining 5.3 Gaseous fuels - composition, properties and uses of Natural Gas, Blast furnace Gas, Coke oven gas, and Liquefied Petroleum gases and comparison of different gaseous fuels 5.4 Production of producer and water gas..	10
6. Furnaces	1 Classify furnaces used in metallurgical industries 2 Draw sketches of muffle furnace, reverberatory, crucible , salt bath, pit furnace 3 Describe operation of various Furnaces 4 List factors affecting furnace efficiency 5 Calculate efficiency of a given furnace 6 Utilize furnaces for various applications in metallurgical industries	6.1 Furnaces: classification, types ,sketches and applications of following furnaces used in metallurgical industries : a. muffle furnace, b. reverberatory, c. crucible , d. salt bath, e. pit furnace 6.2 Factors affecting furnace Efficiency	13
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
01.	Identify planes and directions in cubic structure Draw planes and directions in cubic structure	Nature of solids	2
02	Test different properties of refractories	Refractory materials:	4
03	1 Carry out proximate analysis of Coal 2 Determine Percentage of C ,S ,Ash content in coal	Solid fuels	4
04	Measure the Viscosity of Oil.	Liquid and gaseous fuels and	4
05	Determine Calorific value of fuels	Solid fuels	4
07	Measure flash & fire point of fuels	Liquid and gaseous fuels and	4
08	Measure the temperature using radiation pyrometer	Pyrometry	4
09	Draw sketches of muffle furnace, reverberatory, crucible , salt bath, pit furnace	Furnaces	2
10	Calculate the efficiency of any one of the furnaces used in metallurgy	Furnaces	2
Skill Assessment			2
Total			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Nature of Solids	04(00)	04(00)	00(00)	08(00)
02	Pyrometry	02(00)	12(00)	00(00)	14(00)
03	Refractory	02(00)	04(00)	06(00)	12(00)
04	Solid fuels	02(00)	08(00)	00(00)	10(00)
05	Liquid fuels, gaseous fuels	02(00)	04(00)	06(00)	12(00)
06	Furnaces	02(00)	06(00)	06(00)	14(00)
	Total	14(00)	38(00)	18(00)	70 (00)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01 to 35	1	R	2	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	35/35
	6	R	2	1	U	2	1	U	2	2	U	2	2	U	2	2	U	2	
	2	U	2	2	U	2	2	U	2	3	U	2	3	U	2	4	U	2	
	4	U	2	4	U	2	4	U	2	5	U	2	5	U	2	6	U	2	
	6	U	2	6	U	2	3	A	2	3	A	2	3	A	2	5	A	2	
	5	A	2	5	A	2	6	A	2	6	A	2	6	A	2				

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Online Exam. Report	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ SCHEME OF PRACTICAL EVALUATION

S.N.	Description	Max. Marks
1	Draw crystal structures, sketch furnaces, selection of equipment's. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
5	Viva voce	10
	TOTAL	50

❖ MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	3	3	3	-	-	3	3	3	3	-	-
2	3	3	3	3	-	-	3	3	3	3	-	-
3	3	3	3	3	3	3	3	3	3	3	-	-
4	3	3	3	3	3	3	3	3	3	3	-	-
5	3	3	3	3	3	3	3	3	3	3	-	-
6	3	3	3	3	3	3	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Introduction to Physical Metallurgy by	S.H. Avner. McGraw-Hill Education (India) Pvt Limited, 1997	13: 978-0074630068
2.	Fuels, Furnaces and Refractories	J.D. Gilchrist Pergamon; 2 nd edition, 2013	ASIN: B00J3N6SNI
3.	A text book of Engineering Chemistry by	M.M. Uppal Khanna Publishers ,2002	13: 978-8174091017

❖ E-REFERENCES:

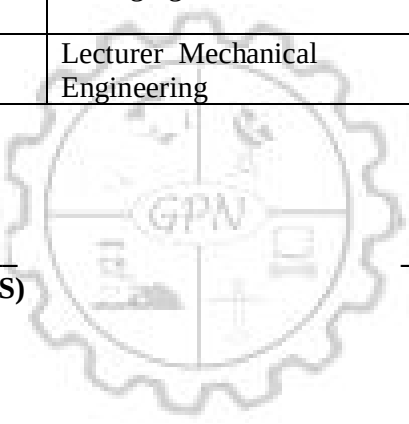
- <http://nptel.ac.in/courses/113105024/>, assessed on 29 June 2016
- <http://www.electrical4u.com/optical-pyrometer-construction-and-working-principle/>, assessed on 29 June 2016
- <https://www.youtube.com/watch?v=1506ONfkfF0> , assessed on 29 June 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

- Various types of refractories.
- Pyrometer-Resistance, Optical.
- Muffle furnace.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli



 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES
COURSE CODE	: MT302E
COURSE TITLE	: METALLURGICAL THERMODYNAMICS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 01; PR: 00 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT =2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: NIL
PT.	: 01 HR

❖ RATIONALE:

The enormous metallurgical industries require enormous energy. The energy sources are limited. Therefore it is necessary to understand the principles underlying energy requirements in these industries so that minimum energy input may be achieved. The thermodynamics laws and their applications contribute towards this understanding. Basic terms such as energy, system, path and state properties, extensive and intensive properties, etc, are required to understand these thermodynamics laws and therefore covered in the present course

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply knowledge of metallurgical thermodynamics.
2. Formulate different laws of thermodynamics.
3. Draw Ellingham diagrams.
4. Analyze intersecting lines on Ellingham diagrams
5. Calculate enthalpy, entropy & gibbs free energy for thermodynamic reactions
6. Calculate free energy of mixing in solutions

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Introduction	1. Define thermodynamics. 2. State various forms and sources of energy 3. Select thermodynamic system. 4. Describe various thermodynamic processes. 5. Justify reversible and irreversible processes. 6. Compare reversible and irreversible processes. 7. Illustrate State and Path functions 8. Define standard state of a system 9. State the scope of metallurgical thermodynamics	1.1 Definition of thermodynamics, scope of metallurgical thermodynamics. 1.2 Energy- concepts , properties, forms, and sources of energy 1.3 Thermodynamic system and its classification, State of systems 1.4 Extensive and Intensive properties, equation of state 1.5 Thermodynamic processes: isobaric, isothermal, isochoric, adiabatic and polytropic. 1.6 Path and state functions, standard state 1.7 Thermodynamic equilibrium, reversible and irreversible processes	06
2.First law of Thermodynamics	1. State first law of thermodynamics 2. Formulate expression for first law of thermodynamics 3. Relate C_p and C_v 4. Justify Exothermic and Endothermic reactions in thermodynamics 5. Define Heat capacity 6. Derive mathematical expression of enthalpy 7. Estimate Specific heat capacity of materials	2.1 Statements and formulation of first law of thermodynamics 2.2 Internal energy as a state property 2.3 Heat capacity: specific heat at constant volume and constant pressure, relation between C_p and C_v. 2.4 Enthalpy : definition and mathematical expression 2.5 Thermo -chemistry: exothermic and endothermic reactions 2.6 Hess's law – statement and significance. calculation based on Hess's law	08
3.Second law of Thermodynamics	1. State second law of thermodynamics 2. Define entropy 3. Derive mathematical expression of second law of thermodynamics. 4. Formulate Helmholtz free energy and Gibbs free energy 5. Define Fugacity and activity 6. Calculate entropy for a thermodynamic reactions 7. Derive Combine statement of first and second law 8. Justify Change in free energy as	3.1 Statement and mathematical expression of second law of thermodynamics. 3.2 Concept of entropy, entropy change associated with thermodynamic processes 3.3 Calculation of entropy of the reaction. 3.4 Significance of entropy. 3.5 Combine statement of first and second law 3.6 Concept of Free energy, 3.7 Expression of Helmholtz free energy and Gibbs free energy	08

	criteria for deciding nature of process 9. Illustrate Free energy in thermodynamics	3.8 Change in free energy as criteria for deciding nature of process. 3.9 Fugacity and activity	
4. Third law of Thermodynamics	1. State Zeroth law of thermodynamics and give its significance. 2. Derive Phase rule. 3. Evaluate equilibrium constant for a given chemical reactions 4. Formulate Third law of thermodynamics 5. Co-Relate temperature and stability of phases in thermodynamics 6. State the Phase rule.	4.1 Statement of law and its significance 4.2 Zeroth law of thermodynamics and its significance 4.3 Phase rule; statement and its Derivation 4.4 Free energy-temperature relation and relative stability of phases. 4.5 Equilibrium constant for chemical reactions	08
5 Ellingham Diagrams	1. Draw general form of Ellingham diagram 2. Apply Ellingham diagram for reactions occurring in steel making processes 3. Describe Oxide Ellingham diagram 4. State applications of Ellingham diagram 5. Identify various reaction lines on Ellingham diagram 6. Select Ellingham diagram for particular reactions 7. Interpret Intersecting lines on Ellingham diagrams 8. Analyze Intersecting lines on Ellingham diagrams	5.1 General form of Ellingham diagram 5.2 Oxide and sulphides Ellingham diagrams 5.3 Characteristics of Ellingham diagrams 5.4 Significance of diagrams- reduction and dissociation of oxides. 5.5 Intersecting lines on Ellingham diagrams.	08
6. Solutions	1. Define various solution 2. State various laws and its significance. 3. Evaluate free energy of mixing in solutions 4. Describe Gibbs-Duhem Equation 5. Describe Activity Laws 6. Formulate Sieverts' Law 7. Compare Ideal and Regular solutions 8. Categorize the solutions in thermodynamics with justification	6.1 Ideal solution- activity coefficient, Raoult's law and Henry's law, Sievert's law and its significance 6.2 Gibbs-Duhem Equation & Activity Laws 6.3 Free energy of Mixing & Regular Solutions	10
Total Hrs.			48

B.LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS/TUTORALS

Practic als	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Calculate Enthalpy for thermodynamic reactions	First law of Thermodynamics	02
2	Calculate Entropy for thermodynamic reactions	Second law of Thermodynamics	02
3	Calculate Free energy for thermodynamic reactions	Third law of Thermodynamics	02
4	Calculate Specific heat capacities of reactions involved in Thermodynamic	First law of Thermodynamics	02
5	Draw Ellingham diagram. for Oxides and Sulphides	Ellingham diagrams	04
6	Calculate free energy of mixing in solutions	Solutions	04
Total Hrs			16



❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	02(04)	08(00)	00(00)	10(04)
02	First law of thermodynamics	02(00)	08(04)	00(00)	10(04)
03	Second law of thermodynamics	02(00)	04(08)	06(00)	12(08)
04	Third law of thermodynamics	04(00)	08(08)	00(00)	12(08)
05	Ellingham diagrams	02(02)	04(00)	06(06)	12(08)
06	Solutions	02 (02)	06 (00)	06(06)	14(08)
	Total	14(08)	38(20)	18 (12)	70 (40)

R-Remember

U-Understand

A-Analyze/ Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	5	R	2	6	R	2	6	R	2	5/7
	5	R	2																
02	4	U	4	2	U	4	5	U	4	2	U	4	1	R	4				3/5
03	1	U	4	4	U	4	3	U	4	3	U	4	3	U	4				3/5
04	1	U	4	2	U	4	4	R	4	4	U	4	4	U	4				3/5
05	3	A	6	6	A	6	5	A	6										2/3
06	5	A	6	6	U	6	6	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	--	--	--	--
		Journal Writing		Continuous	--	--	--	--
				TOTAL	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL/TUTORIAL EVALUATION:**

S.N.	Description	Max. Marks
	NIL	

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-	3	3	-	-	3	-	3
2	-	3	-	-	3	3	3	3	-	3	2	3
3	-	3	-	-	-	3	3	3	-	3	-	
4	-	3	2	2	3	3	3	3	2	3	-	-
5	-	3	2	2	3	-	-	3	2	3	2	-
6	-	-	2	2	3	3	3	3	2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/112105123/1>, assessed on 2nd July 2016
- <https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLA56207A7B4047D04>, assessed on 4th JULY 2016
- <https://www.youtube.com/watch?v=8N1BxHgsoOw> , assessed on 8th July 2016

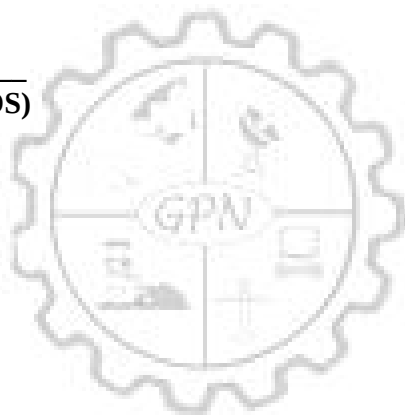
❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Metallurgical thermodynamics	R.H. Tupkary, Tu Publishers Nagpur, First Edition, 1995	10: 8122403220
2.	Problems in metallurgical thermodynamics and kinetics	G. S. Upadhyaya, Pergamon Publisher, First Edition, 1985	10-0080208657

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

(Member Secretary PBOS)



(Chairman PBOS)

LEVEL - IV

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT401E^s
COURSE TITLE	: TESTING OF MATERIALS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 04; TU: 00; PR: 04 (CLOCK HRs.)
TOTAL CREDITS	: 06(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ RATIONALE:

Metallurgical engineering is a discipline that mainly deals with various metallic materials on the earth for the benefit of mankind. For that it is required to assess properties of metallic materials during various stages of their formation. Testing is essential to control and correlate various manufacturing parameters and also to decide suitability and predict probable behavior of metallic materials in practice. With the knowledge of testing procedures, students conduct various mechanical tests like tension, hardness, fatigue, impact test etc. and Non-destructive tests such as ultrasonic, penetrant & magnetic tests etc.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify different parts of testing equipments.
2. Select destructive and NDT methods of testing
3. Recommend suitable test for different applications.
4. Prepare sample for different tests to be carried out
5. Operate various Testing equipments.
6. Perform different NDT tests

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Scope Of Testing	1. Define elastic and plastic materials/bodies. 2. Compare different Standardizing agencies 3. Describe Reports; Types and Forms of various Testing Results. 4. Prepare various reports on testing 5. Describe Mechanical, Physical and Chemical properties of metals 6. State the scope and need of testing	1.1 The scope and need of testing 1.2 Mechanical, Physical and Chemical properties of metals 1.3 Concepts of Stress, strain, elastic and plastic bodies strain under axial load in tension and compression Temperature stress. 1.3. Presentation of Results: Arrangement of Reports; Types and Forms of various Testing Results. 1.4 Standardizing Agencies: SAE,AISI,ASTM,BIS ,IS	06
2. Mechanical Testing:	1. Compare true and engineering stress – strain. 2. Describe proof stress for steel. 3. Calculate Gauge length for tensile test specimen 4. Describe the method to Carry out tensile test on UTM machine 5. Use Hook's law to find Young's modulus 6. Describe Effect of important variables on Tensile Test 7. Sketch a standard Tensile Specimen 8. Describe Extensometer and recorders, strain gauges. 9. Evaluate Young's modulus	2.1 Tensile test: Scope and applicability 2.2 Modulus of elasticity / Young's modulus 2.2 Specification of testing specimen 2.3 Conduct and observation of test Effect of important variables, 2.4 Hook's law -Relation between linear strain and normal stress 2.5 Yield stress and proof stress determinations, calculation of true and engineering stress – strain. 2.6 Types of tensile testing machine & their construction: • Universal testing machine • Extensometer and recorders, strain gauges.	10
3. Hardness Test	1. Identify different hardness Testers 2. List MOH'S scale 3. Select Minor and major loads for various tastings. 4. Formulate BHN 5. Describe Rockwell Test	3.1 Scope and applicability of hardness test. 3.2 Constructional principles of common hardness machines. 3.3 Brinell hardness test: Procedure, derivation of BHN, effect of variables, applications, advantages and limitations	18

	6. Relate various systems of hardness numbers 7. Relate hardness with tensile strength 8. Describe Micro hardness tester 9. Find hardness Values for different materials. 10. Interpret the result of various hardness Tests. 11. Evaluate hardness of a given material using various hardness testers	3.4 Rockwell test: procedure, effect of variables, Rockwell Superficial hardness tester 3.5 Vickers hardness test- applications, advantages and limitations 3.6 Micro hardness tester- applications, advantages and limitations 3.7 Scratch and wear hardness test- moh's scale 3.8 Shore Scheleroscope –principle of operation, advantages and limitations. 3.9 Relation between various systems of hardness numbers 3.10 Relation of hardness to tensile strength, 3.11 Numericals to calculate different hardness values	
4. Service Tests :	1. Identify type of fractures 2. Draw S-N curve. 3. Illustrate fatigue test on metals and alloys. 4. Select Impact tests to detect fracture 5. Justify factors influencing creep 6. Describe Creep Test 7. Compare Charpy and Izod impact tests 8. Compare ductile and brittle fracture. 9. Describe the Role of temperature and stress concentration on impact test 10. State the Effect of important variables, on fatigue test 11. Select suitable service test	4.1 Impact test: Behavior of material under impact loading. 4.2 Charpy and Izod impact tests: standard samples used, test procedure, 4.3 Calculation of energy relation, ductile and brittle fracture. 4.4 Effect of variables.: Role of temperature and stress concentration factors like holes, cracks etc 4.5 Fatigue test: concept of fatigue, loading condition to cause fatigue. 4.6 Nature of fatigue in metal 4.7 Scope and applicability of fatigue test Machine for fatigue test on metals, general procedure 4.8 Effect of important variables, Correlation with other properties. 4.9 Study of S-N Curve. 4.10 Creep test : concept of Creep Scope and applicability of creep test 4.11 Creep apparatus. Rupture test: creep curve 4.12 Factors Influencing Creep.	12
5. Conventional Non-	1. State the need for NDT. 2. Classify NDT methods. 3. Describe Magnetic analysis method of	5.1 Concept of non destructive testing Need of Non-destructive test 5.2 Types of non-destructive test 5.3 Methods of Examination for	09

Destructive Testings	testing - Select dye penetrant tests for crack detection. - Discuss Different types of Types of non-destructive test - Describe Method based on Electrical analysis for testing. - Select suitable NDT for proper application - Apply probe type magnetic crack detector for crack detection	defects: Visual examination, Penetrant tests, Hammer tests etc. 5.4 Method based on Electrical analysis: Sperry detector for flaws in rails and in tubes Electromagnetic steel sorter 5.5 Method based on magnetic analysis: Magnetic particle method, yoke type ,probe type magnetic crack detector	
6. Recent Non-Destructive Testings	- Describe Radiographic Examination methods of testing - Describe Ultrasonic testing in brief - Compare NDT with Destructive testing - State safety precautions in radiographic examination - State Principle of radiography, - Select suitable NDT for proper application - Interpret obtained radiograph of testing - Justify the need of NDT	6.1 Radiographic Examination : - Principle of radiography, - X-ray and Gamma ray generation and their practical application in radiography. - Irridium/Cobalt rays base radiography - comparison of X-ray and gamma ray radiography - Equipments for X-ray and gamma rays. 6.2 Radiograph and effect of important variables, requirement for good radiograph, Interpretation of radiograph. 6.3 Safety precautions in radiographic examination 6.4 Ultrasonic Testing: Fundamentals, Equipments, procedure and applications. Interpretation of results. 6.5 Eddy current testing 6.6 Comparison of NDT with Destructive testing	09
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Determine Tensile strength on U.T.M	Mechanical Testing:	8
2	Measure Hardness by Brinell hardness tester	Hardness Test	6
3	Measure Hardness by Poldy impact hardness tester		4
4	Measure Hardness by Rockwell hardness and Rockwell superficial tester.		6
5	Measure Hardness by Vickers hardness tester.		6
6	Measure Hardness by Rebound hardness tester.		4
7	Determine Impact strength by Charpy / Izod impact tester.		6
8	Perform Fatigue test.	Service Tests	6
9	Conduct Magnetic Particle Crack detection test	Conventional Non-Destructive Testing	6
10	Perform Crack detection using dye penetrant test	Conventional Non-Destructive Testing	6
11	Observe Ultrasonic flaw detector.	Recent Non-Destructive Testing	4
Skill Assessment			2
Total			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Elasticity	02(04)	04(00)	00(00)	06(04)
02	Mechanical Testing	02(02)	08(04)	00(00)	10(06)
03	Hardness Test	02(02)	12(04)	06(06)	20(12)
04	Service Tests	02(00)	06(08)	06(00)	14(08)
05	Conventional Non-destructive Testings	02(00)	08(04)	00(00)	10(04)
06	Recent/Advance Non-destructive Testings	04(00)	00(00)	06(06)	10(06)
	Total	14(08)	38(20)	18(12)	70(40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	3	R	2	5/7
	2	R	2																
02	6	R	4	1	U	4	2	U	4	1	R	4	2	U	4				3/5
03	2	U	4	3	U	4	5	U	4	3	U	4	4	U	4				3/5
04	3	U	4	3	U	4	5	U	4	4	U	4	5	U	4				3/5
05	3	A	6	4	A	6	6	A	6										2/3
06	6	A	6	4	U	6	3	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagram, selection of equipment's. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	3	-	3	3	3	3	3	-
2	-	3	-	-	3	-	3	3	-	3	3	-
3	-	3	-	-	3	2	-	3	-	3	3	-
4	-	3	3	3	3	2	3	3	3	3	3	-
5	-	3	3	3	3	-	3	3	3	3	3	-
6	-	3	3	3	3	2	3	3	3	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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	81-7409-026-6
3.	Mechanical Metallurgy	George Dieter, Mc Graw Hill, Third edition , March 2013	0-07-084453-4

❖ **E-REFERENCES:**

- <http://www.nptel.ac.in/courses/112106141/https://www.youtube.com/> assessed on 11th August, 2016
- <https://www.youtube.com/watch?v=D8U4G5kcpcM> , assessed on 11th August, 2016
- <https://www.youtube.com/watch?v=EeiwCbtJWyl> , assessed on 11th August, 2016
- <https://www.youtube.com/watch?v=dGT233GsqHE> , assessed on 11th August, 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS 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

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONALCOURSES
COURSE CODE	: MT402E ^s
COURSE TITLE	: MECHANICAL METALLURGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 04; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 06(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ RATIONALE:

The shaping of metals to suitable forms requires adequate understanding of mechanical behavior of metals under different applied stress. Moreover knowledge of various methods & processes of working on metals are essential. This course deals with Principles, Equipment's, and Applications of various metal working methods e.g. Rolling, Forging, and Extrusion.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Analyze effect of metal working operations on properties and structure of metals
2. Analyze various defects in metal working operations
3. Apply corrective measures for the defects in metal working operations.
4. Perform wire drawing operation.
5. Perform rolling, forging operations on metals /alloys
6. Carry out forming operation in sheet metal working of metals /alloys

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1 Introduction	1. State scope of mechanical metallurgy 2. Describe metal working processes 3. Define Workability of materials 4. Describe Modes of plastic deformation 5. Describe Critical resolved shear stress 6. Compare Cold Working & Hot working 7. Describe Types of lubrications 8. Describe recovery, Recrystallisation and grain growth. 9. Describe Lubricating mechanisms 10. Calculate CRSS	1.1 Definition and scope of mechanical metallurgy 1.2 Objectives and classification of forming processes and metal working processes 1.3 Workability of materials-forming limit diagram 1.4 Elastic and Plastic deformation of single crystal, flow curve 1.5 Modes of plastic deformation-slip and twinning 1.6 Critical resolved shear stress (CRSS)- derivation and numerical. 1.7 Work hardening/strain hardening, causes of strain hardening. 1.8 Cold Working, Cold worked-annealed cycle, Recovery, Recrystallisation and grain growth.. 1.9 Hot working and warm working, Changes of Structures during plastic deformation. 1.10 Anisotropy 1.11 Friction in deformation processes 1.12 Lubricating mechanisms 1.13 Types of lubrications:- a. Solid film lubrication b. Extreme pressure lubrication c. Hydrodynamic lubrication d. Mixed film lubrication.	12
2. Rolling Of Metals	1. State principle of metal rolling 2. Describe in brief different parameters in rolling 3. Classify rolling processes 4. Describe rolling plant layout 5. Identify different defects in rolled products 6. Describe defects in rolled products and suggest their remedies	2.1 Concept and Principle of metal rolling 2.2 Structural changes in rolled products.. 2.3 Classification of rolling processes 2.4 Parameters in rolling: • entry and exit zone • neutral plane • Spreading Rolling force, torque and power 2.5 Elastic deformation of rolls and remedies	10

	7. Classify rolling mills 8. Describe LTMT and HTMT	2.6 Rolling Mills: • Construction in brief. • Classification – main features of each • Types with their sketches 2.7 Hot rolling and cold rolling 2.8 Types of Rolled products. 2.9 Defects in rolled products and their remedies 2.10 Concept of LTMT and HTMT 2.11 Tube making by rolling • Mannesmann's process • Pilger process • Plug rolling 2.12 Rolling plant lay-out.	
3 Forging Of Metals	1. Define Forging 2. Enumerate Different forging operations 3. Compare Open die and closed die forging 4. Describe Forging Plant Layout 5. Describe different Hammers and presses for forging Operations 6. Identify different Forging defects and 7. Describe residual stresses in forging 8. List various Forging equipments 9. Select suitable forging operations for particular application	3.1 Forging : definition, principle, structure of forgings 3.2 Types of forgings -Open die and closed die forging; principle and comparison 3.3 Forgings die- die materials, properties of die materials 3.5 Forging temperatures and time for Heating. 3.6 Heating methods for forgings: principle and description a) Furnace heating b) Induction heating c) Resistance heating 3.7 Different forging operations. 3.9 Press forgings and hammer forgings 3.10 Forging defects and residual stresses in forgings 3.11 Forgings Design considerations 3.12 Forging equipments- Working principles of following Hammers and presses for forging: a) Steam Hammer b) Pneumatic Hammer c) Board drop Hammer d) Spring Hammer e) Mechanical Press f) Hydraulic Press g) Forging Plant Layout.	10
4. Extrusion Of Metals:	1. Define extrusion 2. Describe Deformation in extrusion 3. List Types of extrusion	4.1 Extrusion -Principle and Definition 4.2 Deformation in extrusion 4.3 Types of extrusion-	10

	4. Identify Extrusion defects 5. Describe Extrusion defects in brief and suggest their remedies 6. Describe Extrusion equipments/machineries 7. Select Lubricants for extrusion process. 8. Describe parameters affecting extrusion pressure 9. Compare different tube making by extrusion.	• Direct • Indirect • Hydrostatics • Impact extrusion • High velocity rate extrusion 4.4 Extrusion Equipments/machineries: extrusion dies, extrusion machines 4.5 Lubricants used in extrusion. 4.6 extrusion pressure and parameters affecting it 4.7 Aluminium extrusion – Architectural use with plant layout. 4.8. Extrusion defects. 4.9 Tube making by extrusion- • From hollow billet • From solid billet • With porthole die Advantages of extrusion tube making	
5 Drawing Of Wire and Rod	1 Describe rod/wire drawing operation 2 Illustrate deformation pattern of metal in drawing die 3 Describe Draw Benches and wire drawing machines 4 List Heat treatment of wires 5 Identify Defects in Extruded wire/rod 6 Describe Lubrication in wire drawing 7 State the effects of friction and die angle on energy required for drawing	5.1 Principle of Drawing, 5.2 Classification of drawing processes. 5.3 Comparison of Wire drawing and rod drawing 5.3 Raw materials for wire/rod drawing 5.4 Sequential procedure for Preparation of wire, rod for drawing 5.5 Deformation pattern of metal in drawing die 5.6 Drawing die – Effects of friction and die angle on energy required for drawing. 5.7 Selection of Die material for drawing operations 5.8 Wire/rod Drawing machines- Principle and description • Draw Bench • Bull block • Continuous wire drawing machine 5.9 Lubrication in wire drawing- 5.10 Function and types of lubricants. 5.11 Heat treatment of wires- annealing and patenting 5.12 Defects in wire/rod.	10

		5.13 Compare Tube drawing and. Tube making.	
6 Sheet Metal Working	1. State Characteristics and properties of metal sheets for forming operations 2. Describe different Type of the presses used in metal working 3. Describe various Forming operations. 4. Identify Defects in sheet metal products 5. Describe Shear action in die cutting 6. Analyse the effect of clearance on cut edge 7. Illustrate Component of typical press tools 8. Analyze Various defects in sheet metal products ,their causes and suggest suitable remedies	6.1 Characteristics and properties of metal sheets for forming operations 6.2 Typical press tools and processes for sheet metal working, 6.3 Shear action in sheet metal cutting, clearance and its effects on cut edge, cutting forces. 6.4 Component of typical press tools. 6.4 Type of the presses used, their construction and advantages and disadvantages. 6.5 Forming operations, blanking, bending, deep drawing, Stretch forming, 6.6 Defects in sheet metal products 6.8 Principle of spinning of metals, spinning ratio 6.9 Advantages, applications of spinning 6.10 Equipments and tools: spinning lathe	12
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Operate Hydraulic press for plastic deformation of metals/Alloys	Introduction	8
2	Operate the rolling mill for Mild steel bar and Aluminium Bar	Rolling Of Metals	6
3	Determine effect of rolling on properties and structure of metals		6
4	Draw Roll pass sequences for round bar and square bar sections		8
5	Prepare any component by Press Forging operation	Forging Of Metals	6
6	Perform microscopic examination of forged component and analyse the result.		4
7	Operate Draw bench machine for Drawing operation of Wire and Rod	Drawing Of Wire And Rod	8
8	Perform Erichson's Cupping Test	Sheet Metal Working	8
9	Operate Spinning Lathe, Bullblock machine, blanking and punching operation, shearing ,analyze defects and suggest remedies	Sheet Metal Working	8
Skill Assessment			2
Total Hrs.			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	02 (04)	06 (04)	06(00)	14 (08)
02	Rolling of metal	02 (02)	04 (04)	06(00)	12 (06)
03	Forgings of metal	02 (00)	08 (00)	00(06)	10 (06)
04	Extrusion of metal	02 (02)	08 (04)	00(00)	10 (06)
05	Drawing of wire and rod	02 (00)	08(00)	00(06)	10 (06)
06	Sheet metal working	04 (00)	04(08)	06(00)	14 (08)
	Total	14 (08)	38(20)	18 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	2	R	2	5/7
	4	R	2																
02	2	U	4	3	U	4	4	U	4	2	U	4	1	U	4				3/5
03	3	U	4	4	U	4	5	U	4	4	U	4	6	U	4				3/5
04	5	U	4	6	U	4	6	R	4	1	R	4	6	U	4				3/5
05	1	A	6	2	A	6	3	A	6										2/3
06	1	U	6	6	A	6	5	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-	-	-	3	-	3	-	-
2	-	3	-	-	-	-	-	3	-	3	-	-
3	-	3	-	-	3	-	3	3	-	3	-	-
4	-	3	3	3	3	3	3	3	3	3	3	-
5	-	3	3	3	3	3	3	3	3	3	3	-
6	-	3	3	3	3	3	3	3	3	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Mechanical Metallurgy	George Dieter, Mc Graw Hill 3 rd Edition June 1986	978-0070168930
2.	Metallurgical Processes	Campbell, Mc Graw Hill, 18 th Edition, October 2008	978-0-07-336880-1.
3.	Handbook of Shaping and Making of steel	Kurt lance	0-07-084453-4
4.	Engineering Metallurgy part II	Raymond A. Higgins, Mc Graw Hill Publisher. Elsevier. 6 th Edition	978-0-340-56830-9

❖ **E-REFERENCES:**

- <http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=113106035>, assessed on 16 august 2016
- <https://www.youtube.com/watch?v=XTU0Z-FkhtU>, assessed on 15 sept 2016
- <https://www.youtube.com/watch?v=UW6HZKWJwJL>, assessed on 15 sept 2016
- <https://www.youtube.com/watch?v=SE-gMYZgUys>, assessed on 15 sept 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Draw Bench
2. Erichsen Cupping Apparatus
3. Hydraulic Press
4. Rolling Mills
5. Extrusion Press

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT403E
COURSE TITLE	: IRON MAKING
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 00 (CLOCK HRs.)
TOTAL CREDITS	: 03(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: NIL
PT.	: 01 HR

❖ RATIONALE :

The extraction of ferrous metals in pure & semi pure form from their ores is the stepping-stone in understanding the advance Metallurgical courses. This course deals with the important extraction techniques involved in Ferrous Metallurgy. Emphasis is given on iron production, the resources available and practices adopted from Indian viewpoint.

❖ COURSE OUTCOMES:

After completing this course students will –

1. Apply various principles for production of quality Iron.
2. Organize steps in sequence involved in Blast Furnace practice.
3. Evaluate different raw materials required for iron production.
4. Calculate efficiency of Blast furnace.
5. Suggest suitable remedies for Irregularities in Blast furnace operation.
6. Recommend various methods of iron production.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Introduction	1. State ancient iron making processes. 2. Write developments in iron making 3. Describe integrated steel plant.	1.1 Ancient Iron Making Processes 1.2 Development in Iron Making 1.3 Modern Iron Making 1.4 Alternative methods of Iron Making 1.5 Introduction to integrated Steel Plant	04
2. Raw Materials and Burden Preparation	1. Define reducibility 2. State types of iron ores 3. Evaluate iron ore. 4. Recommend different raw materials for iron production. 5. Describe beneficiation of iron ore. 6. Compare sintering with Pelletization. 7. Select appropriate burden distribution for enhancing blast furnace productivity. 8. Describe drum and disc pelletizer.	2.1 Source of iron- types of iron ores/minerals. Properties of iron ores. Reducibility of iron ore. Evaluation of iron Ore 2.2 Fuels: Coke- Properties, and functions. 2.3 Fluxes – types , Properties, functions and applications. 2.4 Beneficiation of Iron ore- need and methods of beneficiation 2.5 Agglomeration – need, advantages and principle involved. 2.6 Sintering - principle, techniques, advantages 2.7 Pelletization- principle, techniques (disc and drum pelletizer), Advantages. 2.8 Burden Distribution- Types, characteristics	10
3. Blast Furnace Construction:	1. Sketch blast furnace. 2. Describe constructional details of various parts of Blast furnace. 3. State function of each part of blast furnace. 4. Recommend suitable charging system 5. Select proper refractories for blast furnace. 6. Describe hot blast stove. 7. Describe Gas cleaning plant. 8. State function of each part of Gas cleaning plant	3.1 Constructional details and functions of Blast Furnace parts a. Hearth b. Bosh c. Stack, d. Bustle pipe e. Tuyers 3.2 Burden charging systems. 3.3 Refractories used in blast furnace 3.4 Hot blast stove- construction, refractories used, working. 3.5 Gas Cleaning Plant- functions and details of each part of Gas Cleaning plant.	12

4. Blast Furnace Operation:	1. State working principle of blast furnace. 2. Describe sequential Operational steps of Blast furnace. 3. State chemical reactions indifferent zone f blast furnace. 4. Draw temperature profile in blast furnace. 5. State compositions of blast furnace products. 6. Calculate efficiency of blast furnace.	4.1 Working principle of blast furnace 4.2 Operation of blast furnace. 4.3 Chemical reactions at different zones in Blast Furnace, temperature profile in blast furnace. 4.4 Blast Furnace Products— composition of Pig Iron, slag and gas. 4.5 Productivity of Blast Furnace.	10
5. Modern Trends in Blast Furnace:	1. State irregularities in blast furnace operation. 2. Solve irregularities in blast furnace operation. 3. Analyze effects of irregularities on blast furnace operation. 4. Describe modern trends in blast furnace. 5. Compare mini blast furnace with blast furnace.	5.1 Irregularities and their remedies in Blast furnace operations and their remedies. 5.2 Modern trends in Blast Furnace practice. 5.3 Mini blast furnace.	05
6. Sponge Iron Production:	1. Define sponge Iron. 2. State reactions in DRI production 3. Describe HyL, Midrex and Rotary Kiln process of DRI Production 4. Compare sponge iron with Pig iron. 5. State uses of Sponge iron. 6. Report status of sponge iron making industries in India.	6.1.Principle of Sponge Iron Production(DRI) 6.2. Physical Chemistry of Sponge Iron Processes 6.3.Sponge Iron Making Processes— a. HyL Process b. Midrex Process c. Rotary Kiln Process 6.4 Sponge Iron Making in India, Uses of Sponge Iron.	07
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
NIL			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	02(00)	04(04)	00(00)	06(04)
02	Raw Materials and Burden Preparation for Iron Making	02(04)	06(04)	06(00)	14(08)
03	Blast Furnace Construction	02(02)	10(04)	06(04)	18(10)
04	Blast Furnace Operation	04(00)	06(04)	04(04)	14(08)
05	Modern Trends in Blast Furnace	02(00)	00(04)	06(00)	08(04)
06	Sponge Iron Production	02(00)	08(00)	00(06)	10(06)
	Total	14(06)	36(20)	22 (14)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	4	R	2	5	R	2	5/7
	6	R	2																
02	1	U	4	1	R	4	2	U	4	2	U	4	3	U	4				3/5
03	3	U	4	3	U	4	3	U	4	4	U	4	4	U	4				3/5
04	4	U	4	5	A	4	6	U	4	6	U	4	4	R	4				3/5
05	3	A	6	3	U	6	2	A	6										2/3
06	4	U	6	5	U	6	6	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	--	--	--	--
		Journal Writing		Continuous	--	--	--	--
				TOTAL	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
NIL		

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-	-		3	-	3	-	3
2	-	3	2	-	3	-	3	3	-	3	2	-
3	-	3	-	3	3	-	3	3	-	3	2	3
4	-	3	2	3	3	2	3	3	-	3	-	3
5	-	3	-	3	3	-	3	3	1	3	-	-
6	-	3	-	-	3	2	3	3	1	3	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	An Introduction to Modern Iron Making	Dr.R H Tupkary, V R Tupkary. Khanna Publication.,3rd edition.,2012.	174090215
2.	Beyond the Blast Furnace	Amit Chatterjee, CRC Press, Second edition ,1999	0849366763, 9780849366765
3.	General Metallurgy	Boris Kuznestsov, Mir Publishers, Moscow, 2 nd Edition,1979	5-03-000026-7 5030000267.

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=ysLqUDa5GEA> assessed on 11th July, 2016
- <https://www.youtube.com/watch?v=CzQrLIPirIY> assessed on 11th July, 2016
- <https://www.youtube.com/watch?v=JjC1YVbHWc0> assessed on 11th July, 2016
- nptel.ac.in/courses/113104060/MHB_pdf/lecture26.pdf assessed on 13th July, 2016.

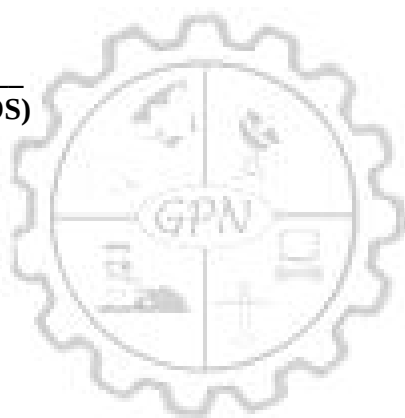
❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Charts
2. Videos,
3. Ppts.
4. Models

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C. Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli.

(Member Secretary PBOS)



(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT404E ^s
COURSE TITLE	: STEEL MAKING
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ RATIONALE:

Steel is a very important material for construction as well as manufacturing industries. Knowledge of various methods of steel making is very much essential for metallurgists. Emphasis is given on principles of steelmaking and different processes of steel making from Indian viewpoint.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply principles of steel making to obtain quality steel.
2. Select proper raw materials for steel production.
3. Recommend suitable method of production of Steel.
4. Prepare visit report on steel making processes.
5. Identify various components of different continuous casting machines.
6. Prepare plant layout of steel making shop.

❖ COURSE DETAILS:

A . THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Introduction	1. Write history of steel making. 2. State different raw materials for steel making 3. Select suitable raw materials for steel making. 4. State status of different iron and steel industries in India.	1.1 History of steel making 1.2 Raw materials for steel making: a. sources of metallic iron b. oxidizing agent c. fluxes d. sources of heat e. deoxidizers f. Furnace refractories 1.3 Present status of iron and steel Industries in India.	04
2. Principles of Steel Making :	1. Describe reactions in decarburization, dephosphurization and desulphurization. 2. Define different slag properties. 3. Compare acid steel making with basic steel making 4. Calculate efficiency of steel making process.	2.1 Principles of steel making: a. Carbon reaction-decarburization b. Phosphorous reaction-dephosphurization c. Sulphur reaction-desulphurization d. Manganese and silicon reactions. e. De-oxidation of steel f. Slag properties. 2.2 Types of steel making processes- acid and basic steel making 2.3 Efficiency of steel making processes	10
3. Conventional Steel Making Processes	1. Describe Bessemer process, open hearth process and side blown converter and L.D. processes of steel making. 2. Sketch Bessemer, Open Hearth and L.D. Converter. 3. Describe constructional details of Bessemer, Open Hearth and L.D. Converter. 4. Compare characteristics of steel produced by Bessemer method with open hearth process. 5. Describe Rotary process	3.1 Bessemer process- principle, constructional details of Bessemer converter, process details, outline, merits and demerits, characteristics of steel produced 3.2 Open - hearth process- principle, constructional details of open hearth furnace, process details, outline, merits and demerits, characteristics of steel produced, Twin Hearth Furnace (THF). 3.3 Rotary process (Kaldo, Oberhausen): principle, merits and demerits, characteristics of steel produced. 3.4 Oxygen steel making - L.D.	12

	of steel making. 6. Justify characteristics of steel produced.	Converter: principle, constructional details of L.D. Converter, process details, outline, merits and demerits, characteristics of steel produced.	
4. Electric Arc Furnace Steel Making	- Describe constructional details of Electric Arc Furnace. - State raw materials for steel making by Electric and induction furnace. - State merits, demerits and characteristics of steel produced by Electric arc and induction furnace. - Describe sequential stages for steel making by electric and induction furnace. - Select suitable refractories for different parts of furnaces	4.1 Electric steel making processes: Electric arc furnace process: Electric Arc furnace constructional details, charge materials, Process detail, outline, merits and demerits, characteristics of steel produced. Induction furnace: principles of heating process, charge materials, merits and demerits of process, characteristics of steel produced.	08
5. Secondary Steel Making	- State merits of secondary steel making. - Describe different Decarburizing techniques. - State Sievert's law. - Compare different Degassing techniques.	5.1 Introduction and Merits of secondary steel making process. 5.2 Synthetic slag refining, 5.3 Decarburization techniques- AOD, VOD, CLU 5.4 ESR and VAR process 5.5 Ladle furnace 5.6 Hybrid process. 5.7 Vacuum Treatment of Steel- Principles, Sievert's law 5.8 Degassing techniques: - Ladle degassing - Stream degassing - Recirculation degassing	08
6. Continuous Casting of Steel	- State principle of continuous casting. - Describe different continuous casting machines. - Compare different continuous casting machines. - State developments in continuous casting. - Select proper Continuous casting machines.	6.1 Principle of continuous casting 6.2 Construction of continuous casting machine and outline of processes 6.3 Types of continuous casting machines with their sketches and comparison. 6.4 Merits, Demerits and modern development in continuous casting machines	06
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Prepare report on current status of iron and steel industries in India/world.	Introduction	04
2	Find out tapping and teeming temperature for refined plain carbon steel using standard diagrams. (Assignments to be given to find out tapping and teeming temperature for varying carbon content of steel.)	Principles of Steel Making	02
3	Select proper oxidizer based on thermodynamics data/diagrams of deoxidation.		04
4	Prepare outline for design of refractories for Electric arc furnace.	Conventional Steel Making Processes and Electric Arc Furnace Steel Making	04
5	Prepare Outline of heat for production of plain carbon steel by electric steel making process/LD steel making process.		04
6	Observe videos/films on steel making by Electric Arc Furnace/LD process. (Assignments to be given after observing these films/videos)		04
7	Demonstrate the Continuous Casting Machine.	Continuous Casting of Steel	02
8	Prepare plant layout of steel making shop for Electric steel making/ LD Process	Introduction	04
9	Prepare Report on visit to any steel plant.		02
Skill Assessment			02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	04(00)	00(04)	00(00)	04(04)
02	Principle of steel making	02(04)	12(04)	00(00)	14(08)
03	Conventional Steel making processes	02(00)	04(04)	12(06)	18(10)
04	Electric Steel Making	02(00)	04(06)	06(00)	12(06)
05	Secondary steel making	04(02)	08(04)	00(00)	12(06)
06	Continuous casting	02(00)	04(00)	04(06)	10(06)
	Total	16(06)	32(22)	22 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	5/7
	6	R	2																
02	1	U	4	2	R	4	2	U	4	2	U	4	2	U	4				3/5
03	2	U	4	3	U	4	3	U	4	4	U	4	5	U	4				3/5
04	6	U	4	6	A	4	5	U	4	5	U	4	5	R	4				3/5
05	3	A	6	3	A	6	3	A	6										2/3
06	4	A	6	4	U	6	6	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagram / sketch	10
2	Identification / performance	10
3	Result/ Conclusion	10
4	Viva voce	20
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-	3	3	-	-	3	-	3
2	-	3	-	-	3	3	3	3	-	3	2	3
3	-	3	-	-	-	3	3	3	-	3	-	
4	-	3	2	2	3	3	3	3	2	3	-	-
5	-	3	2	2	3	-	-	3	2	3	2	-
6	-	-	2	2	3	3	3	3	2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Modern Iron Making	Dr. R.H. Tupkari , 3rd edition Khanna, 2004	81-20300716-X
2.	Modern steel Making	Dr. R.H. Tupkari ,Khanna Publishers; 7th edition2000	81-7409-026-6
3.	Elements of Metallurgy	Dr. D. Swaroop & Dr. M. N. SaxenaRastogi Publications, first edition , 2005	10: 8171338135 13: 9788171338139

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=98lh5Q0M0cg>, assessed on 16th March 2016
- https://www.youtube.com/watch?v=3_BH6HqpPtk, assessed on 16th March 2016
- <https://www.youtube.com/watch?v=eHFI-xuZliQ>, assessed 16 March 2016
- <http://www.engmatl.com/index.php?start=6>, assessed on 16 March 2016
- <http://downloadingisnotsin.net/material-science-and-metallurgy-by-kodgire-pdf-free-download/>, assessed on 22 March 2016
- <http://scitech.quickfound.net/> assessed on 27th April 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Charts
2. Models

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT405E
COURSE TITLE	: NON FERROUS METALLURGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 00 (CLOCK HRs.)
TOTAL CREDITS	: 03(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HRs)
TH. TEE	: 03 HRs
PR. TEE	: NIL
PT.	: 01 HR

❖ RATIONALE:

This course mainly deals with the various extraction processes of non-ferrous and rare earth metals from their ores. Knowledge of raw materials, methodology of extraction, furnaces and other necessary equipments required for extraction of non-ferrous metals in industry are crucial. Proper understanding of this course is very important in the field of application of various significant Non-Ferrous Metals & Alloys.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify ferrous and nonferrous metals.
2. Select Pyrometallurgical, Hydrometallurgical & Electrometallurgical methods of extraction of Non-ferrous Metals.
3. Employ suitable processes of extraction depending on Non Ferrous Metals to be extracted.
4. Draw flow sheet for various extraction processes of different Non Ferrous Metals
5. Apply knowledge of various extraction processes to get final product.
6. Suggest proper non-ferrous metals for nuclear applications

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1 Principles Of Extraction	1. State different sources of metals. 2. Classify extraction process 3. Define the terms Pyrometallurgy, hydrometallurgy and electrometallurgy. 4. State principles of roasting and calcinations 5. Describe roasting techniques. 6. Illustrate counter current decantation 7. Compare pyro, hydro and electrometallurgy	1.1 Classification and sources of Metals, Minerals, Ores etc. 1.2 Pyrometallurgy- Definition, principles involved, stages of Pyrometallurgy, advantages ,disadvantages 1.3 hydrometallurgy- Definition, stages of hydrometallurgy, principles of hydrometallurgy , advantages ,disadvantages 1.4 Electrometallurgy- Definition, principle of electrometallurgy, advantages ,disadvantages 1.5 Comparison amongst Pyrometallurgy, Hydrometallurgy and electrometallurgy 1.6 Principles of roasting and calcinations 1.7 Roasting techniques: fluidized bed roasting, multiple hearth roasting 1.8 Solvent extraction 1.9 Counter current decantation	05
2.Extraction Of Copper	1 State properties and uses of copper 2 State types of sources of copper 3 Draw flowsheet for Pyrometallurgical extraction of copper 4 Describe Hydrometallurgical extraction of copper. 5 Describe WORCRA process of copper extraction 6 Select proper refining process of copper extraction 7 Describe ferric chloride leaching of copper	2.1 Properties and uses of copper 2.2 Ores/minerals of copper, preparation of ore, current status of copper production in India 2.3 Production of copper by 2.4 Pyrometallurgy- production flow sheet(by conventional and newer route) , stages of Pyrometallurgy 2.5 Flash smelting of copper 2.6 WORCRA process- features and merits of the process. 2.7 Refining of Copper- fire and	12

		electrolytic refining 2.8 Hydrometallurgy of copper- ferric chloride leaching of copper ore, advantages and disadvantages	
3 Extraction of Zinc	1 State properties and uses of Zinc 2 List various sources of Zinc 3 Describe Pyrometallurgical extraction of Zinc. 4 State current status of zinc production in India 5 Draw flow sheet for extraction of zinc	3.1 Properties and uses of Zinc 3.2 Ores/minerals of Zinc, preparation of ore, current status of zinc production in India 3.3 Pyrometallurgical extraction of zinc with flow sheet	08
4.Extraction of Lead	1 State properties and uses of Lead 2 Select sources of Lead 3 Describe pyrometallurgical extraction of Lead. 4 Describe refining of Base Bullion 5 State current status of Lead production in India 6 Draw flowsheet for extraction of Lead	4.1 Properties and uses of Lead 4.2 Ores/minerals of Lead, preparation of ore, current status of Lead production in India 4.3 Pyrometallurgical extraction of lead with flow sheet 4.4 Refining of base bullion	05
5.Extraction Of Aluminium	1 State properties and uses of Aluminium 2 Select sources of aluminium 3 Justify Bayers process for extraction of aluminium 4 Justify Hall Heroult process of Al extraction 5 Illustrate refining process to obtain pure aluminium 6 Describe manufacturing of carbon electrodes 7 Describe anode effect 8 Describe steps steps for preparation of cryolite	5.1 Properties and uses of Aluminium 5.2 Ores/minerals of Aluminium, preparation of ore, current status of aluminium production in India 5.3 Feasibility of carbothermic reduction of Alumina 5.4 Requirements for aluminium extraction. 5.5 Bayer's process- flow sheet, stages involved, factors affecting Bayer's process 5.6 Preparation of Cryolite- flow sheet and description with reactions involved 5.7 Manufacturing of carbon electrode	11

		5.8 Hall Heroult process (Aluminium cell) - construction, working, composition and properties of bath, anode effect 5.9 Refining of aluminium.	
6.Extraction Of Uranium And Thorium	1 State properties and uses of Uranium & Thorium 2 Select sources of Uranium & Thorium 3 Illustrate recovery of Uranium from minerals 4 Describe recovery of Thorium from mineral 5 Describe steps of ore preparation of uranium and thorium	6.1 Properties and uses of Uranium and Thorium 6.2 Ores/minerals of Uranium and Thorium and preparation of ore 6.3 Recovery of Uranium from their minerals with flow sheets 6.4 Recovery of Thorium from their minerals with flow sheets.	07
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
NIL			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Principles Of Extraction	02(04)	04(00)	00(00)	06(04)
02	Extraction Of Copper	04(02)	08(08)	06(00)	18(10)
03	Extraction Of Zinc	02(00)	04(06)	06(00)	12(06)
04	Extraction Of Lead	02(00)	06(04)	00(00)	08(04)
05	Extraction Of Aluminium	02(02)	08(08)	06(00)	16(10)
06	Extraction Of Uranium And Thorium	02(00)	08(00)	00(06)	10(06)
	Total	14(08)	38(26)	18 (06)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	3	R	2	4	R	2	5	R	2	6	R	2	2	R	2	5/7
	5	R	2																
02	1	R	4	2	U	4	3	U	4	4	U	4	5	U	4				3/5
03	2	U	4	5	U	4	6	U	4	2	U	4	5	U	4				3/5
04	2	U	4	5	U	4	6	U	4	1	R	4	2	R	4				3/5
05	2	A	6	3	A	6	6	A	6										2/3
06	4	U	6	5	A	6	3	U	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	--	--	--	--
		Journal Writing		Continuous	--	--	--	--
				TOTAL	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION: NIL**

S.N.	Description	Max. Marks
NIL		

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

❖ Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3		-	-	-	3	3	3	3	-	-
2	-	3		3	3	3	3	3	3	3	-	-
3	-	3	3	3	3	3	3	3	3	3	-	-
4	-	3	3	3	3	3	3	3	3	3	-	-
5	-	3	3	3	3	3	3		3	3	-	-
6	-	3		-	-	-	3		3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/113105021/>, assessed on 29th June 2016
- <httpS://www.youtube.com/watch?v=SA55zz4Lno&list=PLC3F0FC4543ADAC48>, assessed on 29th June 2016
- <https://www.youtube.com/watch?v=UgmlmDUhR6A>, assessed on 29th June 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

NIL

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Mineral dressing	A.M. Gaudin McGraw-Hill Inc.,US, December 1939	13: 978-0070230309
2.	Extraction of Non-Ferrous Metals by	K. S. Roy, R. Sridhar & K.P. Abraham. Affiliated East-west Press Pvt Ltd , 2008	13: 978-8185095639
3.	Non-ferrous Extractive Metallurgy - Industrial Practices: Industrial Practices: 1 (Non-Ferrous Metallurgy)	Roger Rumbu, CreateSpace Independent Publishing Platform , September 2014	13: 978-1483952420

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli.

(Member Secretary PBOS)



(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT406E^s
COURSE TITLE	: PHYSICAL METALLURGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 04; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 06(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ **RATIONALE:**

Physical and mechanical properties of ferrous and non-ferrous metals and alloys depend on composition and structure. The structure of an alloy is predicted from phase equilibrium diagram. So it is essential to know the structure of an alloy. This course mainly deals with the study of Phase equilibrium diagram, macro and microstructures of ferrous and non-ferrous alloys. The study of this course prepare the students for analysis of the microstructure observed under microscope in a metallurgical industries which is further required for controlling the quality.

❖ **COURSE OUTCOMES:**

1. Interpret Fe- Fe₃C Phase equilibrium diagram.
2. Calculate amount of phases using Lever Rule
3. Select appropriate non-ferrous alloys for given applications.
4. Prepare specimen for macro and micro examination.
5. Operate Metallurgical microscope for microstructures analysis.
6. Use Image Analyzer for quantitative Metallography.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Solidification of metals:	1. Describe solidification. 2. Define grain and grain boundary. 3. Compare solidification of pure metal with alloy. 4. Draw cooling curves for pure metal and alloy. 5. Describe coring.	1.1 Concept of solidification - Transformation of liquid in to solid. 1.2 Nucleation and growth, dendrite formation 1.3 Grain and grain boundaries 1.4 Cooling curves for pure metals and binary alloys 1.5 Coring defect	06
2.phase Equilibrium Diagrams:	1. Define phase. 2. Derive Gibbs rule for metallurgical systems. 3. Apply Hume-Ruthery's principles for formation of solid solutions. 4. Describe different solid solutions. 5. Describe different compounds. 6. Construct binary equilibrium diagram. 7. Derive Lever Rule. 8. Determine proportions of phases by applying lever rule.	2.1 Definition of phase 2.2 Gibbs's phase rule and its application, its modification for metallurgical systems 2.3 Solid solutions - Substitutional solid solution, Interstitial solid solution, Terminal solid solution & Intermediate solid solution. 2.4 Hume- Ruthery's rules for formation of solid solution. 2.5 Intermediate compounds, electron compounds, their examples. 2.6 Construction of equilibrium diagrams; viz. Monotectic, Peritectic, Eutectoid, peritectoid reactions. 2.7 Numerical based on construction of Binary equilibrium diagram. 2.8 Lever Rule: Its derivation and application to equilibrium diagram, Numerical based on lever rule.	10
3. Iron- Carbon Equilibrium Diagram:	1. Define allotropy 2. Draw iron –Carbon diagram. 3. Write reactions in iron carbon diagram. 4. Classify steel and cast iron based on iron carbon diagram. 5. Draw microstructures of different steels and	3.1 Allotropic transformation of iron. 3.2 Reactions in Iron- Carbon diagram 3.3 Critical temperatures in Iron-carbon diagram 3.4 Classifications of plain carbon steel and cast irons with reference to iron carbon diagram. 3.5 Microstructure and properties of plain carbon steels and cast iron	16

	cast irons. 6. Describe cooling of iron and cast iron.	with reference to iron carbon diagram. 3.6 cooling of different carbon steels 3.7 Cooling of different cast irons.	
4. Micro and Macroscopic Examination:	- Describe steps for microscopic and macroscopic examination. - Select proper etchant. - Draw microstructures of steels and cast irons. - Use optical principle to operate microscope. - Sketch metallurgical microscope. - Determine sulphur, phosphorous and oxides in steel by macroscopic examination. - Draw structure of forged components.	4.1 Microscopic Examination: - Preparation, techniques & methods of sampling. - Mechanical and electrolytic polishing. - Etching techniques and etching reagents - Analysis and interpretation of phases related to steel and cast iron. - The metallurgical microscope and metallograph. - Optical principles of metallurgical microscope. Optical system, objectives, eye pieces and properties etc - Microphotography, films properties, exposing, developing and printing. 4.2 Macroscopic Examination: - Principles and procedure of macroscopic examinations - Sulphur printing, phosphorus printing, oxide printing - Etching reagents - Grain / fibre flows of forged components. - Hydrogen flakes and its determination	14
5. Quantitative Metallography:	- State different attachments on microscope. - Describe the method to measure grain size with microscope. - Describe the method to measure case depth with microscope. - Calculate ASTM Grain size no. - Describe various feature of Image Analyzer.	5.1 Measuring attachment on microscope 5.2 Calibration of microscope, measurement of grain size. 5.3 ASTM grain size no. 5.4 Measurement of case depth, plating, thickness, etc. 5.5 Phase distribution in microstructure and its effect on mechanical properties. 5.6 Image analyzer software- Use, features and advantages	04
6. Metallurgy of Non ferrous	Draw Cu-Zn equilibrium diagram.	6.1 Brasses- Cu-Zn equilibrium diagram.	14

Alloys:	2. Compare single phase brass with double phase brass 3. State properties and applications of brasses. 4. Draw Cu-Sn equilibrium diagram. 5. Select proper bronze for given application. 6. Draw Al-Si equilibrium diagram. 7. Describe Al- Si modified structure. 8. State properties and applications of Al- Si alloys. 9. Classify bearing metals. 10. State Requirements of good bearing metal 11. Compare Lead base with Tin base bearing metals. 12. Describe Effects of copper addition on properties of bearing metals.	b. Brasses- single phase and double phase brass. c. Mechanical properties and application of commonly used industrial brasses. 6.2 Bronzes: a. Cu-Sn equilibrium diagram- cast dendritic structure, b. composition, microstructure, mechanical properties and application of commonly used industrial bronzes c. composition and properties Gun metal and phosphor bronze 6.3 Al Alloys: a. Al-Si equilibrium diagram, b. cast and modified structures of Al-Si alloys c. Compositions and properties of commonly used as cast and as wrought Al-Si Alloys. 6.4 Bearing metals: a. Classification of bearing metals, b. Requirements of good bearing metal. c. Composition, microstructure, mechanical properties and applications of Lead base and Tin base bearing metals d. Effects of copper addition on properties of bearing metals.	
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Prepare Sample for microscopic examination.	Micro and Macroscopic Examination	08
2.	Carry out Mounting of specimen by mounting press.		04
3.	Carry out polishing and etching by Electrolytic polishing & etching.		04
4.	Operate metallurgical microscope for analysis of microstructures.		06
5.	Prepare chart of ASTM grain size Number.		06
6	Determine Sulphur distribution by Sulphur printing		06
7	Determine Phosphorous distribution by Phosphorous printing.		06
8	Determine oxide distribution by oxide printing		06
9	Use image analyzer for analysis of microstructures.	. Quantitative Metallography	06
10	Determination of grain size, case depth by image analyzer		06
11	Draw microstructures of various steels, cast irons and non ferrous alloys by microscopic observation.	Iron- Carbon Equilibrium Diagram and Metallurgy of Non ferrous Alloys	04
Skill Assessment			02
Total Hrs.			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Solidification of metals	02(02)	04(00)	00(00)	06(02)
02	Phase Equilibrium Diagrams	04(02)	08(04)	06(04)	18(10)
03	Iron- Carbon Equilibrium Diagram	02(02)	04(04)	06(00)	12(06)
04	Micro and Macroscopic Examination	02(02)	12(00)	00(06)	14(08)
05	Quantitative Metallography	02(00)	04(04)	00(00)	06(04)
06	Metallurgy of Non ferrous Alloys	02(00)	06 (04)	06(06)	14(10)
	Total	14(08)	38(16)	18(16)	70(40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	5/7
	6	R	2																
02	1	U	4	2	R	4	2	U	4	2	U	4	2	U	4				3/5
03	2	A	4	3	U	4	4	U	4	4	U	4	4	U	4				3/5
04	5	U	4	5	U	4	6	U	4	6	U	4	6	U	4				3/5
05	2	A	6	3	A	6	4	A	6										2/3
06	4	U	6	6	U	6	6	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing	10
2	Performance	10
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	20
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	3	-	-	-	3	3	3	-	-
2	-	3	-	-	-	-	-	3	-	3	-	-
3	-	3	-	-	3	-	3	3	-	3	-	-
4	-	3	3	3	3	1	3	3	3	3	-	-
5	-	3	3	3	3	-	3	3	3	3	-	-
6	-	3	3	3	3	-	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Heat Treatment: Principles and Techniques	T.V.Rajan, C.P.Sharma, Ashok Kumar Sharma, Prentice Hall Of India. 2 nd Edition 1994	978-81-203-4095-4
2.	Introduction to Physical Metallurgy	Sidney H. Avner, McGraw-Hill International Edition, 2 nd Edition, 1964	81-20300716-X
3.	Material science & Metallurgy for engineers	V.D.Kodgire, S.V.Kodgire, Everest Publishing House, first Edition, 2011	10:8186314008 13:9788186314005
4.	Physical Metallurgy for Engineers	Donald S. Clark, W.R. Varney, Van Nostrand Reinhold Company; 2 nd Revised Edition, December 1962	10: 0442015704 13: 978-0442015701
5	Engineering Physical Metallurgy	Y. Lakhtin, CBS Publisher, 1st Edition, 2005	9788123906027 8123906021

6	Introduction To Materials Characterization	Dr. P.R. Khangaonkar, Penram International Publishing, Edition, 2010	13: 9788187972808
7	ASM Handbook Volume 9: Metallography and Microstructures	ASM International, 2004	978-0-87170-706-2

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/108108076/1> , assessed on 11th July 2016
- https://www.youtube.com/watch?v=3_BH6HqpPtk , assessed on 11th July 2016
- <https://www.youtube.com/watch?v=eHFI-xuZliQ> , assessed 11th July 2016
- <http://www.engmatl.com/index.php?start=6>, assessed on 16th March 2016
- <http://downloadingisnotsin.net/material-science-and-metallurgy-by-kodgire-pdf-free-download/>, assessed on 22nd March 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Standard Fe-Fe₃C equilibrium diagram
2. Microscope- magnification 100X
3. Mounting press
4. Emery papers
5. Grinder
6. Polishing machine
7. Image analyzer

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Mr.K.L.Meshram	Head of Department, Metallurgy	Government Polytechnic, Nagpur.
2.	V.C.Humney	Lecturer, metallurgical Engineering	Government Polytechnic, Nagpur.
3.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
4.	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
5.	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT407E ^s
COURSE TITLE	: HEAT TREATMENT
PREREQUISITE	: MT406E
TEACHING SCHEME	: TH: 04; TU: 00; PR: 04 (CLOCK HRs.)
TOTAL CREDITS	: 06(1 TH/TU CREDIT=1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ RATIONALE:

In present day metallurgical practice, heat treatment has come to represent whole class of techniques- involving thermal, mechanical and chemical treatment- by which desired properties of structural materials are obtained to suit a variety of applications. The properly designed and implemented heat treatment results in optimum modification in the composition and distribution of phases and corresponding changes in physical, mechanical and chemical properties are achieved in substantial measures. The contents of this course will help the students to understand the principle involved and applications of various heat treatment processes.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Analyze the effect of different transformation mechanisms
2. Select different heat treatments applied to steels.
3. Suggest suitable remedies for various heat treatment defects.
4. Perform various heat treatment processes on steel.
5. Prepare samples for various heat treatment processes.
6. Design heat treatment cycle for different heat treatment processes.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. General Aspects of Heat Treatment	1. State Heat treatment variable. 2. State role of heat treatment in industries. 3. Define austenitization. 4. Recall critical temperatures. 5. Draw heat treatment cycle. 6. Describe various methods for determination of grain size of Austenite.	1.1 Role and importance of heat treatment in the industry. 1.2 Heat treatment process variables. Heat treatment cycles. 1.3 Critical Transformation temperatures and their notation. 1.4 Heat treatment cycles. 1.5 Austenitization: mechanism and kinetics of formation of Austenite. 1.6 Effect of grain size on heat treatment. 1.7 Determination of austenite grain size in steel	08
2. Isothermal transformation	1. Draw T.T.T. diagram 2. State Characteristics of martensitic transformation. 3. Compare pearlitic and Bainitic transformation. 4. Define C.C.R 5. Describe C.C.T. Diagram. 6. Use TTT, CCT Diagrams for heat treatments. 7. Determine Ms and Mf temperatures.	2.1 T.T.T. diagram, construction of T.T.T. diagram from transformation curves. 2.2 Use of T.T.T. Diagram for determining H.T. cycles. 2.3 Transformation of austenite into pearlite - Nucleation and growth of cementite and ferrite, effect of time, grain size etc. 2.4 Characteristics of martensitic transformation - Ms- Mf temp. Volumetric changes during martensitic transformation. 2.5 Retained austenite - effect of carbon and alloying elements. 2.6 C.C.R. – effect of austenitic grain size. 2.7 Characteristics of Bainitic transformation. 2.8 C.C.T. Diagram.	12
3. Hardenability of steel	1. Define Hardenability, critical, ideal critical diameter, severity of quenchant. 2. State factors affecting	3.1 Hardenability - factors affecting Hardenability. 3.2 Hardness vs Hardenability. 3.3 Determination of Hardenability of steel by	08

	Hardenability. 3. Describe Grossman method to determine Hardenability. 4. Describe Jominy end quench test. 5. Select proper quenchant.	Grossman method, Jominy end quench test and chemical composition method 3.4 Determination of ideal critical diameter. 3.5 Use of Hardenability data in industry 3.6 Quenchant- Severity of quenchant, types and characteristics quenching mediums.	
4. Heat treatment Processes	1. Define Annealing & Normalizing 2. Identify heat treatment defects, causes and remedies 3. Determine heating temperature for various heat treatment processes. 4. Describe tempering treatment. 5. Describe controlled atmospheres. 6. Select proper hardening method. 7. Describe spheroidizing of steel. 8. Compare Austempering with Martempering. 9. Describe Heat treatment of Grey cast iron-	4.1 Heating of steel- Heating time, Oxidation and decarburization, furnace atmosphere and control. 4.2 Annealing treatments : Purpose of Annealing, Recrystallisation annealing, stress relieving, full annealing, partial annealing, diffusion annealing isothermal annealing, vacuum annealing 4.3 Normalizing-purposes, micro structural changes and its applications. 4.4 Hardening: - Purpose of hardening selection of hardening temp. - Methods of quenching. sub-zero treatment 4.5 Tempering - purpose of tempering - stages in tempering - effect of temp., and time on structure - temper Embrittlement. 4.6 Spheroidizing of steel. 4.7 H.T. based on T.T.T.diagram- Austempering, Martempering, Ausforming, Patenting of steel 4.8 Heat Treatment defects, causes and remedies 4.9 Heat treatment of Grey cast iron- stress relieving, annealing, normalizing, hardening and tempering 4.10 Malleabilization of white cast iron 4.11 Heat treatments of Spheroidal	24

		graphite (SG) iron .	
5. Surface Hardening	1. Describe Case hardening/surface hardening of steel 2. Select proper case hardening method. 3. Compare different case hardening methods. 4. Analyze effect of case hardening on steel properties. 5. Determine case depth	5.1 Case hardening of steel - carburizing, heat treatment after carburizing. Cyaniding, Nitriding, Tufftriding and Sursulf process. 5.2 Surface hardening of steel: a. Induction hardening - principle, equipments and steels used. b. Flame hardening-principle, equipments and steels used.	08
6. Heat Treatment of non ferrous alloys	1. State Heat treatment processes for Aluminium alloys 2. Define various terms related to precipitation hardening. 3. Use Cu-Al equilibrium diagram for precipitation hardening of Al alloys. 4. Interpret Al-Cu equilibrium diagram.	6.1 Heat treatment processes for Aluminium alloys 6.2 Aluminium bronze: Cu-Al equilibrium diagram, hardening of Al bronze 6.3 Precipitation hardening of Al alloys. 6.4 Al-Cu equilibrium diagram	04
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Perform Annealing on steel	Isothermal transformation and Heat treatment Processes	08
2.	Perform Normalizing on steel		08
3.	Perform Hardening on steel with varying carbon content to analyze effect of carbon % on hardness		08
4.	Perform Hardening on steel with varying hardening temperatures to analyze effect of temperatures on hardness.		08
5	Perform Hardening on steel with different quenchant medias to analyze effect of quenchant on hardness.		08
6	Determine Hardenability of steel by Jominy End Quenched test	Hardenability of steel	08
7	Perform tempering on hardened steel at different temperature /time to analyze effects of temperature/time on hardness.	Isothermal transformation and Heat treatment Processes	08
8	Perform any one surface treatment process (carburizing, flame hardening) of steel. OR Perform Age hardening process on Al –Cu alloy. OR Perform any one heat treatment on cast iron.	Surface Hardening/ Heat treatment of Non ferrous alloys/ Heat treatment of cast iron	06
Skill Assessment			02
Total Hrs.			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	General Aspects of Heat Treatment	02(00)	06(04)	00(00)	08(04)
02	Isothermal transformation	02(02)	04(04)	06(00)	12(06)
03	Hardenability of steel	02(00)	08(00)	00(06)	10(06)
04	Heat treatment Processes	00(04)	14(04)	10(06)	24(14)
05	Surface Hardening	02(02)	06(00)	00(04)	08(06)
06	Heat treatment of Non ferrous alloys	02(00)	00(04)	06(00)	08(04)
	Total	10(08)	38(16)	22(16)	70(40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	5/7
	1	R	2																
02	1	U	4	1	U	4	2	U	4	2	U	4	2	U	4				3/5
03	2	U	4	3	U	4	3	U	4	4	U	4	4	U	4				3/5
04	4	R	4	4	U	4	4	U	4	4	U	4	4	U	4				3/5
05	4	A	6	4	A	6	4	A	6										2/3
06	5	A	6	3	A	6	3	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagram, selection of equipments & tools, writing procedure etc.	10
2	Performance	10
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	20
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-	-	-	3	-	3	-	-
2	-	3	-	-	3	3	3	3	-	3	-	-
3	-	3	-	-	-	-	-	3	-	3	-	-
4	-	3	3	3	3	3	3	3	3	3	2	-
5	-	3	3	3	3		-	3	3	3	2	-
6	-	3	3	3	3	3	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Heat Treatment: Principles and Techniques	T.V.Rajan, C.P.Sharma, Ashok Kumar Sharma, Prentice Hall Of India. 2nd Edition 1994	978-81-203-4095-4
2.	Metallurgy and heat treatment of tool steel	Robert Wilson, Mc Graw Hill publication, 1 st Edition, 1975	0-07-084453-4
3.	Introduction to Physical Metallurgy	Sidney H. Avner, McGraw-Hill international Edition, 2 nd Edition 1974	81-20300716-X
4.	Material science & Metallurgy for engineers	V.D.Kodgire, S.V.Kodgire, Everest Publishing House, 1 st Edition 2011	10:8186314008 13:9788186314005

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=98lh5Q0M0cg>, assessed on 11th July 2016
- https://www.youtube.com/watch?v=3_BH6HqpPtk, assessed on 11th July 2016
- <https://www.youtube.com/watch?v=eHFI-xuZliQ>, assessed 11th July 2016
- <http://www.engmatl.com/index.php?start=6>, assessed on 16th March 2016
- <http://downloadingisnotsin.net/material-science-and-metallurgy-by-kodgire-pdf-free-download/>, assessed on 22nd March 2016
- <http://scitech.quickfound.net/> assessed on 27th April 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Standard Fe-Fe₃C equilibrium diagram-
2. Microscope- magnification 100X
3. Grinder- double ended
4. Polishing machine- cloth polishing, disc type
5. Muffle furnace- max temperature 1000⁰c
6. Hardness tester- Rockwell c scale
7. Jominy Hardenability test apparatus- standard apparatus
8. Safety equipments and accessories.
9. Image analyzer- microcam 4.0 software
10. Flame hardening set up

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSE
COURSE CODE	: MT408E ^s
COURSE TITLE	: METALLURGICAL ANALYSIS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 04 (CLOCK HRs.)
TOTAL CREDITS	: 05(1 TH/TU CREDIT = 1 CLOCK HR., 2 PR CREDIT = 1 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ RATIONALE:

The chemical composition of metal and alloy determine their properties and metallurgical analysis shows the chemical composition of sample. It is essential that the students should be familiar with the standard procedures used for determining the important constituents of metals and alloys.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Collect samples by sampling of ores/metals/alloys
2. Plan layout of chemical laboratory.
3. Utilize Instrument methods for analysis of Metals & Alloys
4. Perform volumetric and gravimetric analysis of metals and alloys
5. Determine Carbon and sulphur percentage in given steel sample.
6. Determine (quantitative analysis) alloying elements in nonferrous metals

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1 Introduction	1. State the importance of Chemical analysis 2. Describe sampling procedure. 3. Illustrate a Chemical Laboratory. 4. Describe Errors in quantitative determination – their causes and remedies.. 5. List Important chemicals required in chemical laboratory 6. Classify Methods of quantitative analysis 7. Compare Quantitative & Qualitative analysis	1.1 Importance of chemical analysis of metals and alloys, 1.2 Methods of quantitative analysis 1.3 Sampling of ores, metals, alloys and other metallurgical important products 1.4 Layout of chemical laboratory and equipments in chemical laboratory, 1.5 Important chemicals required in chemical laboratory 1.6 Quantitative & Qualitative analysis, 1.7 Errors in quantitative determination – their causes and remedies..	08
2 Gravimetric Analysis	1. State Requirements of precipitated and weighed form 2. Describe Filtration, Drying and Ignition of precipitate. 3. Illustrate Solubility product rule 4. Describe Co-Precipitation, Masking 5. Describe Salt effect 6. Justify effect of pH on completion of precipitation	2. 1 Gravimetric Analysis: Principle and Applications 2.2 Solubility product rule: statement and applications of solubility product 2.3 Requirements of precipitated and weighed form, 2.4 Effect of excess precipitant and temperature in gravimetric analysis 2.3 Salt effect, Effect of pH on completion of precipitation in gravimetric analysis 2.4 Importance of Co-Precipitation, Masking in gravimetric analysis 2.5 Steps in gravimetric analysis: Filtration, Drying and Ignition of precipitate.	08
3 Volumetric Analysis	1. Describe Volumetric Analysis of elements in metals and alloys 2. Define Normality of solution. 3. Justify different Indicators used for titrations 4. Illustrate Preparation of standard solutions 5. List Requirements of reactions in volumetric methods 6. Describe titration of oxidizing and reducing solutions.	3.1 Principle, Advantages of volumetric analysis. 3.2 Classification of methods of volumetric analysis , 3.3 Volume Measurement, 3.4 Requirements of reactions for volumetric analysis methods, 3.5 Normality of solution, Gram Equivalent –Definition and Importance 3.3 Steps for Preparation of standard solutions, 3.4 Indicators and their properties used for volumetric analysis 3.5 Titration of acid and alkaline solutions, titration curves, titration of oxidizing and reducing solutions.	11

4 Instrumental Methods	- Describe Strohlein Apparatus for determination Carbon & sulphur . - Describe Spectroscope - Describe Photocolorimetry - State the applications of spectrograph - Describe Electro gravimetric analyzer	- Spectroscope – principle, spectrograph and applications - Electro gravimetric analyzer – operation and application - Photocolorimetry - operation and application - Carbon & sulphur determination by combustion method – Strohlien apparatus instrument and operation	7
5 Fire-Assay Principle	- Describe Fire Assay - Describe standard solutions for fire assaying of different metals - Define Standard solutions - Determine Quantitatively percentage of – C, Si, S, P and Mn in steel, - Write steps for Preparation of standard solutions - Prepare standard solutions for various tests - Determine percentage of Cu and Zn in brass	- Fire Assay – Principle, - Methods of Silver and Gold determination from ores - Steps for Preparation of standard solutions for Fire-Assay - Quantitative determination of – - C, Si, S, P and Mn in steel, - Cu and Zn in brass	7
6 Analysis of Slags	- Classify Types of Slags in metallurgical industries - Describe Iron Blast furnace slag - Describe Evolution – Titration method for determination of sulphur - Describe Steel open Hearth furnace and its slag - Write steps to determine silica and alumina in Basic Open hearth Slag	- Iron Blast furnace slag Analysis : - Determination of silica - Determination of sulphur by Evolution –Titration method - Steel making slag Analysis - Basic Open Hearth Slag - Acid Open Heart slag - Determination of Silica and Alumina	7
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Draw Layout of chemical analysis Lab	Introduction	4
2	Prepare Standard solution for chemical analysis of metals and alloys	Volumetric Analysis	4
3	Determine Manganese by Sodium Bismuthate method		4
4	Phosphorus by ammonium phosphomolybdate methods		4
5	Quantitative determination of manganese in steel		4
6	Operate Strohlein Apparatus to determine Carbon and Sulphur in steel sample		8
7	Determine combined Carbon in iron or steel by Eggert's method		8
8	Determine S, in steel and cast iron by Evolution-titration method		8
9	Determine Silicon in plain carbon steel by Gravimetric method		6
10	Analysis of iron ore for determination of Fe		4
11	Determine of Cu & Zn in brass	Fire-Assay Principle	4
12	Determine Cu, Tin in bronze		4
Skill Assessment			02
Total			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	04(02)	08(00)	00(06)	12(08)
02	Gravimetric Analysis	02(04)	04(04)	06(00)	12(08)
03	Volumetric Analysis	02(02)	08(04)	06(06)	16(12)
04	Instrumental Methods	02(00)	06(04)	00(00)	10(04)
05	Fire-Assay Principle	02(0)	04(04)	06(00)	10(04)
06	Analysis of Slag	02(00)	08(04)	00(0)	10(04)
	Total	14(08)	38(20)	18 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	3	R	2	5/7
	1	R	2																
02	1	U	4	2	U	4	3	U	4	2	R	4	1	R	4				3/5
03	1	U	4	3	U	4	5	U	4	3	U	4	4	U	4				3/5
04	6	U	4	6	U	4	5	U	4	6	U	4	2	U	4				3/5
05	2	A	6	3	A	6	1	A	6										2/3
06	4	U	6	5	A	6	3	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		Questionnaires	1, 2, 3, 4,5,6
	End Of Course			End Of The Course				

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of equipment's, apparatus, solutions, writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
5	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	3	3	3	3	3	3	3	-	-
2	-	3	-	3	3	-	3	3	3	3	3	-
3	-	3	-	3	3	3	3	3	3	3	3	-
4	-	3	3	3	-	-	3	3	3	3	3	-
5	-	3	3	3	-	3	3	3	3	3	3	-
6	-	3	3	3	-	3	3	3	3	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Quantitative analysis	V. Alexeyev, MIR Publisher MOSCOW, 2 nd Edition, 2nd Printing of 1979	81-239-0293-X
2.	A Text Book of Metallurgical Analysis	B.C. Agarwal & S.P. Jain, Khanna Publishers, Fifth Edition, 2002	13: 978-8174091352

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=gR1ZULV3n5E> , assessed on 5th july 2016
- <https://www.youtube.com/watch?v=gzAgIijHyqI> , assessed on 5th july 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Test samples of metals and alloys
2. StrohleinApparatus
2. Analytical balance
3. Glass Beakers, pippets , burettes, glass rods etc
4. Hot plate
5. Muffle furnace (upto 1000 ° Celcius)

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT 409E
COURSE TITLE	: FOUNDRY TECHNOLOGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 04; TU: 00; PR: 02 (CLOCK HRS.)
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2CLOCK HRS
TH. TEE	: 03 HRS
PR. TEE	: 2HRS (External)
PT.	: 01 HR

❖ RATIONALE:

Foundry technology deals with the pattern making, core making, mould making and production of casting of various metals and alloys. It also includes post casting techniques, melting practices. In general, it includes the processes involved for making metal casting in details.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Sketch different metallurgical furnaces used in foundries.
2. Utilize various Moulds and Patterns for making castings
3. Estimate the charge materials for final casting products.
4. Perform various tests on moulding sand to find its suitability in foundry applications
5. Produce castings of different metals/alloys for various applications
6. Implement foundry tools and equipments for various foundry applications

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Pattern and Pattern Making	1. Classify manufacturing processes for production of various components 2. Illustrate layout of a Foundry 3. Justify the need of pattern allowances 4. Describe ISI coloring code on pattern 5. State the steps involved in pattern construction 6. Compare Pattern and castings 7. Enlist various application soft metal casting 8. State the steps involved in making a casting 9. Describe various sections of a foundry	1.1 Various manufacturing processes 1.2 Steps involved in Making a Casting. 1.3 Advantages of metal casting 1.4 Applications of Metal Casting 1.5 Different sections of a Foundry, types of foundry, Function of pattern, Difference between pattern and casting 1.6 Choice of Pattern materials, types of pattern materials. 1.7 Types of patterns 1.8 Pattern allowances 1.9 Steps involved in pattern layout and pattern construction 1.10 ISI coloring code on pattern 1.11 Core print fillet on pattern	14
2. Core and Core Making	1. State Function Core 2. Enlist applications of a Core in casting 3. State Core sand properties. 4. Describe Core making, & core baking machines 5. Describe Core prints 6. Describe procedure of core making 7. Describe machining operations on core	2.1 Function of core, core applications, 2.2 Core sand properties, Core sand ingredients 2.3 Core materials, core sand mixture, 2.4 Core making procedure, Types of core, Core prints 2.5 Core making machines, core baking and machining operations on cores. 2.6 Core shifting and Chaplet, Core applications 2.7 Construction of core box.	10
3. Mould and Mould Making	1. State Functions of mould 2. List types of Moulding sands 3. Describe Moulding sand properties 4. Describe various Sand control tests to obtain desired qualities in sand 5. Illustrate hand moulding tools in preparing of sand moulds 6. Describe Mould coat	3.1 Functions of mould 3.2 Mould materials-sand, binder, water, additives, etc 3.3 Types of Moulding sands and their Properties 3.4 Mould surface coating, Mould Coat Testing 3.5 Moulding sand preparation and conditioning – a. objectives of sand preparation b. Steps for sand preparation.	13

	testing 7. Illustrate methods of Ramming 8. State steps involved in mould making 9. Describe Mould-metal reaction 10. Describe Venting of molds	c. Working of sand Muller. 3.6 Sand reclamation 3.7 Sand control tests- a. Moisture content test b. Clay content test c. Grain fineness test d. Permeability test. e. Hot Strength test. 3.8 Moulding processes, Methods of ramming Moulding boxes 3.9 Steps involved in mould making, mould making machines, Moulding methods, hand Moulding tools 3.10 Types of mould, venting of moulds 3.11 Mould -metal reaction 3.12 Typical green and dry sand composition for Cast Iron and steel	
4. Solidification Of Castings, Gating And Riser	1. Describe proper gating system to obtain sound casting. 2. State function of each Component of the gating system 3. Estimate the Riser Efficiency for effective casting practice. 4. Enumerate Means to achieve directional solidification. 5. Describe methods to improve riser efficiency 6. Compare pressurized and unpressurized gating systems 7. State functions of Riser 8. Illustrate types of gates	4.1 Concept of solidification of metals, nucleation & growth, mechanism of Dendrite formation 4.2 Progressive and Directional solidification and control of solidification to obtain sound casting. Means to achieve directional solidification. 4.3 GATING system: - function of each component of the gating system. Types of gates, pressurized and unpressurized gating systems Elimination of slag and dross 4.4 RISER - Function of risers, types of riser, riser and directional solidification, increasing riser efficiency.	10
5. Melting Practice	1. Classify Furnaces for melting ferrous and non-ferrous metals. 2. Describe various operation of Cupola 3. Describe working principle, advantages, disadvantages of various furnaces used in metallurgical industries. 4. Describe zones of cupola 5. Estimate proper charge for	5.1 Furnaces for melting ferrous and non-ferrous metals 5.2 Cupola – Construction, Various operations, Zones of Cupola, Charge calculations, Numericals based on design of cupola 5.3 Electric Arc furnace- working principle, advantages ,disadvantages and applications 5.4 Induction furnace - working principle, advantages ,disadvantages and applications	10

	cupola operation 6. Describe Crucible furnaces 7. State principle of electric arc furnace and induction furnace 8. Sketch furnaces used in metallurgical industry	5.5 Crucible furnaces-types, working principle, advantages, disadvantages and applications	
6. Post Casting Treatments	1. List different post casting operations to get sound castings. 2. Describe Stress Relieving /Recrystallisation of castings 3. Describe Shot blasting & Sand blasting 4. Define Heat treatment 5. Describe operation of Tumbling Barrel	6.1 Heat treatment of Castings a Stress Relieving /Recrystallisation of castings 6.2 Post casting operations: a. Fettling b. Removal of cores c. Cleaning of casting surfaces d. Shot blasting e. Sand blasting f. Tumbling barrel 6.3 Finishing of castings	07
Total Hrs.			64

B LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Sketch various Foundry tools	Pattern and Pattern Making.	2
2	Draw various patterns		4
3	Construct various core boxes for making castings	Core And Core Making	2
4	Determine Moisture content in Moulding sand by Infra-red bulb method	Mould And Mould Making	2
5	Determine the amount of clay content in moulding sand..		2
6	Determine A.F.S. fineness No. of sand		4
7	Determine the permeability of the moulding sand..		2
8	Prepare any type mould for making casting.		2
9	Calculate the efficiency of the riser in casting process	Solidification Of Castings, Gating And Riser	4
10	Perform melting operation for Aluminium alloys	Melting Practice	6
Skill Assessment			2
Total			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Pattern And Pattern Making	02(00)	08(04)	06(06)	16(10)
02	Core And Core Making	02(02)	08(04)	00(00)	10(06)
03	Mould And Mould Making	02(04)	06(00)	06(06)	14(10)
04	Solidification Of Castings, Gating And Riser	02(02)	04(04)	06(00)	12(06)
05	Melting Practice	02(00)	08(04)	00(00)	10(04)
06	Post Casting Treatments	04(00)	04(04)	00(00)	08(04)
	Total	14(08)	38(20)	18 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	2	R	2	5/7
	4	R	2																
02	6	R	4	1	U	4	2	U	4	4	U	4	3	R	4				3/5
03	6	U	4	5	U	4	5	U	4	1	U	4	2	U	4				3/5
04	1	U	4	2	U	4	4	U	4	5	U	4	6	U	4				3/5
05	3	A	6	4	A	6	1	A	6										2/3
06	1	A	6	3	U	6	3	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ SCHEME OF PRACTICAL EVALUATION:

S.N.	Description	Max. Marks
1	Drawing diagram, selection of equipment's & tools. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:

❖ Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	3	3	3	3	3	3	-	-
2	-	3	-	-	3	3	3	3	3	3	-	-
3	-	3	-	3	3	3	3	3	3	3	3	3
4	-	3	2	3	3	3	3	3	3	3	3	3
5	-	3	2	3	3	3	3	3	3	3	3	3
6	-	3	2	3	3	3	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ REFERENCE & TEXT BOOKS:

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, 1996, January 2011	13: 978-8189928346
2.	Foundry Technology	D.B. Goyal & Sinha Standard Publishers Distributors, 1 st edition, 2002	8186308121, 9788186308127
3.	Principle of metal castings	R.W. Heine and P.C. Rosenthal McGraw Hill Education; 2 nd Edition, February 2001	13: 978-0070993488

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/112107144/13> , assessed on 28th June 2016
- <https://www.youtube.com/watch?v=qbUDYobvqvI>, assessed on 28th June 2016
- <https://www.youtube.com/watch?v=MoTKlQLdtTQ> , assessed on 28th June 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Various types of Patterns , sand, moulding machines, Foundry tools and equipments
2. Furnaces for melting of metals/alloys.(Induction, Electric arc)
3. Sieve shaker setup(Set of 50 Sieves IS specification)
4. Infra red bulb(1000Watt)& Rapid moisture Teller

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT410E ^s
COURSE TITLE	: SPECIAL CASTING TECHNIQUES
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 04TU:00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 05(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT	: 01 HR

❖ RATIONALE:

This course deals with precision castings and special castings of metals and alloys. The increasing demand for production of articles of intricate and complex shapes can be made with the implementation of various special casting processes. It also includes principle of gating and risering systems, general defects observed in casting, their causes and remedies. Emphasis is also given on the casting design and foundry mechanization.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Employ Special Casting Techniques for production of different casting
2. Design suitable casting for particular application
3. Analyze castings produced by any method of Special casting techniques.
4. Prepare mould of different shapes using various moulding techniques.
5. Draw the layout of mechanized foundry with different departments on sheet.
6. Identify defects and suggest remedial measures

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Introduction	1. List Special Casting Techniques 2. State the scope of foundry in India 3. Apply knowledge of casting techniques to produce different castings 4. Recommend special casting techniques for various applications	1.1 Special Casting Techniques – Importance, classification Present scenario of Foundry in India 1.2 Scope of foundry in India.	06
2 CO ₂ Moulding and Shell Moulding	1. Describe Shell Moulding process 2. Prepare moulds by Shell Moulding process 3. Produce castings by Investment Mould Casting process 4. Identify Defects observed in CO₂, shell Moulding, and investment casting 5. Suggest suitable remedial measures for defects occurred in castings 6. Apply gassing techniques in casting methods	2.1 CO₂ Moulding – Principle, operation, advantages, limitations, applications, Core, mould and mixture for CO₂ process, gassing techniques, fluid sand Moulding 2.2 Shell Moulding – Principle, steps involved for the production of casting, advantages, limitations, applications, production of resin coated sand, shell Moulding machines, 2.3 Defects observed in CO₂, shell Moulding, and investment casting	18
3 Investment Mould Casting & Centrifugal Casting	1. Describe Investment Mould Casting 2. State steps involved for the production of casting 3. Describe Slush casting technique 4. List applications of slush casting 5. Design castings for Slush casting technique 6. Select pattern materials for investment casting 7. Select proper metals and alloys for slush casting and investment casting techniques	3.1 Investment Mould Casting principle, 3.2 Types of pattern materials and their properties for investment moulds, 3.3 Steps involved for the production of casting, advantages, limitations, applications 3.4 Slush casting technique: casting process details, alloys used and Applications.	13
4 Gravity Die Casting,	1. Describe Gravity Die Casting	4.1 Gravity Die Casting – Permanent moulds, cores,	09

Pressure Die Casting, Slush Casting	2. Describe Pressure Die Casting method 3. Describe Centrifugal Casting process 4. Illustrate metal injection mechanism 5. Identify defects in castings and suggest remedial measures 6. Compare hot and cold chamber die casting. 7. Compare gravity die casting with sand casting 8. Describe gating system with each component of it.	gating system, process, casting design, casting alloys, comparison with sand casting technique, applications 4.2 Pressure Die Casting– Die casting machines, dies, die design, die material, 4.3 Metal Injection Mechanism - Hot Chamber & Cold Chamber Die-casting, advantages, limitations, applications 4.4 Centrifugal Casting – Principle, Methods – True centrifugal casting, Semi-centrifugal casting, Centrifuge casting 4.5 Defects observed in Die casting and centrifugal casting.	
5 Mould Design Casting Design And Casting Defects:	1. Describe gating and risering system for sound casting 2. State Chvorinov's rule 3. Identify defects, causes and remedial measures 4. Apply Cain's equation to calculate riser 5. Illustrate NRL method 6. Solve numerical based on Chvorinov's rule 7. Design components of gating systems	5.1 Sand mould design considering gating and risering principles 5.2 Casting design consideration. 5.3 Design features of each component of gating system. 5.4 Sand-casting design:- Introduction, casting design consideration, software packages for the design of casting and production of castings. 5.5 Riser calculation using Cain's equation and NRL method for simple casting. Numericals based on Chvorinov's equation 5.6 General Defects in casting: - classification, causes and remedies	09
6 Foundry Mechanization And Foundry Lay Out	1. Describe various moulding machines 2. Sketch different tools and equipments in foundry 3. Select proper tools and equipments in foundry 4. Design layout of mechanized and manual foundry. 5. Employ suitable dust extraction equipments in foundry	6.1 Moulding Machines – Functions, Type of Moulding machines , 6.2 Constructional details and working of Jolt-squeeze, pattern draw Moulding machines, sand slinger, material handling equipments in foundry 6.3 Dust control and dust extraction in foundries. 6.4 Foundry Mechanization -	09

	6. Recommend methods for dust control in foundry 7. Describe foundry mechanization 8. Classify moulding machines 9. Modify manual foundry for better production	Introduction, Mechanization, Layout of Manual Foundry and Mechanized foundry, Processing steps in mechanized foundry	
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Prepare one mould in moulding sand, silicate bonded sand, investment mixtures and produce castings by any special casting technique in laboratory by melting and pouring Aluminium,	Investment Mould Casting & Centrifugal Casting	10
2	Produce a simple casting by slush casting process OR Prepare a report on moulding processes and centrifugal casting and investment mould casting by observing a video CD		
3	Demonstrate Permanent Moulding process, centrifugal process and die casting process. OR Prepare a report Permanent Moulding process, centrifugal process and die casting process by observing a video CD	Gravity Die Casting, Pressure Die Casting, Slush Casting	8
4	Prepare visit report on die casting foundry and other foundries where above processes are employed OR Prepare a report on different casting processes by observing a video CD	Introduction	4
5	Identify various casting defects and suggest remedies	Mould Design Casting design And Casting defects	6
5	Draw Layout of Mechanized foundry	Foundry Mechanization And Foundry Lay Out	2
Skill Assessment			2
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	02(00)	04(04)	00(00)	06(04)
02	Co ₂ Moulding, Shell Moulding, Investment Mould Casting & Slush Casting	02(02)	12(04)	06(06)	20(12)
03	Gravity Die Casting, Pressure Die Casting, Centrifugal Casting	02(00)	06(08)	06(00)	14(08)
04	Mould Design	04(00)	00(00)	06(06)	10(06)
05	Casting Design And Casting Defects:	02(02)	08(04)	00(00)	10(06)
06	Foundry Mechanization And Foundry Lay Out	02(04)	08(00)	00(00)	10(04)
	Total	14(08)	38(20)	18 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	5	R	2	6	R	2	2	R	2	5/7
	5	R	2																
02	1	U	4	2	U	4	5	U	4	2	U	4	3	U	4				3/5
03	2	U	4	5	U	4	6	U	4	1	U	4	3	U	4				3/5
04	2	U	4	6	U	4	4	U	4	5	U	4	6	R	4				3/5
05	2	A	6	3	A	6	4	A	6										2/3
06	4	A	6	3	U	6	2	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of equipment's., materials, writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-	-	3	3	3	3	-	-
2	-	3	-	-	-	3	3	3	3	3	3	-
3	-	3	-	-	3	3	3	3	3	3	3	-
4	-	3	2	2	3	3	3	3	3	3	-	-
5	-	3	2	2	3	3	3	3	3	3	3	-
6	-	3	2	2	3	3	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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, 1996 Edition, January 2011	13: 978-8189928346
2.	Foundry Technology	D.B. Goyal & Sinha Standard Publishers Distributors, Paperback Edition, 2005	8186308121, 9788186308127
3.	Principle of metal castings	R.W. Heine and P.C. Rosenthal Mc Graw Hill Education; 2 nd Edition, February 2001	13: 978-0070993488

❖ **E-REFERENCES:**

- <http://www.nptel.ac.in/courses/112107084/> , assessed on 11th August, 2016
- <http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=112107083> , assessed on 11th August, 2016
- <https://www.youtube.com/watch?v=44R2IbzTvt4> , assessed on 11th August, 2016
- <https://www.youtube.com/watch?v=G5z9KknFs8&list=PLXpffcSh0aySqd1MX4NI68YyA4Nisui> , assessed on 11th August, 2016
- <https://www.youtube.com/watch?v=UrUsaGussfc> , assessed on 11th August, 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Gravity die casting machine
2. Shell moulding machine
3. Resin coated sand
4. CO₂ Moulding setup
5. Investment moulding setup

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

 (Member Secretary PBOS)

 (Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT411E
COURSE TITLE	: POWDER METALLURGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HRs.)
TH. TEE	: 03 HRs
PR. TEE	: 02 Hrs (Internal)
PT.	: 01 HR

❖ **RATIONALE:**

The demand for production of dimensionally accurate engineering components gave rise to the emergence of various metal processing techniques. Powder Metallurgy is one of such emerging technique. This course deals with the production of metal powders and manufacturing of finished products for special application. It also deals with the testing of metal powders.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Apply principles of Powder metallurgy for preparation of industrial products
2. Select suitable powder manufacturing methods
3. Recommend suitable metal powders various applications
4. Produce different metal powders by implementing manufacturing techniques
5. Carry out compaction and sintering of metal powders
6. Measure density of compacted and sintered product

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1 Introduction	1. State principles of various powder manufacturing processes 2. Classify powder manufacturing process 3. Compare manufacturing processes 4. List applications of powder metallurgy	1.1 Principle of process 1.2 Applications 1.3 Comparison with other manufacturing process 1.4 Advantages and limitations	04
2 Production Of Metal Powder	1. Enumerate powder manufacturing processes 2. Describe characteristics of different processes for powder manufacturing 3. Describe condensation methods of manufacturing powder 4. Describe atomisation methods of manufacturing powder 5. Describe electro-deposition methods of manufacturing powder 6. Describe sol-gel methods of manufacturing powder 7. Recommend suitable powder manufacturing process for required application	2.1. Classification of powder manufacturing methods 2.2 Various powder manufacturing processes with description and characteristics :- a. Machining, b. Crushing, c. Milling, d. Water and gas Atomization e. Condensation f. Thermal decomposition g. Reduction method, h. Electro deposition i. Sol – gel method	12
3 Characteristics And Testing Of Metal Powder	1. Identify different particle size 2. State the importance of particle size in powder metallurgy 3. Select suitable particle measurement techniques 4. Compare particle size of the powders produced from various methods 5. Illustrate various Particle characteristics 6. Define Green density and apparent density 7. Describe Elutriation	3.1 Particle size, and its importance 3.2 Particle size measurement techniques and Methods of analysis:- a. Sieving Method b. Sedimentation Method c. Elutriation Method, d. Fisher Sub-sieve Seizer 3.3 Particle characteristics:- Particle shape, Specific Surface, Apparent Density, Tap Density, Flow Rate, Green Density, Green Strength, Pressing Properties.	08

	method 8. Describe Analysis methods for powder produced by various techniques		
4 Powder Conditioning And Compaction	1. Identify different powder shaping techniques 2. State the role of lubrication in tooling system 3. Describe Compaction techniques of various powders 4. State the physical and micro structural properties of compacted product. 5. Describe powder conditioning 6. Classify powder compaction techniques 7. Describe the role of heat treatment in powder metallurgy	4.1 Powder Conditioning – Preliminary Heat Treatment, Blending Process 4.2 Powder Compaction – Classification, a) Pressureless shaping technique. b) Cold pressure shaping technique – Die compaction, Die compaction technique, Isostatic Pressing, Explosive Forming, Powder Rolling, Cycle Compacting, Powder Extrusion, c) Pressure shaping technique with heat – Hot pressing, hot isostatic pressing, Sinter forging, hot rolling. 4.3 Powder Compaction - Role of lubrication, Tooling System Presses	06
5 Sintering	1. Identify stages of sintering 2. Describe mechanism of sintering 3. Select suitable Sintering Furnaces 4. Enlist advantages and disadvantages of sintering 5. Describe Liquid phase sintering 6. State the importance of sintering atmosphere in powder production	5.1 Introduction, Stages of Sintering 5.2 Mechanism of Sintering, Liquid Phase Sintering, solid state sintering, spark sintering, activated sintering 5.3 Sintering Furnaces, Classification of Sintering Furnaces, Sintering Atmosphere 5.4 Advantages and disadvantages of sintering	11
6 Special Powder Metallurgical Materials	1. Identify proper material for making Bearings 2. Describe various Manufacturing method to produce magnetic materials and 3. Select methods to produce Tool material 4. State applications of Tool materials 5. Describe sintered friction materials	6.1 Bearing Materials – Types, Methods of production, Properties of Oil Impregnated Bearings 6.2 Sintered Friction Materials – Manufacturing method, Properties, Formulation, Applications 6.3 Production of magnetic materials 6.4 Tool Materials – Production, Application	07

	6. Describe oil impregnated bearings 7. Recommend suitable bearing Material for particular application.		
Total Hrs.			48

B LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Collect various metal powders and analyze its properties.	Introduction	04
2	Perform filling, grinding and machining operation for production of aluminium metal powder.	Production Of Metal Powder	04
3	Produce metal powders of different metals using various powder production processes		02
4	Determine Flow rate of metal powders	Characteristics And Testing Of Metal Powder	04
5	Determine Apparent density and tap density of metal powders		04
6	Determine size, shape and size distribution of metal powders		04
7	Perform Compaction of metal powder	Powder Conditioning And Compaction	04
8	Carry out Sintering of Compacts	Sintering	04
Skill Assessment			02
Total			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	02(02)	04(00)	00(00)	06(02)
02	Production of Metal Powder	04(02)	08(08)	06(00)	18(10)
03	Characteristics and testing of Metal Powder	02(00)	04(00)	06(06)	12(06)
04	Powder conditioning and compaction	02(00)	06(04)	00(00)	08(04)
05	Sintering	02(04)	08(08)	06(00)	16(12)
06	Special Powder Metallurgical Materials	02(00)	08(00)	00(06)	10(06)
	Total	14(08)	38(20)	18 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	3	R	2	4	R	2	5	R	2	6	R	2	1	R	2	5/7
	2	R	2																
02	1	U	4	2	R	4	3	U	4	4	U	4	5	U	4				3/5
03	2	U	4	5	U	4	5	U	4	2	U	4	5	U	4				3/5
04	2	U	4	6	U	4	6	U	4	5	R	4	2	U	4				3/5
05	2	A	6	3	A	6	6	A	6										2/3
06	4	U	6	5	A	6	3	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of equipment's. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	3	-	3	3	3	3	-	-
2	-	3	-	3	3	-	3	3	3	3	-	-
3	-	3	-	-	3	-	3	3	3	3	-	-
4	-	3	2	3	3	2	3	3	3	3	-	-
5	-	3	2	3	3	2	3	3	3	3	-	-
6	-	3	2	3	3	2	3	3	3	3	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Powder Metallurgy	A.K. Sinha, Dhanpat Rai Publications, tenth edition, 1988.	13:9789383182145
2.	Powder Metallurgy Technology Textbook	G. S. Upadhyaya Publisher: Cambridge International Science Publishing, January 1998	13: 978-1898326403
3.	Powder Metallurgy Science	Randall M. German Publisher: Metal Powder Industry; 2 nd Edition, March 1994	13: 978-1878954428
4.	Powder Metallurgy: Science, Technology And Applications	R. Subramanian, P. C. Angelo, PHI, March 2008	13: 978-8120332812

❖ **E-REFERENCES:**

<http://nptel.ac.in/courses/112107144/10> assessed on 28/06/2016

<https://www.youtube.com/watch?v=mUyzb1fzWKs> assessed on 28/06/2016

<https://www.youtube.com/watch?v=5VmeIunoyKw> assessed on 28/06/2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Various metals/metal oxide powders(50-100 gm each).
2. Standard Hall Flowmeter setup
3. Hydraulic Press
4. Furnace
5. Sieve Shaker Apparatus

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli.

(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT412E
COURSE TITLE	: MINERAL DRESSING
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HRs)
TH. TEE	: 03 HRs
PR. TEE	: 02 Hrs (Internal)
PT.	: 01 HR

❖ **RATIONALE:**

Preparation of ores and minerals are essential for efficient and economical extraction of metals. This course mainly deals with the economically viable beneficiation methods for important minerals available. Needs for proper ore dressing for particular type of ores are also highlighted.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

- 1 Apply the knowledge of various mineral and ore dressing methods for economical extraction of metals.
- 2 Apply communiton methods in mineral dressing
- 3 Draw flowsheet for ore beneficiation
- 4 Perform reduction of ore/mineral in Ball mill
- 5 Perform Magnetic separation of metals /alloys
- 6 Perform screening /sieving of dressed ore/metals

A. COURSE DETAILS:**THEORY:**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1 Introduction to Mineral Dressing;	1. Define Ores /minerals dressing 2. Draw flowsheet for ore beneficiation 3. State factors affecting ore beneficiation 4. Describe Ore beneficiation processes 5. Describe factors affecting ore beneficiation 6. Describe Status of mineral beneficiation industry in India	1.1 Ores, Minerals and their properties, necessity and advantages. 1.2 Mineral dressing.- definition, objectives, advantages 1.3 Ore dressing.- definition, objectives, advantages 1.4 Ore beneficiation 1.5 Recovery ratio of concentration 1.6 flow sheets for ore beneficiation 1.7 Factors affecting ore beneficiation 1.8 Status of mineral beneficiation industry in India 1.9 Study of some representative practices with flow sheets	04
2 Comminution Techniques	1. Identify Comminution methods 2. State laws of comminution. 3. Describe working of Ball mill. 4. Describe working of various Crushers 5. Describe working of various Mills 6. Select different Crushers and Milling machines used for reduction 7. Define reduction ratio 8. Compare crushing and grinding operations 9. Describe pulverisers 10. Select primary and secondary techniques of comminution	2.1 Classification of Comminution methods. 2.2 Primary and secondary techniques 2.3 Size reduction units: crushing and Grinding 2.4 Reduction ratio, laws of Comminution 2.5 Jaw crusher, Gyratory crusher, cone crusher - working principle, construction, advantages, disadvantages and applications. their comparison 2.6 Ball mill, Rod mill and pulveriser: working principle, construction advantages, disadvantages and applications. Their comparison	12
3 Screening, Sizing And Classification	1. Describe the role of thickener in mineral dressing operation 2. State applications of Thickeners 3. Describe screening Operations.	3.1 Principles units and performance of Screening, Sizing and Classification 3.2 Application and Role of Thickeners Hydro cyclones- Working and applications 3.3 Standards screening tests and	08

	- Describe Hydro- Cyclones - Employ standard screening tests - List different sizing techniques - Describe Classification methods	graphical representation of results	
4 Gravity Concentration Methods	- State principles of Jigging operations - State principles of tabling operations - Describe factors affecting Jigging operation & Tabling operation. - Describe controlling factors for Heavy media separation - Describe Heavy media separation mineral dressing. - Enlist applications Gravity Concentration Methods	- Jigging- principles controlling factors in operation and selective applications - Tabling- principles controlling factors in operation and selective applications - Heavy media separation- principles controlling factors in operation and selective applications	06
5 Froth Floatation	- Define floatability. - State role and application of Collectors in floatation process - Select Frothers in floatation process - State role and application of depressors, in floatation process - State role and application of activators and modifiers in floatation process. - Describe working of froth floatation units - State factors affecting froth floatation	- Natural and artificial floatability, - Collectors, Frothers, depressors, activators and modifiers- their types and role in floatation process. - Conditioning of process - Floatation units and variable affecting froth floatation. - Representative practices of sulphides non - sulphides and non-metallic ores	11
6 Magnetic And Electrostatic Separation	- Describe working of magnetic separator - Describe working Electrostatic separator - Compare magnetic Separator and Electrostatic separator. - Select suitable separators according to material. - Enlist applications of	- Magnetic separator: working Principles of magnetic separator, construction , operation advantages, disadvantages and applications. - Electrostatic separator: working Principles of magnetic separator, construction , operation , advantages,	07

	magnetic separator and Electrostatic separator	disadvantages and applications 6.3 Comparison of magnetic and electrostatic separation	
Total Hrs.			48

B LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Perform size reduction of ores in jaw crusher	Comminution Techniques	4
2	Perform size reduction of ores in Roll crusher		6
3	Perform size reduction of ores in Ball mill		6
4	Perform size reduction of ores Rod mill		4
5	Carry out Froth flotation process for settling of different particles and their separation.	Froth – Floatation Process	6
6	Categorize different sized particles obtained after tabbling and jigging operations.	Gravity Concentration Methods	4
Skill Assessment			02
Total			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction to mineral dressing	02(02)	04(00)	00(00)	06(02)
02	Comminution techniques	04(02)	08(08)	06(00)	18(10)
03	Screening, sizing and classification	02(00)	04(00)	06(06)	12(06)
04	Gravity concentration methods	02(00)	06(04)	00(00)	08(04)
05	Froth floatation	02(04)	08(08)	06(00)	16(12)
06	Magnetic and electrostatic separation	02(00)	08(00)	00(06)	10(06)
	Total	14(08)	38(20)	18 (12)	70 (40)

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	1	R	2	5/7
	2	R	2																
02	1	U	4	3	U	4	6	U	4	4	U	4	3	U	4				3/5
03	2	U	4	5	U	4	6	U	4	2	U	4	5	U	4				3/5
04	2	U	4	5	U	4	2	R	4	2	U	4	5	U	4				3/5
05	2	A	6	5	A	6	3	A	6										2/3
06	3	A	6	4	A	6	6	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION**

S.N.	Description	Max. Marks
1	Drawing diagram, selection of equipment's. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	3	1	-	3	3	3	-	3
2	-	3	-	-	3	-	-	3	3	3	-	3
3	-	3	3	-	-	-	-	3	3	3	-	3
4	-	3	3	2	3	-	2	3	3	3	-	3
5	-	3	3	2	3	-	2	3	3	3	-	3
6	-	3	3	2	3	-	2	3	3	3	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Elements of mineral dressing	A. M. Gaudin, McGraw-Hill Inc., US; First edition , 1939	978-0070230309
2.	Mineral Processing Paperback	S. K. Jain , 2 nd Edition, CBS Publisher & Distributors P Ltd; 2nd edition , 2012	978-8123907536
3.	Operational Handbook Of Mineral Processing	Vedula V. Ramana Murty , Denett, Paperback– 2014	978-8189904876

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/113104060/10> , assessed on 18th July 2016
- <https://www.youtube.com/watch?v=gyshydmnZMI> , assessed on 18th July 2016
- <https://www.youtube.com/watch?v=xmHE4gr7Bh0> , assessed on 18th July 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Jaw Crusher
2. Ball Mill
3. Magnetic Separator
4. Electrostatic Separator
5. Froth Flotation Unit

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT413E
COURSE TITLE	: METALLURGICAL QUALITY CONTROL
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 00 (CLOCK HRs.)
TOTAL CREDITS	: 03(1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT = 2CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: NIL
PT.	: 01 HR

❖ RATIONALE:

This course mainly deals with the topics of quality control, inspection quality assurance, concept of ISO-9000, which are essential for metallurgical student to know basics of these. Also materials management, total productive maintenance topics are dealt in details.

❖ COURSE OUTCOMES:

After completing this course students will –

1. Apply statistical Quality Control Methods in metallurgical industries..
2. Interpret Material Flow Charts.
3. Apply management concepts for procurement and managing the materials
4. Select Quality Control Methods specifically on shop floor in Metallurgical industries
5. Apply concept of ISO-9000 in Metallurgical Industries.
6. Identify the pillars of TPM.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Quality Control and Inspection:	1. Define mode, medium, frequency. 2. Describe different gauges for measurements. 3. Formulate ISI Specifications. 4. State principles of measurement 5. Describe various control charts	1.1. Statistics of quality control, Mode, Medium, Frequency distribution, Standard deviation, Normal distribution, Sampling techniques 1.2. Use of control charts and other statistical sampling tables 1.3. Principles of measurement, Vernier scales, Various types of gauges 1.4. I.S.I. specifications: formulation and importance	07
2. Quality Assurance:	1. Define quality and quality assurance system. 2. Describe independency of quality assurance department. 3. Describe the method to carry out calibration of equipments. 4. State the importance of retention of record. 5. Describe need of personal training..	2.1 Definition of Quality Assurance and Essentials of an effective Quality Assurance System. 2.2 Independence of Quality Assurance Department 2.3 Establishment of Quality Standards, written procedures, Control of document flow. 2.4 Maintaining identity and traceability of materials. Non-confirming material and corrective action, Calibration of equipment. 2.5 Retention of Records, Personnel training & qualification, Control of purchased material, Periodic audit.	08
3. Material Management:	1. Describe scope of material purchase department. 2. Define inventory and inventory control. 3. Draw store room layout. 4. Describe PPC. 5. State procedure for ordering materials.	3.1 Classes of materials. 3.2 Scope of material control 3.3 Scope of purchasing department. 3.4 Purchasing department. 3.5 Inventory control, Ordering procedures, Materials identifications, Physical inventory. 3.6 Store-room location, Layout and facilities. 3.7 Introduction to production, Planning and control	08

4. Quality Control Methods in Metallurgical Shops:	1. State different metallurgical tests. 2. Describe quality assurance for rolling and forging shops. 3. Describe quality assurance for steel melting shop. 4. Describe quality assurance for heat treatment shop. 5. Describe quality assurance for foundry shop.	4.1 Various steps involved in Quality Assurance in: a. Rolling Mill b. Steel Melting Shop c. Forging Shop d. Heat Treatment shop. e. Foundry shop 4.2 Metallurgical Evaluation Tests.	10
5. Concept of ISO:	1. Define ISO- 9000 2. Define TQM 3. Recommend appropriate ISO standards. 4. Describe procedural details of ISO- 9000 5. Distinguish between ISO- 9000 and ISO- 14000.	5.1 Definition of ISO-9000 and TQM 5.2 Various standards of ISO-9001, ISO-9002, ISO-9003, ISO-9004 5.3 Complete procedural details of ISO-9000 and various steps involved in it. 5.4 Introduction of ISO-14000 series	07
6. Total Productive Maintenance (TPM)	1. Define TPM 2. State objectives of TPM. 3. State types of maintenance. 4. Describe pillars of TPM. 5. Follow health safety rules. 6. Describe 5S.	6.1 Principle of TPM, Objectives of TPM 6.2 Types of maintenance, Steps of introduction of TPM in Organization. 6.3 Pillars of TPM – 5S, Autonomous Maintenance, Kaizen, Planned Maintenance, Quality Maintenance, Training, Office TPM, Safety Health and Maintenance	08
Total Hrs.			48

❖ LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:NIL

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
NIL			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Quality Control and Inspection	02(00)	08(06)	00(00)	10(06)
02	Quality Assurance	02(02)	04(04)	06(00)	12(06)
03	Material Management	02(04)	04(04)	06(00)	12(08)
04	Quality Control Methods in Metallurgical Shops	00(02)	08(00)	06(06)	14(08)
05	Concept of ISO	02(00)	08(00)	00(06)	10(06)
06	Total Productive Maintenance (TPM)	04(02)	04(00)	04(04)	12(06)
	Total	12(10)	36(14)	22(16)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	2	R	2	5/7
	6	R	2																
02	1	U	4	1	U	4	2	U	4	2	U	4	3	R	4				3/5
03	3	U	4	3	U	4	4	U	4	4	U	4	5	U	4				3/5
04	5	U	4	6	R	4	6	U	4	6	A	4	6	A	4				3/5
05	1	U	6	2	A	6	3	A	6										2/3
06	4	A	6	4	A	6	5	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	--	--	--	--
		Journal Writing		Continuous	--	--	--	--
				TOTAL	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:NIL**

S.N.	Description	Max. Marks
NIL		

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	3	3	3	3	3	-	3	3	3	-	-
2	-	3	-	-	3	3	-	3	-	3	-	-
3	3	3	3	3	3	3	3	3	3	3	-	-
4	-	3	3	3	3	3	3	3	3	3	1	-
5	-	3	3	-	3	3	3	3	3	3	-	-
6	3	3	-	-	3	3	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Testing of materials by	Prof. A.V.K. Suryanarayana.BS Publications, 2nd Edition, 2007	81-20300716-X
2.	The Testing & Inspection of Engineering materials,	H. E. Davis, G. E. Troxell, Mc Graw Hill, International student edition, 1982	81-7409-026-6
3.	Mechanical Metallurgy-	George Dieter, Mc Graw Hill, 3 edition , 1986	0-07-084453-4
4.	Handbook of Material Management	P. Gopalkrishnan ,Eastern economy edition, PHI Learning, 1993	8120307097, 978812030709
5.	ISO-9000 A family of standards	Seear, David John, Publisher : Authorhouse	13 : 9781477226407 10 : 1477226400

❖ **E-REFERENCES:**

- https://www.google.co.in/search?q=material+management&ie=utf-8&oe=utf-8&client=firefox-b&gfe_rd=cr&ei=uYSDV assessed on 11th July 2016-

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Charts
2. Models

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGINEERING
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT414E
COURSE TITLE	: METALLURGICAL WORKSHOP
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT.	: NIL

❖ **RATIONALE:**

A technician comes across the various problems in metallurgical industries. Also, at the work place, it is always necessary, to tackle the problem so that the sound metallurgical product can be obtained by application of suitable metallurgical engineering techniques. Hence, the basic knowledge of various industrial metallurgical practices is necessary for a technician. This course helps to impart the basic knowledge to technician for increasing the productivity and a sound metallurgical product.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Follow safety rules and regulations in different metallurgical workshop/labs.
2. Draw sketches of different tools/machines in metallurgical workshops/labs
3. Identify the tools and use them for preparing jobs.
4. Operate different equipments/machineries used in Metallurgical workshop/labs.
5. Select proper tool for different machines/equipments.
6. Prepare jobs on machine in metallurgical workshop.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Follow safety rules and regulation to be followed in metallurgical workshop.	Metallurgical tools	02
2.	Identify hand tools, machine Tools, measuring tools and draw their sketches and write specifications.		04
3.	Draw the sketch of power press and write specifications.	Power press	02
4.	Prepare one metallic job by performing various operations on power press .		08
5.	Draw the sketch of hydraulic press and write specifications.	Hydraulic press	02
6.	Prepare one metallic job by performing various operations on hydraulic press .		08
7.	Draw the sketch of spinning lathe and spinning tools and write specifications.	Spinning lathe	02
8.	Prepare one metallic job by performing various operations on spinning lathe		08
9.	Draw the sketch of shearing machine , write specifications and operate it to prepare job on metallic sheet.	Shearing machine	04
10.	Draw the sketch of lathe machine and machine tools and write specifications.	Lathe machine	02
11.	Prepare one metallic job by performing various operations on lathe machine .		08
12.	Draw the sketch of Draw bench machine and its tools/accessories and operate it to prepare wire.	Draw bench Wire drawing	04
12.	Draw the sketch of bull block machine and its tools/accessories and operate it to prepare metallic job		04
13.	Draw the sketch of Rolling mill and its tools/accessories and operate it to prepare metallic job	Rolling mill	04
Skill Assessment			02
Note -One job for batch of 3-4 students to be given.			
Total Hrs.			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:** Nil❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:** Nil

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	40	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	10	--	Journal	1, 2, 3, 4,5,6
				TOTAL	50	20		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics &Practical Answer Sheets	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagram/ selection of equipment's/ writing procedure etc.	10
2	Performance	10
3	Skill	10
4	Viva voce	20
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	3	3	-	3	3	3	3	3	3	-	-
2	3	3	3	3	-	-	-	3	3	3	-	-
3	3	3	3	-	3	-	-	3	3	3	-	-
4	3	3	3	3	3	3	3	3	-	3	-	-
5	3	3	3	3	3	3	3	3	-	3	-	-
6	3	3	3	3	3	3	3	3	3	3	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Mechanical Metallurgy	George Dieter, Ellwood Mc Graw Hill, 3 edition, 1986	0-07-084453-4
2	Metallurgical Processes	Campbell Mc Graw Hill, 3rd ed., 2000	81-7409-026-6
3	Handbook of Shaping and making of steel	Kurt lance, 5th Edition	0-07-084453-4
4	Engineering Metallurgy part II	Raymond a. Higgins, Mc Graw hill 6th edition, 1987	81-20300716-X

❖ **E-REFERENCES:**

- https://www.youtube.com/watch?v=IkFdJwW_0GI , assessed on 12th July 2016
- <https://www.youtube.com/watch?v=MZ7KdFUI-xI> , assessed on 12th July 2016
- <https://www.youtube.com/watch?v=fDSLWYHuj4g> , assessed on 12th July 2016
- <http://www.faadooengineers.com/threads/34234-Workshop-Technology-vol-2-by-hajara-choudhari> , assessed on 12th July 2016.

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Power press
2. Hydraulic press
3. Draw bench
4. Rolling mill
5. Shearing machine
6. Lathe machine/ Spinning lathe
7. Machine tools.
8. Bull block machine
9. Grinder

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L.Meshram	HOD, Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	V.C. Humney	Lecturer, Metallurgical Engineering	Government Polytechnic, Nagpur.
3.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
4.	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
5.	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALURGICAL ENGINEERING
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: ME415E
COURSE TITLE	: COMPUTER AIDED DRAWING
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04 (CLOCK HRS.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 Hrs (Internal)
PT.	: NIL

❖ RATIONALE:

Now a day a manual drafting is obsolete in industry. Computers being the inevitable part in an engineer's life due to its inbuilt characteristics which helps him to do various task with acceleration. Using computers and Computer Aided Drafting (CAD) software it is easy to create and modify a drawing which ultimately saves time. It also may be useful to generate assembly and manufacturing drawings. CAD is widely popular drafting CAD software.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Create, save CAD drawing files & modify particular drawing
2. Adapt use of drafting set-up
3. Modify 2D and isometric drawing
4. Integrate layers and blocks in drawing
5. Develop customized drawing template
6. Accomplish proper layout and printing

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practi - cals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify and locate components of CAD classic screen by creating new drawing. Practical includes: - CAD screen layout, drawing area, menu and toolbars, status bar - Working with toolbar and commands, changing drawing limits, creating rectangle etc. saving drawing for first time	CAD Basics	4
2	Draw a line diagram using absolute coordinate method. Use LIMITS, UNITS, LINE, ARC Commands Practical includes: - Absolute coordinate method - Drafting set-up: units, angle, area, coordinate system, limits, grid, object snap - Creating two dimensional drawings using draw commands- line & arc	Drawing in Two Dimensions	6
3	Draw a line diagram using relative coordinate and relative polar coordinate method. Use LIMITS, UNITS, LINE, ARC, Commands Practical includes: - Relative coordinate and relative polar coordinate method - Drafting set-up: units, angle, area, coordinate system, limits, grid, object snap - Creating two dimensional drawings using draw commands- line & arc	Drawing in Two Dimensions	6
4	Draw a 2D figure using Draw and Modify commands. Use LINE, CIRCLE, OFFSET, TRIM, FILLET commands. Practical includes: - Creating two dimensional drawings using draw commands- line & circle - Modifying two dimensional drawings using modify commands- offset, trim, fillet	Drawing in Two Dimensions & Modifying the Drawing	6
5	Draw a 2D figure using Draw and Modify commands. Use LINE, ARC, POLYGON, ELLIPSE, COPY, MIRROR, TRIM, ROTATE, CHAMFER commands. Practical includes:	Drawing in Two Dimensions & Modifying the Drawing	6

	- Creating two dimensional drawings using draw commands- line, arc, polygon, ellipse - Modifying two dimensional drawings using modify commands- copy, mirror, trim, rotate, chamfer		
6	Draw 2D drawing of mechanical component using required commands. (any one component like gear, pulley, bearing etc. may be selected) Practical includes: Creating 2D drawing using draw commands- line, circle, arc, offset, copy, mirror, trim, extend, rotate, polygon, ellipse, array	Drawing in Two Dimensions & Modifying the Drawing	6
7	Dimensioning the object. Open the previously saved file and dimension the lines, arc, circle, polygon etc. Practical includes: - Dimensioning the object using Annotate - Dimension- linear, aligned, angular, arclength, radius, diameter - Tolerance, leader, dim center, dimedit, dimoverride - Dimension style manager	Dimensioning, Layout and Printing	8
8	Plot the drawing from model space and printing it. Practical includes: - Plot- print a drawing to a plotter, printer or file - Batch plot- file can be plotted as DWF, DWFx, or PDF or to a plotter - Preview, page setup manager	Dimensioning, Layout and Printing	4
9	Draw isometric drawing of mechanical component. Use LIMITS, UNITS, ZOOM, GRID, SNAP, LINE, COPY, ISOPLANE, ELLIPSE, TRIM, ERASE, PROPERTIES, SAVE Commands Practical includes: - Drafting set-up: units, limits, zoom, grid, object snap, ortho mode - Snap and grid- snap spacing, grid spacing, isometric snap type	Isometric Drawing	8
10	Create the customized template, draw title block using LAYER, RECTANGLE, EXPLODE, TEXT, AND COPY Commands. Practical includes: - Creating new drawing with template - Use of layer, rectangle, explode, text, and copy command - Command sequence- limits, zoom, layer, colour, rectangle, explode, layer, set grid. Line, copy, line, layer, set, dtext, scale, layer, off, grid	Drawing Organization and information	8
Skill Assessment			02
Total Hrs.			64

- ❖ **SPECIFICATION TABLE FOR THEORY PAPER: Nil**
- ❖ **QUESTION PAPER PROFILE FOR THEORY PAPER: Nil**

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	40	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	10	--	Journal	1, 2, 3, 4,5,6
				TOTAL	50	20		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics &Practical Answer Sheets	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Using drafting set up /aids	10
2	Drawing diagrams of 2D or isometric given figure	20
3	Dimensioning figure	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	3	3	3	--	--	1	2	2	3	--	--
2	3	3	3	3	--	--	1	2	--	3	--	--
3	3	3	3	3	--	--	--	--	--	3	--	--
4	3	3	3	3	--	--	--	--	2	3	--	--
5	3	3	3	3	--	--	--	2	2	3	--	--
6	3	3	3	--	--	--	--	2	2	3	--	--

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	AutoCAD 2002 Bible	Ellen Finkelstein, IDG Books India(P) Ltd., First, 2001	81-265-0233-9
2.	AutoCAD 2016 and AutoCAD LT 2016	Donnie Gladfelter, John Wiley & Sons. Inc. Indiana, First, 2016	978-1-119-05955-4
3.	AUTOCAD IN 3D	Frank J. Johnson, McGraw Hill Inc., New Delhi, First, 1992	0-07-112653-8
4.	Mastering AutoCAD 13	George Omura, BPB Publication, New Delhi, First, 1997	81-7029-785-0
5.	Engineering Drawing	N.D.Bhatt, Charotaar Publishing House Pvt. Ltd., Anand, Gujrat, 51, 2012	978-93-80358-55-0
6.	A text book of Engineering Drawing	P.J.Shah, S.Chand & Co.Ltd., New Delhi, First, 2008	81-219-2964-4
7.	Engineering Drawing with introduction to AutoCAD	Dhananjay A Jolhe, Tata McGraw-Hill Co. Ltd., New Delhi, 2 nd , 2008	978-0-07-064837-1
8.	AutoCAD 2016 exercise workbook for windows	Cheryl R. Shrock & Steve Heather, Industrial Press Inc. South Norwalk, USA, First, 2016	978-0-8311-3518-8

❖ **E-REFERENCES:**

- http://www.mycadsite.com/tutorials/level_3/isometric-drawing-in-autocad-3-2.htm, assessed on 27th June, 2016
- <http://www.cadlearning.com/courses/autocad-mechanical-training-tutorials/>, assessed on 27th June, 2016
- <http://www.staff.city.ac.uk/~ra600/ME1105/Tutorials/CAD-1/Tutorial%20CAD-1a.pdf>, assessed on 28th June, 2016
- https://www.youtube.com/watch?v=yruPUj_61bw, assessed on 29th June, 2016
- <https://www.youtube.com/watch?v=Nv8skZZcUlw>, assessed on 29th June, 2016
- <https://www.youtube.com/watch?v=Lz6piHIBn7g>, assessed on 30th June, 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. CPU with Intel (R) Core (TM) i3 processor or higher latest version
2. A color monitor with highest 32 bit/ 64 bit color display and with screen resolution 1024 by 768 pixels.
3. A scroll mouse.
4. Laser printer
5. Windows 7 operating system or latest operating system
6. Any one open source CAD software at AICTE website

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	G.H.Dahole	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
2.	Dr. V.M.Athawale	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
3.	K.S.Thekedar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
4.	Er. A.M.Onkar	Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
5.	Shri. G.F.Potbhare	Principal	NIT, Polytechnic, Nagpur
6.	Dr.S.S.Baraskar	Lecturer in Mechanical Engineering	Govt. Polytechnic, Arvi

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: MT 415E ^s
COURSE TITLE	: METALLURGICAL DESIGN AND DRAWING
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04 (CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (External)
PT.	: NIL

❖ RATIONALE:

This course deals with the metallurgical design aspects in various sections such as heat treatment, foundry, metal working, welding & joining and powder metallurgy in a metallurgical industry

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Develop proper Metallurgical Design.
2. Prepare drawings as per Computed Design.
3. Draw sketches of different tools/machines in metallurgical workshops/labs
4. Develop different components of machines/equipments used in metallurgical industries
5. Design proper tools for different machines/equipments.
6. Design jobs for various components/parts of required application metallurgical industries

❖ **COURSE DETAILS:****A. THEORY : NIL**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Design fixtures for heat treatment.	Heat treatment	04
2	Design heating elements for furnaces.		04
3	Design Heat treatment cycle for any one steel/alloy steel parts		08
4	Design types of patterns, gating and risering for a cast component.	Foundry Technology	04
5	Draw Die and mould design for a casting		04
6	Design and Drawing of Cupola furnace. Charge calculation for cupola.		06
7	Design and draw Foundry layout/Ferrous Mechanized foundry/Non Ferrous jobbing foundry		06
8	Design forging die and forge shop lay-out	Metal Working	04
9	Draw different rolling mills Calculate rolling mill passes and sequence		02
10	Calculate wire drawing passes and power required etc.		02
11	Draw dies used for Extrusion.		02
12	Draw different types of weld Joints, symbols, equipments and accessories	Welding Technology	04
13	Draw different welding proceses		02
14	Design and draw different dies and punches for compaction.	Powder Metallurgy	02
15	Draw powder production and pressing techniques		02
16	Draw Froth flotation unit.	Mineral Dressing	02
17	Draw Jaw crushers and Ball mills used for size reductions		02
Skill Assessment			02
Total Hrs.			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:** Nil❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:** Nil

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	40	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	10	--	Journal	1, 2, 3, 4,5,6
				TOTAL	50	20		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics &Practical Answer Sheets	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION**

S.N.	Description	Max. Marks
1	Drawing diagram/ selection of equipment's/ writing procedure etc.	10
2	Performance	20
3	Calculation/Result/ Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	3	3	3	3	3	3	3	3	3	3	-	-
2	3	3	3	3	3	3	3	3	3	3	-	-
3	3	3	3	3	3	3	3	3	3	3	-	-
4	3	3	3	3	3	3	3	3	3	3	-	-
5	3	3	3	3	3	3	3	3	3	3	-	-
6	3	3	3	3	3	3	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Powder Metallurgy	A.K. Sinha, Dhanpat Rai Publications	1234567144050
2.	Mechanical Metallurgy	George Dieter. Mc Graw Hill, 3rd Edition, 2013	9781259064791, 1259064794
3.	A Text Book of Foundry Technology	O.P. Khanna, Dhanpat Rai , Publications, 1996 edition, 2011	13: 978-8189928346
4.	Operational Handbook Of Mineral Processing	Vedula V. Ramana Murty , Denett, Paperback– 2014	978-8189904876

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=N7xEITudwdc> , assessed on 19th July, 2016
- https://www.youtube.com/watch?v=yMQSrwtg_gQ , assessed on 19th July, 2016
- <https://www.youtube.com/watch?v=5aCvxlulDyI> , assessed on 19th July, 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Power press
2. Hydraulic press
3. Heat treatment furnaces (Muffle furnace, Pit furnace, Induction furnace)
4. Rolling mill(Two high ,Three High,)
5. Moulding machines
6. Foundry tools.
7. Patterns, runners ,risers, and gating system
8. Crushers/Grinding equipments

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN
LEVEL NAME : PROFESSIONAL COURSES
COURSE CODE : MT 416E^s
COURSE TITLE : INDUSTRIAL PROJECT
PREREQUISITE : NIL
TEACHING SCHEME : TH: 00; TU: 00; PR: 04 (CLOCK Hrs.)
TOTAL CREDITS : 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE : NIL
PR. TEE : 02 HRs (External)
PT. : NIL

❖ RATIONALE:

Industrial project course is the manifestation of technical knowledge acquired by the student during their course of work. This course provides an opportunity to the students to identify and solve real life problem of the industries /research organization / society. Students also get opportunity to provide innovative, economic and technological viable solution to the world of work.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

- 1 Carryout market survey /Literature survey
- 2 Select project and Prepare planning
- 3 Perform project work in group
- 4 Test project work
- 5 Prepare project report
- 6 Present project work

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Perform introductory Task - Form project batch of four-five students - Select project as per area of interest - Select topic / industrial problem / work by consulting the guide from following list: - Physical Metallurgy - Heat Treatment - Mechanical Working - Foundry Technology - Powder Metallurgy - Steel and iron making - Welding technology - Mineral dressing - Testing and Quality control - Interdisciplinary - Any recent development/advancement in any metallurgical field. Perform Literature Survey - Refer various Periodicals, Journals, Books, Internet literature related to project topic - Note down findings - Prepare database of collected literature on the basis of title, area of work, methodology used, type of work - Analyze industrial need - Prepare brief report	Introductory Task and Literature Survey	12
2	Plan project - Prepare Synopsis in standard format which includes following. Title Page: Project Title, Purpose of submission, Institute logo, Students Name, Guide Name, Department and Institute Name - Use Latex for preparing synopsis. - Submit the Synopsis to guide. - Approve synopsis from guide - Prepare action plan of project activities - Submit the action plan to guide. - Approve action plan from guide	Planning	8
3	Perform Project work - Design the project - Draw the project - Select materials - Estimating and costing - Fabricate the project	Project Work	16

4	Test Project work	Testing	12
5	Prepare project report in standard format, which includes following. - Title Page which includes: Project Title, Purpose of submission, Institute logo, Students Name, Guide Name, Department and Institute Name - Certificates: Student declaration, Certificate from guide - Acknowledgement - Table of contents - List of Tables - List of Figures - List of abbreviations and acronyms (if any) - Text 1. Introduction, objectives 2. Literature Survey 3. Methodology/Materials/Methods/Estimate. 4. Results 5. Summary/Conclusion. 6. References Use Latex for preparing report. Perform plagiarism check from free internet site. - Submit report of plagiarism check to the guide with project report	Project Writing	6
6	Present project work - Prepare power point presentation of work done. - Prepare yourself to handle examiner questions after presentation. - Practice group presentation. - Present before guide.	Presentation	6
Skill Assessment			4
Total Hrs.			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Not Applicable

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Not Applicable

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	40	--	Project Report and work done	1.2,3,4,5,6
		Journal Writing		Continuous	10	--	Project Report and work done	1.2,3,4,5,6
				TOTAL	50	20		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	100	40	Project Report and work done	1.2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of topic	10
2	Literature survey	10
3	Project planning and implementation	10
4	Work done, Feasibility of work, Results	50
5	Report writing	10
6	Presentation of work and viva voce	10
Total		100

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	3	2	3	3	-	3	-	-
2	3	3	-	3	3	2	3	3	-	3	2	-
3	3	3	3	3	3	2	3	3	3	3	-	-
4	3	3	3	3	3	2	3	3	3	3	2	-
5	3	3	-	3	3	-	3	3	3	3	-	-
6	3	3	3	3	3	-	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Principles of metal castings	Dr. P.C. Mukharjee	81-20300716-X
2.	Foundry Engineering	Shrinivasan	81-7409-026-6
3.	Introduction to Physical Metallurgy	Sidney H. Avner McGraw-Hill international edition, 2 nd edition	0-07-085018-6
4	Testing of materials	Prof. A.V.K. Suryanarayana.	81-20300716-X
5	The Testing & Inspection of Engineering materials,	H. E. Davis, G. E. Troxell Mc Graw Hil	81-7409-026-6

6	Mechanical Metallurgy	George Dieter. Mc Graw Hil,	0-07-084453-4
7	Heat treatment Principles and techniques	T.V. Rajan , C.P. Sharma, Prentice Hall of india pvt ltd, 12 th edition	81-20300716-X

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=98lh5Q0M0cg>, assessed on 11July 2016
- https://www.youtube.com/watch?v=3_BH6HqpPtk, assessed on 11July 2016
- https://www.youtube.com/watch?v=IkFdJwW_0GI, assessed on 12th July 2016
- <https://www.youtube.com/watch?v=MZ7KdFUI-xI>, assessed on 12th July 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Patterns- sweep pattern,
2. Foundry tools
3. Welding Transformer (Oil Cooled) Three Phase
4. Mould boxes- standard lab size
5. Crucibles- graphite
6. Muffle furnace- 1000⁰c max temperature, box type
7. Draw bench-
8. Rolling mill-two high rolling mill
9. Polishing machine- rotating disc, cloth polished
10. Hardness tester- Rockwell c
11. Microscopes- 100x magnification
12. NDTs equipments- Dye penetrant, ultrasonic flaw detector, magnetic particle test

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L.Meshram	HOD, Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	V.C. Humney	Lecturer in Metallurgical Engineering	Government Polytechnic, Nagpur.
3.	Dr. S.W.Rajurkar	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.
4.	Mr. G.V.Gotmare	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN CE/ME/EE/EC/CM/IT/AE/MT/PK/TX

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : SE401E

COURSE TITLE : SEMINAR

PREREQUISITE : 60 Credits

TEACHING SCHEME: TH:00; TU:00;PR: 02(CLOCK Hrs.)

TOTAL CREDITS : 01(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)

TH. TEE EXAM : NIL

PR. TEE EXAM : 02 HRs (Internal)

PT. EXAM : NIL

❖ **RATIONALE:**

Seminar course is the manifestation of soft skills acquired by the student during their course of work. This course provides an opportunity to develop and present their own technical knowledge, communication skills, presentation skills, self-learning abilities, creativity, and team working abilities. This course will also enable them to gain confidence to face the world of work.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

- 1 Select seminar topic
- 2 Carryout Literature survey
- 3 Prepare planning
- 4 Prepare seminar report
- 5 Prepare seminar presentation
- 6 Present interpersonal skills, presenting skills, soft skills and creativity.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Perform introductory Task - Select seminar topic individually as per area of interest - Select recent technical topic, not covered in curriculum, by consulting the guide.	Topic Selection	2
2	Perform Literature Survey - Refer various Periodicals, Journals, Books, Internet literature related to seminar topic - Note down findings - Prepare brief report	Literature Survey	6
3	Plan Seminar - Prepare outline of selected seminar topic in standard format - Approve seminar topic from guide - Prepare action plan of work - Submit the action plan to guide. - Approve action plan from guide	Planning	2
4	Prepare seminar report in standard format, which includes following. - Title Page which includes: Seminar Title, Purpose of submission, Institute logo, Students Name, Guide Name, Department and Institute Name - Certificates: Student declaration, Certificate from guide - Acknowledgement - Text - Introduction - Literature Survey - Methodology/Materials/Methods - Results - Summary/Conclusion. - References Use Latex for preparing report. Perform plagiarism check from free internet site. - Submit report of plagiarism check to the guide with seminar report	Report Writing	12
5	Prepare power point presentation Prepare yourself to handle audience / examiner questions after presentation. Practice presentation before group of students	Preparation	08
6	Present before guide Present before assessment panel.	Presentation	02
Total Hrs.			32

- ❖ **SPECIFICATION TABLE FOR THEORY PAPER:** Not Applicable
- ❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:** Not Applicable
- ❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	40	--	Rubrics, Assessment Sheets & Seminar Report	1,2,3,4,5,6
		Report Writing		Continuous	10	--	Seminar Report	1,2,3,4,5,6
				TOTAL	50	20		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics, Seminar Report & Presentation	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of topic	05
2	Literature survey	05
3	Project planning and implementation, Work done, Feasibility of work	05
4	Report writing	05
5	Presentation Skills	25
6	Viva voce	05
Total		50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)										PSO	PSO
	1	2	3	4	5	6	7	8	9	10	1	2
1	–	3	–	–	–	–	–	3	3	–	–	–
2	–	3	3	3	–	–	3	3	3	3	–	–
3	–	3	3	3	–	–	3	3	3	3	–	–
4	–	3	3	3	–	–	3	3	3	3	–	–
5	–	3	3	3	–	–	3	3	3	3	–	–
6	–	–	–	–	–	–	–	3	3	3	–	–

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience	Carmin Gallo, McGraw-Hill Education, 1 st Edition, October 2009	10: 0071636080 13: 978-0071636087
2.	Speaking Your Mind: Oral Presentation and Seminar Skills	Rebecca Stott, Tory Young, Cordelia Bryan, Longman, 2001	0582382432, 9780582382435
3.	How to Design TED-Worthy Presentation Slides: Presentation Design Principles from the Best TED Talks	Akash Karia, Create Space Independent Publishing Platform, 3 rd Edition, February 2015	10: 1507638124 13: 978-1507638125
4.	Presenting with Credibility: Practical Tools and Techniques for Effective Presentations	Bruna Martinuzzi, Six Seconds Emotional Intelligence Press, Kindle Edition, April 2012	978-1-935667-12-4

❖ **E-REFERENCES:**

- http://www.prepareforsuccess.org.uk/skills_for_presenting_in_seminars.html , accessed on 5th November, 2016
- <http://www.che.iitb.ac.in/faculty/jb/courses/seminar/tips.html> , accessed on 5th November, 2016
- <https://www.youtube.com/watch?v=dEDcc0aCjaA> , accessed on 5th November, 2016
- <https://www.youtube.com/watch?v=V2q7Q2j7ESs> , accessed on 5th November, 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. DLP Projector, latest specification
2. Computer, latest specification

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr. S. W. Rajurkar	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.
2.	Mr. G. V. Gotmare	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/CM/IT/AE/MT/PK/TX
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: ID401E
COURSE TITLE	: INDUSTRIAL TRAINING
PREREQUISITE	: 70 Credits
TEACHING SCHEME:	TH: 00; TU: 00; PR: 02(CLOCK Hrs.)
TOTAL CREDITS	: 01(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT. EXAM	: NIL

❖ RATIONALE:

The aim of the polytechnic education is to create a pool of skill based manpower to support shop floor and field operations as a middle level link between technicians and engineers. Diploma pass out plays an important role in managing shop-floor operations. Therefore, it is necessary to the diploma pass out to get acquainted with the actual shop floor operations in the industry. This course has been designed to give actual working environment exposure to the diploma students.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

- 1 Adhere industrial safety practices
- 2 Work in industrial working environment.
- 3 Carry out survey related to industrial processes.
- 4 Identify industrial problems for industrial Project Course
- 5 Prepare industrial training report based on work experience
- 6 Present report

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Adhere Industrial Safety Practices - Talk to safety officer - Record the safety practices to be followed in industry. - Record Don'ts and Do's. - Follow all instructions.	Safety Practices	04
2	Perform Industrial Process Survey - Collect information regarding various processes carried out in an industry by discussing the allotted supervisor/officer - Note down findings - Prepare brief report	Survey	06
3	Work in industrial working environment - Follow instructions of supervisor - Observe industrial processes - Record daily work done in diary	Working Experiences	18
4	Identify industrial problems - Discuss with the supervisor and workers - Identify the problem in any of the industrial process/system - Record your findings	Problem Identification	04
5	Prepare industrial training report in standard format, which includes following. - Title Page which includes: Title, Purpose of submission, Institute logo, Students Name, Industry Name, Department and Institute Name - Certificates: Student declaration, Certificate from industry - Acknowledgement - Text - Introduction to Industry - Safety Practices in Industry - Industrial Process - Working Experience - Results - Summary/Conclusion. - References Use Latex for preparing report. Perform plagiarism check from free internet site. - Submit report of plagiarism check to the allotted teacher with industrial training report	Report Writing	After Completion of Training
6	Prepare power point presentation Present before panel of teachers.	Presentation	
Total Hrs.			32

- ❖ **SPECIFICATION TABLE FOR THEORY PAPER:** Not Applicable
- ❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:** Not Applicable
- ❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	40	--	Rubrics, Assessment Sheets & Report	1,2,3,4,5,6
		Report Writing		Continuous	10	--	Report	1,2,3,4,5,6
				TOTAL	50	20		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics, Report & Presentation	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of industry/ industry supervisor's remark	05
2	Survey	05
3	Work done and Feasibility of work/ problem identified	15
4	Report writing	15
5	Presentation Skills	05
6	Viva voce	05
Total		50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	2	2	2	-	-	3	3	3	-	-
2	-	3	2	2	2	-	-	3	3	3	-	-
3	-	3	-	-	-	-	-	3	3	3	-	-
4	-	3	-	-	-	-	3	3	3	3	-	-
5	-	3	-	-	-	-	3	3	3	3	-	-
6	-	3	-	-	-	-	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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

❖ **E-REFERENCES:**

- <http://ihmshimla.org/wp-content/uploads/2013/05/Industrial-Training-Rule-Book.pdf>, assessed on 25th September, 2016

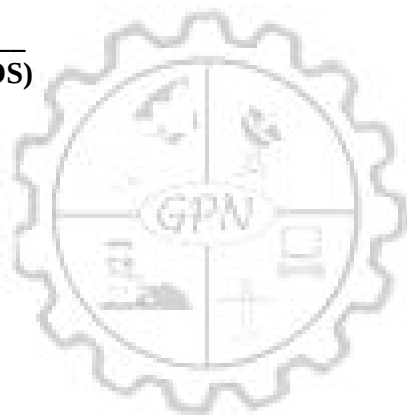
❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

- DLP Projector, latest specification
- Computer, latest specification

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr. S. W. Rajurkar	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.
2.	Mr. G. V. Gotmare	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.

(Member Secretary PBOS)



(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/CM/IT/AE/MT/PK/TX
LEVEL NAME	: PROFESSIONAL COURSES
COURSE CODE	: ID402E
COURSE TITLE	: INDUSTRIAL PRACTICES
PREREQUISITE	: 70 Credits
TEACHING SCHEME	: TH:00; TU:00;PR: 02(CLOCK Hrs.)
TOTAL CREDITS	: 01(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: NIL
PR. TEE EXAM	: 02 HRs (Internal)
PT. EXAM	: NIL

❖ RATIONALE:

The aim of the polytechnic education is to create a pool of skill based manpower to support Construction site and field operations as a middle level link between technicians and engineers. Diploma pass out plays an important role in managing Construction site operations Therefore, it is necessary to the diploma pass out to get acquainted with the actual Construction site operations in the Construction industry. This course has been designed as an optional course to industrial training to give actual working environment exposure to the diploma students, through virtual industry in class room.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

- 1 Visit industries.
- 2 Get acquainted with industrial safety practices through videos and industrial experts.
- 3 Carry out survey related to industrial processes.
- 4 Explore industrial working environment through videos and industrial experts.
- 5 Identify industrial problems for industrial Project Course discussing with industrial experts.
- 6 Prepare and present report based on virtual industrial exposure and industrial visit.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Visit any two industries related to program. Small scale, medium scale, large scale and perform task given in following point 2 to 5.	Industrial Visits	18
2	Get acquainted with industrial safety practices - Observe Video and listen industrial experts - Talk to industrial experts - Record the safety practices to be followed in industry. - Record Don'ts and Do's.	Safety Practices	02
3	Carryout survey related to industrial processes - Observe Video and listen industrial experts - Collect information by discussing with industrial experts - Note down findings - Prepare brief report	Survey	02
4	Explore industrial working environment - Observe Video and listen industrial experts - Observe industrial processes - Note down findings	Working Experiences	08
5	Identify industrial problems - Discuss with industrial experts - Identify the problem in any the industrial process/system - Record your findings	Problem Identification	02
6	Prepare and present report in standard format, which includes following. - Title Page which includes: Title, Purpose of submission, Institute logo, Students Name, Industry Names, Department and Institute Name - Certificates: Student declaration - Acknowledgement - Text - Introduction to Industry - Safety Practices in Industry - Industrial Process - Results - Summary/Conclusion. - References Use Latex for preparing report. Perform plagiarism check from free internet site. - Submit report of plagiarism check to the allotted teacher with industrial training report	Report Writing	Home Assignment
6	Prepare power point presentation Present before panel of teachers.	Presentation	
Total Hrs.			32

- ❖ SPECIFICATION TABLE FOR THEORY PAPER: NIL
- ❖ QUESTION PAPER PROFILE FOR THEORY PAPER: NIL
- ❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	40	--	Rubrics, Assessment Sheets & Report	1,2,3,4,5,6
		Report Writing		Continuous	10	--	Report	1,2,3,4,5,6
				TOTAL	50	20		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics, Report & Presentation	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of industry/ industry supervisor's remark	05
2	Survey	05
3	Work done and Feasibility of work/ problem identified	15
4	Report writing	15
5	Presentation Skills	05
6	Viva voce	05
Total		50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	2	2	2	-	-	3	3	3	-	-
2	-	3	2	2	2	-	-	3	3	3	-	-
3	-	3	-	-	-	-	-	3	3	3	-	-
4	-	3	-	-	-	-	3	3	3	3	-	-
5	-	3	-	-	-	-	3	3	3	3	-	-
6	-	3	-	-	-	-	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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

❖ **E-REFERENCES:**

- <http://ihmshimla.org/wp-content/uploads/2013/05/Industrial-Training-Rule-Book.pdf>, assessed on 25th September, 2016

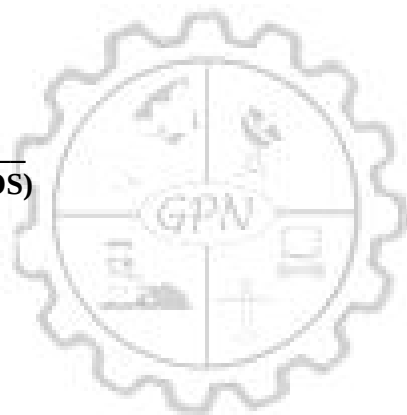
❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

- DLP Projector, latest specification
- Computer, latest specification

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr. S. W. Rajurkar	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.
2.	Mr. G. V. Gotmare	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.

(Member Secretary PBOS)



(Chairman PBOS)

LEVEL - V

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: MT501E\$
COURSE TITLE	: WELDING TECHNOLOGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 02 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ RATIONALE:

In industries, various parts of engineering components are required to be joined on regular basis. Similarly various old parts need replacement very often. Understanding of different joining methods is very much essential in Metallurgy. Welding, is one of the most important joining techniques, will lay emphasis on different processes of joining of metals and alloys which have been using continuously in industries.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Appraise the effects of welding on microstructure of metals and alloys.
2. Select different welding processes for various applications.
3. Recommend most appropriate welding process for particular application based on different criterions.
4. Prepare appropriate joint to perform different welding operation
5. Perform various welding processes
6. Handle different welding equipments and accessories carefully.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Introduction to Welding	1. Classify welding methods. 2. Define different terms involved in welding. 3. Describe welding procedure. 4. Justify weldability of steel.	1.1 Principle of Welding, Classification of Welding Methods 1.2 Weldability, Feasibility, Properties required to weld metal 1.3 Welding terms, Welding procedure, Joint design, Weld positions 1.4 Heat affected zone. 1.5 Microstructure of HAZ of steel	08
2.Welding Processes and Equipments	1. Describe gas welding process. 2. Compare TIG with MIG 3. Select proper welding process. 4. Compare different types of gas welding flames. 5. List advantages, disadvantages and applications of gas welding and different arc welding process.	2.1 Gas Welding Process: Principle, Types of Flames, Working, Machines and accessories, Advantages, Limitations & Applications. 2.2 Shielded Metal Arc Welding Process: Principle, Power Sources, Electrode coating, Working, Machines and accessories, Advantages, Limitations & Applications. 2.3 MIG Welding Process: Principle, Working, Machines and accessories Advantages, Limitations & Applications. 2.4 TIG Welding Process: Principle, Working, machines and accessories, Advantages, Limitations & Applications. 2.5 Submerged Arc Welding Process: Principle, Working, Machines and accessories, Advantages, Limitations & Applications. 2.6 Resistance Welding: spot welding, seam welding, nugget formation.	14
3. Special welding Methods	1. State principle involved in special welding methods. 2. State applications of special welding methods. 3. Describe special welding methods	3.1 Principle and applications of : a. Electroslag Welding, b. Plasma Arc Welding c. Laser Beam Welding d. Electron Beam Welding e. Ultrasonic Welding f. Thermit Welding,	08

	4. Compare different special welding methods	g. Explosive Welding, h. Friction Welding	
4. Brazing and Soldering:	1. Define brazing and soldering. 2. Sketch different joint prepared in brazing 3. Suggest suitable fluxes for brazing and soldering 4. Compare brazing with soldering. 5. Describe different soldering and brazing methods.	4.1 Brazing and Soldering : Principle, Physical aspects of processes , Joint Preparation 4.2 Brazing and Soldering : Fluxes and their purpose, Different Methods, Applications	06
5. Welding Defects and Testing of Weld	1. Enumerate different welding defects. 2. Sketch different welding defects 3. Suggest suitable remedies for welding defects 4. Describe different tests on welded parts.	5.1 Causes and Remedies of Weld Defects : Incomplete Penetration, Cracking, Inclusions, Porosity, Lack of Fusion, Undercutting 5.2 Embrittlement of steel weld. 5.3 Inspection of welded parts. 5.4 Weld Tests : Tension Test, Bend Test, Non destructive tests	06
6. Welding of Important Metals and Alloys and Welding Specifications	1. Describe welding of Aluminium, copper and steel. 2. State safety rules and regulations in welding shop. 3. Classify electrodes as per AWS.	6.1 Steel, Cast Iron, Aluminum and its alloy, Copper and its alloy. 6.2 I.S. Specification, AWS electrode classification, Electrode coating 6.3 Safety rules and regulations in welding shop.	06
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENT

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Prepare Different weld Joints	Introduction	02
2.	Draw different welding equipments and accessories in welding shop.		04
3.	Perform welding of steel parts by Oxy-Acetylene Gas welding process	Welding Processes and Equipments	04
4.	Conduct seam welding and spot welding of steel parts by Electric Arc Welding Process		04
5.	Prepare a report on MIG and TIG process		04
6.	Perform Thermit welding on steel parts	Special welding Methods	04
7.	Prepare sample for analysis of microstructure of weldments.	Introduction	04
8.	Perform Welding of Cu/Al alloys	Welding of Important Metals and Alloys and Welding Specifications	04
Skill Assessment			02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction to welding	04(02)	08(04)	00(00)	12(06)
02	Welding Processes and Equipments	02(00)	12(00)	06(12)	20(12)
03	Special welding Methods	02(00)	04(08)	06(00)	12(08)
04	Brazing and Soldering:	00(04)	04(00)	04(00)	08(04)
05	Welding Defects and Testing of Weld	02(00)	08(00)	00(06)	10(06)
06	Welding of Important Metals and Alloys and Welding Specifications	02(00)	00(04)	06(00)	08(04)
	Total	12(06)	36(16)	22(18)	70(40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	5	R	2	6	R	2	4	R	2	5/7
	4	R	2																
02	1	R	4	1	U	4	1	U	4	1	U	4	2	U	4				3/5
03	2	R	4	2	U	4	3	U	4	3	U	4	3	U	4				3/5
04	4	A	4	4	U	4	5	U	4	5	U	4	6	U	4				3/5
05	2	A	6	2	A	6	5	A	6										2/3
06	2	A	6	3	A	6	6	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		Questionnaires	1, 2, 3, 4,5,6
	End Of Course			End Of The Course				

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagram, selection of equipments & tools, writing procedure etc.	10
2	Performance	00
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	30
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-	-	3	3	3	3	-	-
2	-	3	-	-	-	-	3	3	-	3	-	-
3	-	3	-	-	3	-	3	3	-	3	-	-
4	-	3	2	2	3	2	3	3	3	3	-	-
5	-	3	2	2	3	2	3	3	3	3	1	-
6	-	3	2	2	3	2	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Welding and Welding Technology	Richard L Little, Tata McGraw-Hill Publishing Company Ltd.,1976	0-07-099409-9
2.	Welding Technology	N.K. Srinivasan, Khanna Publishers, Fifth Edition,2012	81-7409-159-9
3.	A Text Book of Welding Technology	O.P. Khanna, Dhanpat Rai Publications, 22 nd Edition., 2008	10. 8189928368.
4.	Welding Handbook-Vol. no-01	Leonard P. Connor ,Amer Weldingsociety,,8 th edition, 1987	13: 978-871712813 10: 0871712814

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/108108076/1> , assessed on 18th January 2016
- <https://www.youtube.com/watch?v=H6QGLGJ-BOE> assessed on 12th July 2016
- <https://www.youtube.com/watch?v=AwL1CAg43PU> assessed on 12th July 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Oxy-Acetylene Gas welding set up
2. Electric arc welding set up
3. TIG /MIG Set up
4. Welding safety equipments/accessories
5. Microscope (min 100x)
6. Crucible
7. Mould box

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: MT502E ^s
COURSE TITLE	: CORROSION ENGINEERING
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HRs.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ RATIONALE:

Continuous decay and destruction of metal when put into use is of immense concern to Engineers. It is the primary job of the Design Engineers to choose the right type of metal for a particular use and apply some protection methods to minimize corrosion. This course includes sources of various types of corrosion and their manifestations in the first part. The second part deals with the various protective measures undertaken by the Quality Control & Design Department

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply principles and laws of thermodynamics in corrosion
2. Detect types of corrosion.
3. Identify coatings for prevention of corrosion
4. Perform Electroplating of metals/Alloys to protect from corrosion
5. Identify Coating defects and suggest remedial measures.
6. Carry out Anodizing and Coloring of Aluminium.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Corrosion	1. Define Corrosion 2. Classify Corrosion 3. State the Use of Electrochemical Series, Galvanic Series 4. State Growth Laws 5. Compare Galvanic Series and Electrochemical Series	1.1 Introduction, Definition 1.2 Electrochemical Series, It's Advantages and Limitations & applications 1.3 Galvanic Series, its Advantages, limitations and applications – 1.4 Growth Laws	06
2. Types Of Corrosion	1. Identify types of films 2. Define Hydrogen Embrittlement & 3. Describe Hydrogen Attack 4. List different forms of corrosion 5. Describe Atmospheric corrosion & underground corrosion 6. Describe concentration cell 7. Compare dry corrosion with Wet Corrosion 8. Examine Season Cracking 9. Detect Pitting Corrosion	2.1 Dry Corrosion : Types, Mechanism, Types of films 2.2 Wet Corrosion : Hydrogen Evolution & Oxygen Absorption 2.3 Action of Hydrogen : Hydrogen Embrittlement & Hydrogen Attack 2.4 Galvanic Corrosion, Concentration Cell Corrosion, Atmospheric Corrosion 2.5 Underground Corrosion, Microbiological Corrosion 2.6 Stress Corrosion, Season Cracking, erosion corrosion 2.7 Pitting Corrosion, Intergranular Corrosion	10
3 Corrosion Control	1. Illustrate various design for components to prevent from corrosion 2. Define passivity 3. State the use of proper Inhibitors for corrosion control 4. Describe corrosion protection by Inhibitors 5. Describe anodic & cathodic Inhibitors	3.1 Proper selection of materials, proper design and fabrication procedure 3.2 Passivity 3.3 Protection by Inhibitors : Anodic & Cathodic Inhibitors 3.4 Cathodic protection	06
4 Thermodynamics In Corrosion	1. State importance of free energy in electrochemical reaction 2. Define Free energy 3. State Faraday's Law 4. Describe pourbaix diagram of iron for corrosion detection 5. Identify Reference electrodes 6. Solve numerical based on Nerst's Equation	4.1 Study of Free energy for Electrochemical reaction. 4.2 Pourbaix diagram : Benefits and Limitations, 4.3 Pourbaix diagram for Iron. 4.4 Nerst Equation. 4.5 Faraday's Law 4.6 Study of reference electrodes: -Calomel Electrode -Hydrogen and -Standard Hydrogen Electrode	08

5. Surface Protection	1. Define Galvanizing, Tinning, Cementation, Metal cladding 2. Describe Anodizing, Phosphating 3. Compare Galvanizing with Tinning 4. Carry out Galvanizing of MS 5. Identify Metallic & Non-metallic coatings 6. Describe Hot Dipping Process 7. Describe chemical conversions coatings 8. Illustrate pretreatment before surface coating	5.1 Pretreatment before surface coating 5.2 Metallic coating, Non-metallic coating & Chemical Conversion Coatings 5.3 Hot Dipping : Galvanizing, Tinning, Cementation, Metal cladding, Metal spraying, Sputtering 5.4 Anodizing, Phosphating	10
6 Electro-Plating	1. Define electroplating 2. Describe Electroplating process 3. Design plant layout for electroplating 4. Identify defects in plating 5. Discuss various Plating thickness tests 6. Identify defects in Plating, 7. State the defect causes and remedial measures	6.1 Electroplating equipments and plant layout, Pretreatments before plating - Copper Plating : Bath Composition, Operating Conditions 6.2 Chromium Plating : Bath Composition, Operating Conditions 6.3 Nickel Plating : Bath Composition, Operating Conditions 6.4 Hard Chrome Plating 6.5 Plating thickness Tests 6.6 Defects in Plating : Causes and remedies	08
Total Hrs.			48

❖ **B LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:**

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Determine the corrosion rate of different metals by weight loss method	Corrosion	6
2	Perform Mercurous Nitrate Test on brass sample	Types of corrosion	4
3	Determine corrosion of iron using Pourbaix diagram.	Thermodynamics in Corrosion Engineering	2
4	Measure plating thickness by weight change method of galvanized Mild Steel	Surface protection	4
5	Perform Anodizing and Coloring of Aluminium.		4
6	Perform Copper Plating on steel Measure Plating thickness on steel.	Electro-plating	4
7	Perform Chromium Plating on Mild Steel Measure Plating thickness on steel.		4
8	Rectify the defects in Electro-plated components. Use remedial measures for the defects occurred		2
Skill Assessment			2
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Corrosion	04(00)	04(04)	00(00)	08(04)
02	Types of corrosion	02(04)	08(00)	06(06)	16(10)
03	Corrosion control	04(02)	04(04)	00(00)	08(06)
04	Thermodynamics in Corrosion	02(02)	04(04)	06 (00)	12(06)
05	Surface protection	02(00)	06(08)	06(00)	14(08)
06	Electro-plating	00(00)	12(00)	00(06)	12(06)
	Total	14(08)	38(20)	18 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	1	R	2	2	R	2	4	R	2	5	R	2	3	R	2	5/7
	4	R	2																
02	1	U	4	2	U	4	3	R	4	1	U	4	2	R	4				3/5
03	3	R	4	6	U	4	4	U	4	3	U	4	5	U	4				3/5
04	3	U	4	6	U	4	6	U	4	4	U	4	5	U	4				3/5
05	2	A	6	4	A	6	2	A	6										2/3
06	5	A	6	5	U	6	6	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagram, designing & selection of equipment's. writing procedure etc	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

❖ Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	3	-	-	3	-	3	-	-
2	-	3	-	-	3	-	-	3	-	3	-	-
3	-	3	-	-	3	-	-	3	-	3	1	-
4	-	3	2	2	3	2	2	3	2	3	-	-
5	-	3	2	2	3	2	2	3	2	3	-	-
6	-	3	2	2	3	2	2	3	2	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Engineering Chemistry	Jain & Jain ,Dhanpat Rai Publishers, 16 edition, -2004	13 : 9788187433170
2.	Corrosion Engineering	Fontana, McGraw Hill Education; 3 edition,1978	13: 978-0070607446
3.	Handbook of Electroplating	Canning; Publisher: Spon; 22Rev e. edition (23 Feb. 1978) ...	13: 978-0419109501
4.	Metals Handbook Volume 2	American Society for Metals; 8 th Edition	ASIN: B0013HJP32

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/113108051/> , assessed on 13 July 2016
- <https://www.youtube.com/watch?v=sRuQKbHiKq0> , assessed on 13 July 2016
- <http://www.corrosion-doctors.org/Corrosion-Thermodynamics/Potential-pH-diagram-iron.htm> , assessed on 13 July 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Copper, Nickel, Chromium, Mild Steel plates of standard size.
2. Electrolytic Tank
3. Analytical balance
4. Power Unit
5. DC motor & DC generator
6. Wooden stand.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: MT503E ^s
COURSE TITLE	: ALLOY STEEL
PREREQUISITE	: MT404E
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ RATIONALE:

Now a days plain carbon steel is replaced by alloy steels in most of the engineering as well as other applications. It is very important to have the knowledge about production, characteristics, heat treatments and applications of alloy steel for the metallurgist. This course includes the study and production of alloy steel, their properties, and effect of alloying elements and engineering applications of alloy steels for benefits of metallurgist. This course will provide justification for accurate selection of alloy steel.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply principles of steel making for alloy steel production.
2. Select suitable method for alloy steel production.
3. Calculate amount of raw materials for different alloy steel production.
4. Draw alloy steel plant lay out.
5. Perform heat treatment on different alloy steels.
6. Design the heat for different alloy steel production.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Introduction	1. Define alloy steel 2. Classify alloy steel based on different Criteria. 1. Describe characteristics of different class of steel.	1.1 Definition , need of alloy steels 1.2 Classification of alloy steels 1.3 Classification and composition of alloy cast irons. 1.4 Characteristics of each class of alloy steels 1.5 Industrial applications of alloy steel and alloy cast irons. 1.6 Alloy steel standards-ASTM/IS	04
2. Alloying Elements:	1. Differentiate ferrite and austenite stabiliser. 2. Analyse effects of alloying elements on Fe-Fe ₃ C diagram. 3. Suggest suitable alloying elements to achieve required property in alloy steel	2.1 Classification of alloying elements w.r.t. Iron- iron carbide diagram – ferrite and austenite stabilizers. 2.2 Classification of alloying elements w.r.t. alloy steel making. 2.3 Effects of alloying elements on S- curve . 2.4 Effects of alloying elements on shape of Fe- Fe ₃ C diagram. 2.5 Effects of important alloying elements on Properties and structures of steels.	06
3. Important Alloy Steels	1. Describe different types of alloy steels. 2. Compare different alloy steels. 3. Select alloy steel for particular applications 4. Enumerate properties required for high temperature applications	3.1 Composition, properties and applications of: a. Structural steel b. Engineering steel c. Spring steel d. OHNS steel e. Mar - aging steel, f. tool steel - HCHC steel, HSS Steel ,Hadfield steel g. Stainless steels 3.2 high temperature alloys- a. Properties required for high temperature applications, b. Properties and applications of Titanium alloys ,Ni-based alloys	12

4. Alloy Steel Production:	1. Describe sequential steps for heat of various alloy steel production. 2. Describe different equipments for alloy steel production 3. Calculate charge for different types of alloy steel production	4.1 General outline of heat for alloy steel Production 4.2 Arc furnace practice for tool steels 4.3 Production of stainless steel by different methods 4.4 Alloy steel Plant lay out- factors to be considered. 4.5 Equipments required for alloy steel plants with proper justifications 4.6 Charge calculations for low and high alloy steels.	10
5 Heat Treatment of Alloy Steel	1. Describe heat treatment cycle for H.S.S; HCHC; Stainless steel and maraging steel 2. Suggest suitable heat treatment for different types of alloy cast irons 3. Design heat treatment of alloy steels. 4. Analyze the effect of heat treatment on properties of alloy steel.	5.1 Heat treatment (h/t cycle, hardening, tempering) of : a. High speed steel b. HCHC steel c. Stainless steels d. Maraging steel e. Alloy cast irons	10
6. Ferro Alloys	1. State the importance of Ferro- alloys 2. Enumerates the properties of raw materials required for Ferro- alloy production 3. Describe different types of ferroalloys with their grades.	6.1 Importance of Ferro alloys. 6.2 Composition, physico-chemical properties of Ferro-Mn, Fe-Si and Fe-Cr. 6.3 Raw materials for Ferro- Mn, Fe-Si and Fe-Cr production. 6.4 General applications of Ferro-alloys. 6.5 Fe-Mn production by Thermit process only.	06
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Perform Heat treatment of high speed steel /HCHC Steel	Heat treatment of alloy steel	04
2.	Prepare plant lay out for an integrated Alloy steel shop.	Alloy Steel production	04
3.	Calculate charge materials for any one low alloy steel		04
4.	Calculate charge materials for any one high alloy steel		04
5.	Prepare Electric arc furnace Heat for tool steel production.		04
6	Prepare Electric arc furnace Heat for stainless steel production.		04
7	Design induction furnace heat for any one alloy steel.		02
8	Prepare Report on current status of alloy steel production in India/World		02
9	Prepare Report on current status of Ferro alloy production in India/World	Ferro alloy	02
Skill Assessment			02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	02(00)	04(04)	00(00)	06(04)
02	Alloying Elements	00(04)	04(04)	06(00)	10(08)
03	Important Alloy Steels	02(02)	08(00)	06(06)	16(08)
04	Alloy Steel Production	04(02)	12(00)	00(06)	16(08)
05	Heat Treatment of Alloy Steel	04(00)	04(08)	06(00)	14(08)
06	Ferro Alloys	02(00)	00(04)	06(00)	08(04)
	Total	16 (08)	32(20)	24(12)	70(40)

❖ R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	3	R	2	5	R	2	5	R	2	6	R	4	3	R	2	5/7
	4	R	2																
02	2	R	4	2	U	4	1	U	4	1	U	4	2	U	4				3/5
03	3	U	4	3	U	4	4	U	4	4	U	4	4	U	4				3/5
04	4	U	4	5	U	4	5	U	4	5	U	4	6	U	4				3/5
05	2	A	6	3	A	6	3	A	6										2/3
06	6	A	6	5	A	6	4	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagram, selection of equipments & tools, writing procedure etc.	10
2	Performance	00
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	30
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-		-	-	3	3	-	3
2	-	3	-	-	3	3	3	3	-	3		
3	-	3	-	-	3	-	-	3	-	3		3
4	-	3	2	2	3	-	3	3	3	3		3
5	-	3	2	2	3	3	3	3	3	3	1	-
6	-	3	2	2	3	3	3	3	3	3		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Heat treatment Principles and techniques	T.V. Rajan , C.P. Sharma, Prentice Hall of India Pvt ltd, 12 th Edition, 2010	10: 8120340957
2.	Modern steel Making	Dr. R.H. Tupkary, Khanna publisher, Sixth Edition, 1996	81-7409-026-6
3.	Metallurgy and heat treatment of tool steel	Robert Wilson, Mc Graw Hill publication, 1 st Edition, 1975	0-07-084453-4
4.	Introduction to Physical Metallurgy	Sidney H. Avner, McGraw-Hill international edition, 2 nd Edition, 1964	13: 9780070024991

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/108108076/1> , assessed on 18th January 2016
- <https://www.youtube.com/>, assessed on 18th January 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Muffle furnace (max temperature 1150⁰c)
2. Polishing machine
3. Hardness tester (Rockwell tester)
4. Microscope (min 100x)
5. Micrometer
6. Image analyzer

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: MT 504E
COURSE TITLE	: SELECTION OF MATERIALS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT=1 CLOCK HR.,1 PR CREDIT = 2 CLOCK HRs.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs (External)
PT.	: 01 HR

❖ RATIONALE:

Introducing a new engineering product or changing an existing model involves making designs, reaching economic decisions, selecting materials, choosing manufacturing processes, and assessing its environmental impact. These activities are interdependent. and materials and processes used in making the product can have a large influence on its design, cost, and performance in service. Industries now emphasis on manufacturing products and goods locally, & how products affect the environment, and society. The aim of the subject is to enable judicious selection of material based upon the relationship between technical and economic facts.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Interpret factors for selection process of different materials
2. Select materials for industrial applications depending on their properties
3. Analyze fractures occurring in components
4. Test various mechanical properties of materials
5. Use Material selection charts for various applications
6. Carry out Failure Analysis of the failed components

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1 Introduction	1. State Principles involved in the selection of materials 2. Illustrate Selection criteria for required materials 3. Identify different Material properties. 4. Employ Material selection charts for various applications 5. Illustrate Factors affecting material prices, material substitution 6. Relate Strength vs. density & Young's modulus vs. density selection charts 7. Select material for various applications depending on the properties	1.1 Principles involved in the selection of materials 1.2 Selection Criteria : Availability, Economics, Properties 1.3 Selection process, determination of performance requirements, Evaluation of alternatives 1.4 Material Properties: Chemical, Physical and Mechanical, properties in detail and limits on properties 1.5 Factors affecting material prices, material substitution 1.6 Material selection charts- 1.7 Strength vs. density 1.8 Young's modulus vs. density.	10
2 Functional Requirement of Engineering Materials	1. State functional requirement of engineering materials 2. Select proper material required for different applications 3. Illustrate selection of materials for toughness 4. Assess toughness of different materials with suitable examples 5. Describe Creep Curve 6. Describe effect of stress and temperature on Creep 7. Select suitable non ferrous materials for given application 8. Draw Creep curve 9. Recommend corrosion resistant materials for a given application	2.1 Selection of material for strength, resistance to corrosion – temperature – wears with practical examples 2.2 Materials selection for stiffness : Stiffness of engineering materials, Importance of stiffness, material selection criterion for stiffness with examples 2.3 Materials selection for toughness : Toughness, Selection of materials for toughness, assessment of toughness of different materials with examples 2.4 Material selection for fatigue strength: Mechanisms, evaluation of fatigue life of different materials. 2.5 Material selection for creep: Mechanism, evaluation of creep resistance, Creep curve, Effect of stress and temperature, development of creep resistant alloys, selection criterion. 2.6 Selection of non ferrous materials.	08
3 Selection of materials	1. Describe Tool steel & , corrosion resistant steels	3.1 High strength, heat resistant alloys, corrosion resistant steels required	08

for different application	- Identify properties required for materials for different applications - Define weldability, formability, and forgeability. - Select proper materials for tools and components for various industrial applications - Select tool materials for various ore-dressing equipments. - Recommend materials for various industrial and metallurgical applications	for good weldability, formability, forgeability, 3.2 Tool steels required for cutting, cold-working dies, hot working dies 3.3 Selection of materials and processes for tools and components of : - automobile engines - machine tools, - foundry - metal-working equipment, - Testing machine,, - ore-dressing equipment.	
4 Composite Materials	- Describe Composite materials - Describe different loading conditions - State Application of composite materials - Calculate load for longitudinal loading and transverse loading conditions - Describe Disperse materials	4.1 Composite materials- Definition, Necessity, Applications, Advantages & Limitations 4.2 Loading under iso-strain condition and isostress condition 4.3 Numerical on longitudinal loading and transverse loading conditions. 4.4 Disperse materials: Definition, Necessity, Applications, Advantages & Limitations	06
5 Magnetic materials & Biomaterials	- Describe different properties of Magnetic materials - List various biomaterials - Compare different biomaterials - State properties of biomaterials - State applications of Magnetic materials - Select different Bio materials in various applications - Select Magnetic material for given application	5.1 Introduction to magnetic materials, 5.2 Types of Magnetic materials 5.3 Concept of Diamagnetism, paramagnetism and Ferromagnetism 5.4 Applications of Magnetic materials 5.5 Introduction to Biomaterials 5.6 Concept of Biocompatibility 5.7 Classification and applications of biomaterials	08
6 Failure Analysis	- Identify Various Fractures - Describe factors influencing brittle fracture - Define Fatigue - State causes of failure of engineering components - Describe remedies for	6.1 Modes of fracture, factors influencing brittle fracture 6.2 Various Fractures : Ductile, Brittle, fatigue , Causes and Remedies 6.3 Griffith's Theory: Statement, Derivation,	08

	Failure Prevention 6. Describe steps for failure analysis 7. Formulate Griffith's equation	6.4 Causes of failure of engineering components - Wear Failures, Corrosion Failures, Mechanical Failures, 6.5 Failure Prevention by selection of proper material. 6.6 Steps for Failure analysis	
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Test various mechanical properties of materials	Introduction	4
2	Use material selection charts for selection of various materials for required applications		4
3	Carry out Visual examination for failure analysis of different materials	Selection of materials for different application	6
4	Perform microscopic examination for failure analysis of different materials		
5	Carry out Ultrasonic examination of materials for failure analysis of different materials		
6	Carry out Case Study for various Applications based on selection of material		6
7	Carry out Cathodic protection to prevent the failure of component due to corrosion	Failure Analysis	6
8	Detect different fractures by visual examinations		4
Skill Assessment			2
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	02(04)	06(04)	06(00)	14(08)
02	Functional requirement of engineering materials	02(02)	04(00)	06(06)	12(08)
03	Selection of materials for different application	02(02)	04(04)	06(00)	12(06)
04	Composite Materials	02(00)	08(04)	00(00)	10(04)
05	Introduction to magnetic materials & Biomaterials	02(00)	08(00)	00(06)	10(06)
06	Failure analysis	04(00)	08(08)	00(00)	12(08)
	Total	14(08)	38(20)	18 (12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	2	R	2	3/5
	3	R	2																
02	6	R	4	2	U	4	3	U	4	4	U	4	6	U	4				3/5
03	4	U	4	5	U	4	6	U	4	1	R	4	1	U	4				3/5
04	4	U	4	5	U	4	6	U	4	3	U	4	6	U	4				3/5
05	1	A	6	2	A	6	5	A	6										2/3
06	1	U	6	3	A	6	2	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of equipment's., materials, writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	3	3	-	-	-	3	3	-	-
2	-	3	-	-	3	-	-	-	3	3	3	-
3	-	3	-	-	3	-	-	3	-	3	3	-
4	-	3	2	3	3	2	2	3	3	3	3	-
5	-	3	2	3	3	2	2	3	3	3	-	-
6	-	3	2	3	3	-	2	3	3	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1	Materials Selection in Mechanical Design	Mike Ashby , Butterworth-Heinemann, New Edition, 2011	9781856176637
2	Engineering Materials – Properties and Selection	Kenneth G. Budinski, Prentice-Hall of India, 1998	13:9780139047152
3	Materials and Process Selection for Engineering Design,	Mahmoud M. Farag Third Edition CRC Press, 2013	1466564091, 9781466564091
4.	Mechanical Metallurgy	George E. Dieter, McGraw-Hill Education; 3 rd Edition, 1986	978-0070168930

❖ **E-REFERENCES:**

- <http://www.nptel.ac.in/courses/112104122/> ,assessed on 14th July, 2016
- <https://www.youtube.com/watch?v=85HxmnLEkwM> ,assessed on 14th July, 2016
- <https://www.youtube.com/watch?v=vnFNl1oVJNY> , assessed on assessed on 14th July, 2016
- <https://www.youtube.com/watch?v=P-tg52VRzZU> , assessed on assessed on 14th July, 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Universal Testing machine 60 ton capacity
2. Fatigue Testing machine
3. Metallurgical microscope
4. Hardness Testers (BHN,VHN, Rockwell, Poldi, Impact)
5. Ashby Charts

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L. Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange City Alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: WS501E ^s
COURSE TITLE	: MANUFACTURING PROCESSES
PREREQUISITE	: NIL
TEACHING SCHEME:	TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 Hrs. (External)
PT.	: 01 HR

❖ RATIONALE:

Diploma technician often comes across various types of basic manufacturing processes. He /she is required to select, operate and control the appropriate processes with respect to machines, specific cutting tools, cutting fluids for specific applications in order to convert raw material into finished products as per the requirement of drawings. He /she is also required to know about latest improvements in manufacturing processes. With sound knowledge of this subject, the diploma technician will be able to handle and control practical situations more effectively and confidently.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Adopt safety practices while working on various machines.
2. Select proper metal joining and various machining process.
3. Select cutting tools, cutting fluids and manufacturing processes for the desired output.
4. Use proper tools, equipments and machineries for specific applications.
5. Manufacture the job by selecting proper process as per given drawing.
6. Inspect the job.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Mechanics of Metal Cuttings	1. State basic elements of machining. 2. Define terms related to cutting tools. 3. Draw cutting tool diagram showing its various nomenclature 4. Describe metal cutting principles.	1.1 Basic elements of machining 1.2 Principles of metal cutting & forces involved in metal cutting, Oblique & orthogonal cutting 1.3 Chip formation, Types of chips. 1.4 Cutting tool nomenclature & tool signature, 1.5 Cutting parameters.	04
2. Cutting Fluid & Tool Materials	1. Define various terms relate to cutting fluid. 2. Classify cutting fluids. 3. Select cutting fluids for various machining operations 4. State characteristics of various tool materials. 5. State factors affecting machinability 6. Describe the procedure of tool resharpener.	2.1 Cutting Fluid: Introduction, classification of cutting fluid, solid & liquid cutting fluid, chemical coolants, Selection of cutting fluids and its application during machining operation. 2.2 Tool Material : Introduction, characteristics of tool material, types of tool material such as plain carbon steel, high carbon steel, high speed steels, carbide tools, ceramics, diamond tools, cemented oxides, abrasives & CBN etc 2.3 Tool life & tool wear, types of tool failure. Resharpener of cutting tools. 2.4 Machinability, factors affecting machinability	06
3. Metal Joining processes	1. Define various terms related to metal jointing. 2. Classify metal jointing process. 3. Describe various welding processes. 4. State various welding defects and its causes. 5. Describe the tools and equipments used in gas welding. 6. Compare soldering and brazing.	3.1 Fusion process, Processes of joining, 3.2 Welding processes –Types, working principle & applications: Gas welding, carbon arc welding, shielded metal arc welding, 3.3 welding defects. 3.4 Tools & equipment used in gas welding. 3.5 Introduction to soldering and brazing – Process, fillers, heating methods & applications. 3.6 Safety precautions taken while performing joining operations	10

4. Machining Operations	1. Define various terms related to machining operations. 2. Classify lathe machines. 3. Describe construction and operation of centre lathe. 4. Define various terms relate to drill. 5. Select proper drill for particular application. 6. Classify drilling machines. 7. Describe the construction and operation of various drilling machines. 8. Describe various drilling operations. 9. Describe shaping, slotting and planning machines. 10. Compare shaping, slotting and planning machines.	4.1 Lathe Machines: Introduction, classification, centre lathe and its details, Different lathe operations like facing, plain turning, taper turning, thread cutting, chamfering, grooving, knurling. Lathe accessories and its attachments. 4.2 Drilling Machine: Introduction, , twist drill nomenclature, Classification, working principle & applications of drilling machine, like portable, sensitive etc, Cutting speed and feed different operations performed on drilling machines like drilling, reaming, boring, counter sinking, counter boring, spot facing. 4.3 Shaping, Slotting & Planning Machine: Introduction, Elements of shaping, slotting & planning machine, Working principles, classification of shaping, slotting & planning machine , Comparison between them. 4.4 Safety precautions adopted while working on machines	12
5. Milling & Grinding Machines	1. Define various terms related to milling operations 2. Classify Milling machines 3. State basic parts of Milling machines. 4. Describe milling cutters. 5. Describe milling operations. 6. Describe cutting parameters of milling machines. 7. Classify grinding machines. 8. State designation and specifications of grinding wheels 9. Describe working of grinding machines 10. Select proper grinding wheel for particular applications 11. Describe wheel dressing, truing & balancing processes.	5.1 Milling: Introduction, classification ,basic parts of column & knee type milling machine & their functions, milling cutters, different milling operations, like plain milling, side milling, straddle milling, gang milling, face milling - slot milling, slitting. Up milling & down milling, cutting parameters of milling operations. 5.2 Grinding Machines: Classification and working of grinding machine - surface, cylindrical, centreless, grinding wheel specifications, grinding wheel dressing & truing. Selection criteria for grinding wheel. Balancing of grinding wheels, safety precautions.	12

6 Introduction to CNC machines.	1. Define NC, CNC, and DNC. 2. Classify CNC Machines. 3. Operate CNC control panel. 4. Describe principle axes of CNC Machine	6.1 NC (Numeric control), CNC (Computer numeric control), DNC (Direct Numeric control) definition. 6.2 Classification of CNC machines. 6.3 Difference between CNC and NC, relative advantages and disadvantages. 6.4 CNC organization – CNC machine body and control panel, CNC machine tool working principle. 6.5 Cartesian Co-ordinate system and right hand rule for identification of axes.	04
		Total Hrs.	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Assignment	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Perform one turning job on lathe containing the operations like plain turning, step turning, taper turning, grooving, knurling and chamfering.(minimum 5 operations) • Read and interpret job drawing • Raw material size – Bar dia. 40 to 50 mm, length 80 to 100 mm. • Set the tool and select the cutting parameters for machining operations • Inspect various dimensions of jobs by using measuring instruments.	Machining process	20
2	Perform one composite job containing the operations on shaper and drill machine.	Shaper machine	12
		Total Hrs.	32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Mechanics of Metal Cuttings	02(00)	04(04)	00(00)	06(04)
02	Cutting Fluid & Tool Materials	06(00)	04(00)	00(06)	10(06)
03	Metal Joining processes	02(02)	04(04)	06(00)	12(06)
04	Machining Operations	02(00)	12(04)	06(06)	20(10)
05	Milling & Grinding Machines	04(02)	06(08)	06(00)	16(10)
06	Introduction to CNC machines.	02(04)	04(00)	00(00)	06(04)
	Total	18(08)	34(20)	18(12)	70 (40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	2	R	2	3	R	2	4	R	2	6	R	2	3	R	2	5/7
	5	R	2																
02	1	U	4	2	U	4	3	U	4	1	U	4	3	U	4				3/5
03	4	U	4	4	U	4	4	U	4	4	U	4	6	R	4				3/5
04	2	R	4	5	R	4	6	U	4	5	U	4	5	U	4				3/5
05	3	A	6	4	A	6	4	A	6										2/3
06	5	A	6	5	U	6	2	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics, Job & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics, Job & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Job drawing, selection of equipment's. writing procedure, precautions etc.	10
2	Performance	20
3.	Skill	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	1	-	-	-	-	3	-	-
2	-	3	-	-	-	-	-	-	-	3	-	-
3	-	3	-	-	-	-	-	-	-	3	-	-
4	-	3	2	2	-	-	-	2	2	3	-	-
5	-	3	2	2	-	-	-	2	2	3	-	-
6	-	3	2	2	-	-	1	2	2	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Workshop Technology (Vol. – II)	B. S. Raghuwanshi. Tata McGraw-Hill	81 -212-0269-8
2.	Workshop Technology (Vol. - II)	Hazara & Chaudhary. Media Promoters & Publishers.	0-210-98173-3
3.	Production Technology	R.K. Jain & S.C. Gupta. Khanna Publishers.	978-0534934293
4.	Manufacturing Science and Technology (Vol.-I,II & III)	Suresh Dalela. Umesh Publication	81-7611-179-1
5.	Manufacturing Processes	Begeman, Myron L. Amstead, B.H. John Wiley & Sons Inc.	0471062405
6.	Fundamental of metal cutting and machine tools	B. L. Juneja, G.S.Sekhon, Nitin New Age International Pvt Ltd Publishers, 2008	10: 8122414672 13: 978-8122414677

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=aC7c1NgA-7M>, assessed on 23rd March 2016
- <https://www.youtube.com/watch?v=is5wdVgPOkI>, assessed on 23rd March 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Lathe Machine with all accessories
2. Drilling Machine pillar type with all accessories
3. Shaping Machines with all accessories
4. Fitting, welding, and equipments as per requirement.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Mr. O. V. Sarode	I/C Head of Mechanical Engineering	Government Polytechnic, Nagpur.
2.	Dr. S. W. Rajurkar	Lecturer , Mechanical Engineering	Government Polytechnic Nagpur
3.	Mr. D. C. Satdeve	Workshop Superintendent,	Government Polytechnic Nagpur
4.	Mr. A. M. Onkar	Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
5.	Shri. G. F. Potbhare	Principal	NIT, Polytechnic, Nagpur
6.	Dr. S. S. Baraskar	Lecturer in Mechanical Engineering	Govt. Polytechnic, Arvi

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN METALLURGICAL ENGG.
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: ME507E ^s
COURSE TITLE	: PRODUCTION TECHNOLOGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 Hrs.
PR. TEE	: 02 Hr. (External)
PT.	: 1 Hr.

❖ RATIONALE:

Modern manufacturing industries have complex production processes. A technician entering into such field comes across various problems involving production processes, methods, planning, scheduling etc. One has to effectively use the industrial engineering techniques for increasing productivity of men, machines, equipments and materials. Therefore, knowledge of work study, plant layout - material handling, advancements in manufacturing processes to increase the output, maintenance of equipments is very essential. The effective control of inventory items and equipments also plays a vital role. This course helps to impart the knowledge of techniques for increasing productivity & better Quality control.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Recognize the various techniques of product design& process planning..
2. Interpret the suitability and application of plant layout and material handling systems in industries.
3. Implement / Apply various Inventory control methods to achieve economy in production..
4. Recognize the need of maintenance & need of safety and use of safety measures.
5. Interpret the various elements of Method study & Work measurement.
6. Identify the new concepts in production technology,& TQM techniques.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Product design & Process Engineering.	1. Define product design & process planning 2. State characteristics of good plant layout. 3. Interpret the requirement of proper production system.. 4. Define Functions of P.P.C. 5. Describe various types of production systems. 6. Select no. of machines required for production.	1.1 Introduction to product design 1.2 Effect of product design on product cost 1.3 Requirement and Factors of good product design 1.4 Product development approaches, Product development process and Concepts- Simplification, Standardization, Specialization 1.5 Process planning, Operation planning 1.6 Machine capacity and Machine selection, Plant capacity. Selection of no. of machines.(numerical to find plant capacity) 1.7 Production System: Definition, Types of Production systems, Jobs, Batch, Mass Production. Ways of productivity improvement. 1.8 Functions of PPC: Forecasting, order writing, product design, planning, routing, scheduling, dispatching & controlling.	10
2. Plant Layout & Material Handling	1. State the objectives and principles of plant layout. 2. Define material handling and its need. 3. Analyze suitability of plant layout & M.H. Devices 4. Compare types of layouts 5. Select material Handling devices as per requirement	2.1 Definition, Objectives & Principles of plant layout. Its advantages and disadvantages 2.2 Types of layouts & their comparison. 2.3 Definition, Scope, Objectives & Principles of material handling. 2.4 Different types of M H Devices and Sketch & Description of manually operated M.H.D and Conveyors.. 2.5 Suitability and application of plant layout & M.H. devices in Industries.	08
3. Inventory Management	1. Define Inventory 2. State various stock control methods. 3. Describe the concept of, E.O.Q., & B.E.P. etc. 4. Implement procurement procedure.	3.1 Inventory: Meaning and its type, Stock control methods, ABC Analysis, VED. 3.2 Economic Order Quantity: order quantity, Lead time, Safety stock, Re-order point.. 3.3 Break even analysis. Importance of	08

	5. Describe inventory cost 6. Describe steps in purchasing 7. Describe concept of JIT in inventory management	break –even point. 3.4 Inventory cost: ordering cost and carrying cost. Total cost. 3.5 Principles of scientific purchasing. Steps in Purchasing / Procurement Procedure and Preservation techniques for different inventory items. 3.6 Concept of JIT in inventory Management	
4. Maintenance Management	1. Define maintenance. 2. State types of maintenance 3. Define safety. 4. State causes of accident & need of safety. 5. Interpret the machine history cards, logbooks. 6. Relate maintenance with safety.	4.1 Definition of maintenance & its need. 4.2 Types of maintenance. Breakdown, preventive, predictive 4.3 Definition of safety, need of safety, causes of accidents. 4.4 Relation between maintenance & safety. 4.5 Safety measures to be adapted in industries. 4.6 Machine history cards, logbooks, their need & importance.	08
5. Industrial Engineering	1. Define Method study & work study / work measurement. 2. State objectives of M.S. and W.M. 3. Implement various steps in M.S. & W.M. 4. Use/Carry out different recording techniques used in method study. 5. Describe principles of motion economy. 6. Calculate standard time required for given operation.	5.1 Method study : – Terminology used, aims & objectives, steps in method study & method improvement, various recording techniques 5.2 Different recording techniques; Outline process, flow process. charts, multiple activity chart, two handed process chart and string diagram 5.3 Principles of motion economy 5.4 Work Measurement: - Definition, aims, objectives, Time study equipment, Scientific methods of work measurement, advanced methods in work measurement, normal time, standard time, allowances, Merit rating.	08
6. New Concepts In Production Technology	1. Describe new concepts in Prod. Technology. 2. State importance of CAPP, SMED. 3. Define Lean tech., kaizen, kanban. 4. Apply ISO / TQM techniques in industry.	6.1 Computer Aided Process Planning (CAPP) 6.2 Single minute exchange of dies 6.3 Lean technology: Concept of 5 S, Kaizen, Kanban. 6.4 ISO 9000, Quality circle, TQM., BPR.	06
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
01	Identify on the basis of cost of product & analysis the product development process	Product design & Process Engineering	04
02	Analyze the Various production system used in Industry	Product design & Process Engineering	04
03	Explore the various modules used in industry	Inventory Management	04
04	Prepare maintenance schedule for various machines used in workshop	Inventory Management	04
05	Determine the process time for Heat Treatment processes by using different recording techniques	Industrial Engineering	04
06	Calculate standard time for casting process considering various allowances	Industrial Engineering	06
07	Analyze various quality control aspect used in industry , visited by students	New Concepts In Production Technology	04
Skill Assessment			02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Product design & Process Engg.	04(04)	10(04)	00(00)	14(08)
02	Plant layout & Material Handling.	04(00)	04(06)	04(00)	12(06)
03	Inventory Management	02(00)	04(06)	06(00)	12(06)
04	Maintenance & Safety	04(04)	06(00)	00(04)	10(08)
05	Industrial Engg.	06(04)	04(02)	02(00)	12(06)
06	New concepts in Prod.Tech.	04(04)	06(00)	00(02)	10(06)
	Total	24(16)	34(18)	12 (06)	70(40)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01	1	R	2	1	R	2	2	R	2	2	R	2	3	R	2	1	A	2	5/7
	1	R	2																
02	1	U	4	2	A	4	2	U	4	1	A	4	4	A	4				3/5
03	4	R	4	3	U	4	5	R	4	4	U	4	5	U	4				3/5
04	5	A	4	5	U	4	6	R	4	6	U	4	6	A	4				3/5
05	3	A	6	4	U	6	2	U	6										2/3
06	1	U	6	6	U	6	3	A	6										2/3

T= Unit/Topic Number

L= Level of Question

M= Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	20	--	Test Answer Sheets	1, 2, 3
		Assignments		Continuous	10	--	Assignment Book / Sheet	1, 2, 3
	TEE (Term End Examination)	End Exam	Students	End Of the Course	70	28	Theory Answer Sheets	1, 2, 3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Data analysis	15
2	Calculation / Procedure	20
3	Viva voce	15
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-	-	-	3	3	3	-	-
2	-	3	-	-	-	-	-	3	3	3	-	-
3	-	3	-	-	-	-	-	3	3	3	-	-
4	-	3	2	2	-	-	2	3	3	3	-	-
5	-	3	2	2	-	-	2	3	3	3	-	-
6	-	3	2	2	-	-	2	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	A Text Book of Production Technology	P.C.Sharma, S.Chand & Co. Ltd, Delhi, 1 st , 2009	81-2191-114-1
2.	Production Technology	R.K. Jain, Khanna Publisher, 17 th , 2001	81-740-9099-1
3.	Production Technology	K.L.Narayana & Swarna Venkate Ramana, I.K.International Publishing House Pvt. Ltd., 2 nd , 2000	978-93-80578-52-1
4.	Production Technology	Pakirappa, Durga Publishing House, 4 th , 2005	13-120-5002-9
5.	Industrial Engineering & Management	T.R. Banga & S.C. Sharma, Khanna Publishers, Edition-25, 2014	978-81-7409-078-9

❖ **E-REFERENCES:**

- <http://link.springer.com/book/10.1007%2F978-3-319-12304-2>
- <http://svmcollege.in/14403/rk-jain-production-technology-free-download-site/>.
- <https://docs.google.com/document/d/1Raos2OWuTZypsp8XE1dUi6FCcHOfl08PE5ojXMdFp2U/edit>
- <http://ebookinga.com/pdf/a-textbook-of-production-engineering-by-pc-sharma-pdf-free-download>
- <http://pec.ac.in/~pecac/new/wp-content/uploads/2015/01/Production-Industrial-Engineering.pdf>
- <http://joteringstu.esy.es/advances-in-production-technology-lecture-notes-in-production-engineering.pdf>.

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

Nil

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	V.S Ikhar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
2.	G.H.Dahole	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
3.	A.R.Sheikh	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4.	Dr.V.M.Athawale	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
5.	Mr. D.J.Ghode	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
6.	Er. A.M.Onkar	Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
7.	Shri. G.F.Potbhare	Principal	NIT, Polytechnic, Nagpur
8.	Dr.S.S. Baraskar	Lecturer in Mechanical Engineering	Govt. Polytechnic, Arvi

(Member Secretary PBOS)

(Chairman PBOS)

FREE ELECTIVES

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/CM/IT/MT/PK/AE/TX/TR
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: FS501E
COURSE TITLE	: FINISHING SCHOOL
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK Hrs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: NIL
PR. TEE EXAM	: 02 HRs (Internal)
PT. EXAM	: NIL

❖ RATIONALE:

Polytechnic Diploma pass outs who are not readily employable in the desired target jobs, need further grooming. Diploma engineers are not fit for relevant jobs in related work areas in corporate due to lack of required skills like communication, team work, arithmetic, public speaking, attitude building, ethics, business etiquettes etc. This 'disconnects' between the desired jobs and the qualifications obtained needs to be addressed by institutes. This course helps in bridging the gap between Formal education and Industry requirements. Industries and Institutes have a role to play. A pre-employment training programme in which curriculum is developed for students to prepare them for requirements of industries. It aims to provide soft skills to student to facilitate their employability and play a part in the supply side issues (of talent) of the industry. Students then can adapt themselves to the industrial scenario.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

- 1 Perform SWOT analysis
- 2 Demonstrate soft skills.
- 3 Enhance employability skills.
- 4 Adapt ethics and values.
- 5 Practice interpersonal skills.
- 6 Refine communication skills.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes(Cognitive Domain)	Topics and subtopics	Hrs
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	- Identify Strengths and Weaknesses of Self - Observe Opportunities and Threats in Self - Exhibit different interpersonal skills in given situations.	A. Soft Skills Understanding self & others a. SWOT Analysis b. Interpersonal Skills	4
2	- Practise face to face communication in formal/informal groups. - Observe Body Language of others and note the changes in different persons. - Construct and demonstrate short public speech of five minutes on a topic of interest. - Identify signs and signals as a means of communication and list them.	A. Soft Skills Communication Skills a. Verbal & Non Verbal Communication b. Body Language c. Sixth sense Intuition d. Public Speaking	8
3	- Identify factors in self esteem. - Produce a list of behavioural elements of concentration. - Practise tongue twister to enhance power of concentration.	A. Soft Skills Self Confidence a. Strength of Conviction b. Power of Concentration c. Self Esteem	4
4	- Practise three different dress combinations for professional presentation. - Demonstrate three social manners and etiquettes in a group task	A. Soft Skills Presenting Self a. Fine Grooming b. Dress Sense c. Manners & Etiquettes	4
5	- Set career goals for next five years and list activities to achieve these goals. - Prepare a chart of daily routine activities with Important, Very important, Urgent and Very urgent	A. Soft Skills Effective Self Management a. Goal Setting b. Time Management c. Emotional Quotient d. Motivating self and	6

	classification. - Identify assertive behavioural aspects of persons in your surrounding - Identify factors/elements related to emotional balance in given situations.	Others e. Positive Thinking & Assertiveness	
6	- Practise yoga /meditation. - Prepare a habit plan and list steps for action plan. - Construct diet chart for self.	A. Soft Skills Personality Development a. Physical & Mental Health b. Habit formation- Do's & Don'ts c. Diet Pyramid	6
7	Exhibit attitude as response to various situations (case studies).	B. Employability Skills Attitudes	2
8	Demonstrate technical skills of different subjects.	B. Employability Skills Technical Skills	6
9	Observe the weakness domain of the individuals in given situations.	B. Employability Skills Adaptability	4
10	- Compose creative essay. - Suggest creative solutions to various given situations.	B. Employability Skills Creativity and Innovation	4
11	Exhibit team spirit and leadership qualities while working in a team.	B. Employability Skills Interpersonal Skills a. Working in Team b. Leadership	4
12	Practise Role play in group to exhibit corporate culture.	B. Employability Skills Corporate culture	4
13	- Prepare Resume. - Practise Group Discussions. - Demonstrate interview techniques through mock interview.	B. Employability Skills Job Selection Process a. Resume Writing b. Group Discussions c. Personal Interview	8
Total Hrs.			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Not Applicable

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Not Applicable

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Report writing	20
2	Presentation Skills	20
3	Viva voce	10
Total		50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (Pos)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	3	2	-	-	-	3	-	3	-	-
2	-	-	3	-	3	-	3	3	3	3	-	-
3	-	-	-	2	3	-	3	3	3	3	-	-
4	-	-	-	-	3	2	3	3	3	3	-	-
5	-	-	3	-	3	2	3	3	3	3	-	-
6	-	-	3	-	3	2	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	How to win friends and Influence people	Dale Carnegie, Fingerprint Edition 2016	10: 8175993480 13: 978-8175993488
2.	The SWOT Analysis	Lawrence G. Fine, Createspace Edition 2009	10: 1449546757 13: 978-1449546755
3.	Body Language	Allan Pease, Manjul Publishing House Pvt. Ltd., Edition 2014	10: 8183224105 13: 978-8183224109
4.	The Spark is Within You	Jagdish Bali, Authorspress, Edition 2016	10: 9352072332 13: 978-9352072330
5.	How to Read a Person Like a Book	Rupa Publications India, Edition 2012	10: 8129119188 13: 978-8129119186

6.	Believe in Yourself	Dr. Joseph Murphy, Manjul Publishing House Pvt. Ltd., 1 st Edition 2014	10: 8183225098 13: 978183225090
7.	Think and Grow Rich	Napoleon Hill, Jaico Publishing House; First edition 2007	10: 817992792X 13: 9788179927922
8.	Communication Skills	Sanjay kumar, Oxford Edition 2011	10: 0198069324 13: 9780198069324
9.	The Power of your Sub conscious Mind	Dr. Joseph Murphy, Amazing Reads Edition 2015	10: 8192910962 13: 9788192910963
10.	The Power of Positive Thinking	Norman Vincent Peale,	10: 0091906385 13: 9780091906382
11.	The Ace of Soft Skills: Attitude, Communication and Etiquette for Success	Gopalaswamy Ramesh	10: 8131732851 13: 978-8131732854

❖ E-REFERENCES:

- https://en.wikipedia.org/wiki/Soft_skills accessed on 20th September, 2016
- <http://www.p21.org/about-us/p21-framework/262> accessed on 1st November 2016
- <http://innovationexcellence.com/blog/2012/08/04/whats-the-difference-between-creativity-and-innovation/> accessed on 10th October 2016
- <http://study.com/academy/lesson/self-understanding-and-self-concept.html> accessed on 20th October, 2016
- <http://www.skillsyouneed.com/ips/understanding-others.html> accessed on 20th October, 2016
- <http://articles.bplans.com/how-to-perform-swot-analysis/> accessed on 19th September, 2016
- <http://www.skillsyouneed.com/ips/body-language.html> accessed on 19th September, 2016
- <https://www.mindtools.com/CommSkll/PublicSpeaking.htm> accessed on 19th September 2016
- https://www.mindtools.com/pages/article/newHTE_90.htm accessed on 20th October 2016

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

Nil

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Mr. D.S. Kulkarni	HOD, Textile Manufacture	Government Polytechnic, Nagpur.
2.	Dr. Surendra Gole	Corporate HR Trainer, Former Principal,	Nagpur Institute of Technology, Nagpur
3.	Mr. Ashish Khole	Divisional Manager	TAL - Areospace Business Unit – (Tata Group of company) Nagpur
4.	Dr. Rozina Rana	Director	ELAN Finishing School, Priyadarshini Group of Institutions
5.	Mr. Sarang Sawangikar	Asstt. Vice President(HR)	Vidarbha Power Ltd., Butibori
6.	Ms. M.M.Machale	Lecturer in English	Government Polytechnic, Nagpur
7.	Dr. S.W.Rajurkar	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.
8.	Mr. G.V.Gotmare	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME/EE/EC/CM/IT/ TX/MT/PK
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: FE501E
COURSE TITLE	: BASIC BUILDING DRAWING
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04 (CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR)
TH.TEE	: NIL
PR.TEE	: 02 HRs (Internal)
PT	: NIL

❖ RATIONALE:

Various agencies involved in engineering works use drawings as effective medium of communication. Engineering professionals of fields, other than civil engineering like mechanical, electrical, chemical, polymer mining, metallurgy etc. are required to interpret the space in the given building to assess whether their installations can be housed in the building or to specify the space requirements of their machineries, assemblies and installations. Moreover as an individual everyone of any profession wants to visualize his/her home before it is build, therefore these professionals need to study basic of building drawings such as plan, elevation and sections etc. This curriculum is designed to develop the basic skills of drawing building plan, elevation and section.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify different types of lines and symbols used in working drawings.
2. Prepare line plans of buildings for different orientations and with different scales.
3. Prepare plan, elevation and section of an existing building by taking measurements.
4. Develop working drawing duly considering rules, regulations and byelaws of sanctioning authority.
5. Identify the units and their sizes required in a building for serving a given purpose.
6. Interpret plan, elevation and section of building.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Draw different types of lines, common notations/symbols used in civil engineering and also symbols used in their field to be shown in the plan (A1size sheet).	Basics of Civil Drawing	10
2	Prepare line plans of small residential building (1BHK) for different plot orientation and with different scale on graph paper (A1size).	Drawing line plans	10
3	Prepare line plans of Public building like (Primary school building and Primary Health Centre) specifying names and sizes of different units. Prepare a separate report giving units, their sizes and justification for sizes.		10
4	Prepare a Measured drawing of institutional workshop/any small building. Show placement of machines/electrical fixtures etc.	Measured drawing	12
5	Develop a working drawing of any one of the building drawn in Practical no.2 considering rules, regulations and bye laws of local /other sanctioning authority.	working drawing	12
6	Draw plan and sectional elevation of Bifurcated/ Dog legged staircase.		06
7	Interpret dimensions and sizes of various units in the given building drawing.	Interpretation	04
Total			64

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
	Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6
End Of Course		End Of The Course	Questionnaires					

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Draw to the suitable scale a detailed plan of two room building.	20
2	Dimensioning	10
3	Neatness	10
4	Viva -Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	-	-	-	-	-	3	-	3	-	-
2	-	-	3	3	-	-	-	3	3	3	-	-
3	-	-	3	3	-	-	-	3	3	3	-	-
4	-	-	3	3	2	2	2	3	3	3	-	-
5	-	-	-	-	-	-	-	3	-	3	-	-
6	-	-	-	-	-	-	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Building Drawing: With an Integrated Approach to Built Environment	M.G. Shah, C.M.Kale and V. Y.Patki Tata McGraw-Hill Publishing Company Ltd. 4 th edition, 2002	10:0074638769
2.	Building Planning and Drawing	Dr.Kumara Swamy and A. Kameshwara Rao , Charotar Publications , 8th edition, 2015	13:9789385039126
3.	Civil Engineering Drawing and House planning	B.P.Verma, Khanna Publications, 11 th Edition,1986	13:9788174091688
4.	Civil Engineering Drawing	Gurucharan Singh, Standard Publications, 2009	13:9788180140044
5.	Civil Engineering Drawing	R. S. Malik,G.S. Meo, Computech Publications ltd./ New Asian Publications, 5 th edition, 2015	13:9788173180026

❖ **E-REFERENCES:**

1. <http://bie.telangana.gov.in/Pdf/civilenggdrawing.pdf>, accessed on 3rd September, 2016
2. <http://www.iar.unicamp.br/lab/luz/ld/Arquitetural/livros/interior%20design%20student%20handbook.pdf>, accessed on 3rd September, 2016.
3. <https://law.resource.org/pub/in/bis/S03/is.962.1989.pdf> accessed on 3rd September, 2016
4. http://civilengineering-notes.weebly.com/uploads/1/1/7/5/11750056/building_bye_laws.pdf accessed on 3rd September, 2016
5. <http://civil.emu.edu.tr/courses/civl103/Tutorial%205.pdf> accessed on 3rd September, 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

Nil

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Mr. R. N. Giradkar	Head of Civil Engineering Deptt.	Government Polytechnic, Nagpur.
2.	Dr. D. N. Kongre	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
3.	Mr. S. R. Kukadapwar	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
4.	Mr. M. K. Panchwate	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
5	Dr. S. J. Nikam	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
6	Mr. M. R. Shelote	Consultant Engineer	M. R. Associates, Nagpur.
7	Dr. R. N. Khapre	Associate Professor	Ramdeobaba College of Engineering and Management, Nagpur
8.	Mr. A. J. Fulzele	Assistant Secretary (Technical)	MSBTE, Regional Office, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/EE/EC/CM/IT/MT/PK/AE/TR/TX
LEVEL NAME	: FREE ELECTIVES
COURSE CODE	: FE502E
COURSE TITLE	: RAC MAINTENANCE
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: NIL
PR. TEE EXAM	: 02 HRs (Internal)
PT. EXAM	: NIL

❖ RATIONALE :

The knowledge of repair and maintenance of domestic refrigerator and air conditioner is helpful in daily life. One should acquire skills in carrying out basic repairs and maintenance of refrigeration and air conditioning.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify various components of refrigeration and air conditioner.
2. Handle various tools
3. Test and find faults in refrigerator and air conditioner
4. Diagnosis fault of refrigerator and air conditioner.
5. Practice maintenance procedure
6. Practice safety procedure.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical No.	Specific Learning Outcomes (Psychomotor Domain)	Topics	Hrs.
1.	Identify the components of domestic refrigerator and write report. Report includes- -Basic concept of refrigeration -Vapor Compression Refrigeration system -COP, Ton of refrigeration	Introduction to Refrigerator	10
2.	Identify the hand tools required for maintenance of domestic refrigerator. Use tools for various applications and write report. -Specification of tools	Hand Tools	04
3.	Dismantle compressor, identify various components in compressor and write report. Report includes – -Hermitically sealed compressor - various components of compressor	Compressor	08
4.	Test Electric circuit and electrical controls used in refrigerator and report writing. Report writing includes – -Electric circuit diagram -Various controls and its function	Electric circuit of refrigerator	04
5.	Identify various faults and write report Report includes – -Various faults - Remedies	Fault finding and maintenance of refrigerator	08
6.	Run water cooler test rig and Write report. Report writing includes- -Working of water cooler -various components of water cooler	Water cooler	04
7	Identify the components of air conditioning system and write report. Report includes- -Basic concept of air conditioning -Various air conditioning systems like summer AC, winter AC, comfort AC.	Air conditioning system	08
8	Identify of various faults and write report Report includes – -Various faults - Remedies	Fault finding of air conditioner	08
9	Test Electric circuit and electrical controls used in AC and report writing.	Electric circuit of air conditioner	04

	Report writing includes – -Electric circuit diagram -Various controls and its function		
10	Identify the components of car air conditioning system and write report. Report includes- -Basic concept of car air conditioning -function of various components of car AC	Car Air Conditioning system	04
Skill Assessment			02
Total Hrs.			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

NIL

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

NIL



❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing of Sketch, selection of equipment's, procedure etc.	20
2	Performance	10
3	Conclusion	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	3	-	-	-	-	3	3	-	-	-
2	-	-	3	3	-	-	-	3	-	3	-	-
3	-	-	3	3	-	-	-	3	3	3	-	-
4	-	-	3	3	1	-	-	3	3	3	-	-
5	-	-	3	3	-	-	-	3	3	3	-	-
6	-	-	3	3	1	-	-	3	3	3	-	-

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Refrigeration and air conditioning servicing	S. Kumar, New Heights Publication New Delhi	--
2.	Refrigeration and Air Conditioning	R.S. Khurmi, S.Chand and Co.	81-219-1687-9
3.	Refrigeration and Air Conditioning	C.P. Arrora, Tata Mc-Graw Hill,	0-07-451515-2
4.	Refrigeration and Air Conditioning	Manohar Prasad, New Age Publications.	13: 9788122414295
5.	Refrigeration and Air Conditioning	P.N. Ananthanarayanan; Tata McGraw Hill	0074620088

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Air conditioning trainer kit
2. Water cooler trainer kit
3. Ice plant trainer kit
4. Window Air conditioner
5. Split air conditioner
6. Domestic Refrigerator
7. Car air conditioning trainer kit

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Prof. O. V. Sarode	Head, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. S. W. Rajurkar	Lecturer, Mechanical Engineering	Government Polytechnic, Nagpur.
3	Prof. D. J. Ghode	Lecturer, Mechanical Engineering	Government Polytechnic, Nagpur.
4	Prof. K. S. Thekedar	Lecturer, Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. A.M.Onkar	Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F.Potbhare	Principal	NIT, Polytechnic, Nagpur
7	Dr.S.S.Baraskar	Lecturer in Mechanical Engineering	Govt. Polytechnic, Arvi

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/AE/PK/MT/EC/IT/CM /TX
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: FE503E
COURSE TITLE	: ELECTRICAL MAINTENANCE
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT =2CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT.	: NIL

❖ **RATIONALE:**

Electricity is a basic need of human beings. All are dealings with the different electrical gadgets as well as electrical installations in day to day life. Therefore, the knowledge of electrical maintenance is must for all the peoples. One should have ability to acquire skills in carrying out repairs of electrical gadgets with accuracy and maintain the electrical installations. This course imparts the practical skills of electrical maintenance.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Use electrical maintenance tools and equipment's.
2. Use fire-fighting equipment on different types of fires.
3. Test, Repair and maintain the domestic appliances.
4. Locate and repair the faults in electrical installation.
5. Identify the faults.
6. Follow safety precautions.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify electrical measuring instruments, sources, ICDP/ICTP, switches, loads, wires and execute safety precautions in laboratory.	Electrical Safety	4
2	Use firefighting equipment on different fire.		4
3	Identify different electrical maintenance tools and electrical accessories.	Maintenance Tools	4
4	Test single phase and three phase supply using test lamp and identify phase and neutral using test lamp.		4
5	Perform continuity, open circuit, short circuit and earth fault test using series test board.		4
6	Test and find fault in an automatic/ semiautomatic/ steam electric iron/toaster/room heater/hot plate	Domestic Appliances	4
7	Test, find faults and repair ceiling fan.		4
8	Test, find faults and repair electric mixer.		4
9	Identify different wiring systems in the premises & prepare list of accessories required for each.	Electrical Installation	4
10	Test & measure insulation resistance of Electrical lab wiring installation by using megger.		4
11	Measure the earth resistance of earth electrode by using earth tester.		4
12	Connect single phase and three phase energy meter to load and note the reading.		4
13	Prepare a wiring of two lamp controlled by two one way switch by using conduit wiring.		6
14	Fix ICDP/M CB/ DB/ELCB on wiring board & connect it to supply.		4
15	Locate the fault in electrical installation		4
Skill Assessment			2
Total Hrs			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Not Applicable

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Not Applicable

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing circuit diagram/selection of equipment's/writing procedure etc.	10
2	Performance	20
3	Result	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	3	3	3	-	-	3	3	3	-	-
2	-	-	3	3	3	-	-	3	3	3	-	-
3	-	-	3	3	3	-	-	3	3	3	-	-
4	-	-	3	3	3	-	-	3	3	3	-	-
5	-	-	3	3	3	-	-	3	-	3	-	-
6	-	-	-	-	3	-	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Electrical Design Estimating and Costing	K.B. Raina and Dr. S.K. Bhattacharya, New Age International (P) Ltd. (2010)	10: 8122403638 13: 978-8122403633
2.	Study of Home Appliances	K. B. Bhatiya, Khanna Publication 2010 Edition.	1234567146703
3.	Home Appliances Servicing	E.P. Anderson, Audels	030114

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/108108076/1> , assessed on 18th January 2016
- <http://www.electrical4u.com> , assessed on 18th January 2016
- <https://www.youtube.com/watch?v=A9KSGAnjo2U>, assessed on 18th January 2016
- <http://www.electricaltechnology.org/2015/09> assessed on 30 Jan 2016
- www.slideshare.net/bawaparam/made-by-param assessed on 30 Jan 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Electrical Maintenance Tool Kit.
2. Megger 500V Hand driven
3. Earth tester 3 spike.
4. Digital Multi-meter

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr. C.S.Thorat	Principal	Government Polytechnic, Nagpur.
2.	K.M.Gaidhane	I/C, Head of Electrical Engineering	Government Polytechnic, Nagpur.
3.	R.I.Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4.	S.P.Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5.	Dr. R.S.Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	G.V.Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	H,N.Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	N.H.Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	A.P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Bhashkar Bale	Dy. Executive Engineer,	MSTCL, Nagpur
11	R.Y.Ghormade	Head of Electrical Engineering	Dharampeth Polytechnic, Nagpur
12	DR. S.S.Bharatkar	Lecturer in Electrical Engineering	Government Polytechnic, Amaravati.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/EE/ME/CM/IT/PK/AE/TX/TR
LEVEL NAME	: PROFESSIONAL ELECTIVE
COURSE CODE	: FE504E
COURSE TITLE	: HOBBY ELECTRONICS
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: NIL
PR. TEE EXAM	: 02 HRs
PT. EXAM	: NIL

❖ **RATIONALE:**

Some students may be interested in interdisciplinary approach therefore it is felt that diploma holder those who have interest in "Hobby Electronics Circuits" must have minimum competency and knowledge of it, so later on some student may take up it as business. Therefore this course has been kept as one of free elective interdisciplinary course in the curriculum.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

- 1 Identify different electronics components.
- 2 Handle electronics circuit development tools & test and measuring equipments.
- 3 Select the hobby electronics circuits as per requirements.
- 4 Test the electronics components and circuits.
- 5 Develop the simple electronics hobby project.
- 6 Present electronics project.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Hrs.
1	Identify and understand different electronics components. -like. resistor, capacitor, inductor, diode, transistor, relay etc.	04
2	Observe and draw Symbols and unit of measurement for electronics parameters like voltage, current, resistor, capacitor, inductor etc.	04
3	Identify the applications of basic electronics test and measuring equipments. Like multimeter LCR meter, Cathode Ray Oscilloscope, Function generator etc.	08
3	Perform the basic handling skill of electronics circuit development tools like soldering gun, de-soldering pump etc	04
4	Test different electronics components like resistor, capacitor, inductor, diode, relay etc.	08
5	Identify simple electronics Hobby circuits by referring journals, websites, and hobby electronics manuals.	04
6	Arrange electronics component and PCB (general purpose) for selected circuit and their testing.	08
7	Prepare component layout of selected electronics circuit.	04
8	Mount and solder electronics components on PCB (general purpose)	08
9	Perform Testing, fault finding, rectification of fault. of circuit.(Test the circuit for performance and rectify the fault)	06
10	Perform the final testing of circuit & packaging.	04
Skill Assessment		02
Total Hrs		64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

NIL

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER**

NIL

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
2	Performance–Demonstration of project work	25
5	Viva voce	25
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-			-	-		3	-	3	-	-
2	-	-	3	3	-	-	3	3	-	3	-	-
3	-	-			-	-	3	3	-	3	-	-
4	-	-	3	3	-	-		3	-	3	-	-
5	-	-	3	3	-	-	3	3	-	3	-	-
6	-	-	3	3	-	-		3	1	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Electronic For You	Journal	--
2.	Electronics Material And Components	Dr. MadhuriA. Joshi, , Shroff Publisher & Dist. Pvt. Ltd. 3 rd Edition,	10: 8173669007 13: 9788173669002
3.	Data Books Of Electronic Components & Devices	Business Promotion Bureau	--

❖ **E-REFERENCES:**

- ❖ Websites www.electronicprojects.com , assessed on 4th May 2016
- ❖ Websites www.circuittoday.com assessed on 4th May 2016
- ❖ Websites www.electroschematics.com assessed on 4th May 2016
- ❖ Websites www.hobbyelectronics.in assessed on 4th May 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Digital Multi-meter
2. LCR-Q meter
3. Cathode Ray Oscilloscope
4. Soldering Gun.
5. De-soldering Pump.
6. Nose Plier

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	S.S.Tadas	HOD, Electronics Telecomm. Engg.	Government Polytechnic, Nagpur.
2.	A.A.Ali	Lecturer (Selection Gr.) Electronics Telecomm. Engg.	Government Polytechnic, Nagpur.
3.	D.A.Brahmankar	Lecturer (Selection Gr.) Electronics Telecomm. Engg.	Government Polytechnic, Nagpur.
4.	U.M.Ramteke	Lecturer (Selection Gr.) Electronics Telecomm. Engg.	Government Polytechnic, Nagpur.
5.	Mr. Sandip V Darwhekar	Director	Beta Computronics Pvt Ltd , Nagpur
6.	Mrs. Gazzala Ali	Head Electronics	Anjuman Polytechnic , Nagpur
7.	Mr S M Kale	Lecturer Electronics	Government Polytechnic, Gadchiroli.

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GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/IT/CM/AE/MT/TX
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: FE505E
COURSE TITLE	: BASIC PACKAGING TECHNOLOGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT =2CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT.	: NIL

❖ **RATIONALE:**

Packaging is the need of every manufactured commodity. Safe delivery of product to end user through package has got many expectations. Packaging has a various functions and aspects. Packaging process starts as soon as finished product is ready. The package with the product is subjected to various situational hazards. The success of packaging largely depends on how these hazards have been considered and taken care of. This all requires a panoramic or holistic view about the field of packaging.

The concept & technology of packaging has taken years together to develop to where it is today, through evolution of technology, market and business. In spite of being a value to the business and developing economy, packaging by virtue of consuming resources, creating solid waste and pollution, is posing a grave threat to the environment.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to -

1. Collect various primary and secondary packages.
2. Identify the packaging materials and appreciate their properties.
3. Identify product characteristics of a packaged product.
4. Estimate the hazards to the package along with its contents.
5. Record by testing/ measurement/ observation various parameters of a package.
6. Search web resources on environmental issues related with packaging.

❖ **COURSE DETAILS:****A. THEORY :**

Unit Number and Name	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Introduction to Packaging. - Form suitable number of groups of students. - Collect 05 empty packages/ containers of different products. (Primary & Secondary packages) Products may be assigned by the course teacher. - Prepare a list of the packages and the products they contained. - Submit the list along with the collection.	Introduction	02
2.	Assort the collection of various packages by the class into primary and secondary packaging. - Classify the collected packages into Primary, Secondary & Primary as well as Secondary packaging. - Classify the collected packages into Rigid, semi-rigid and flexible packaging. - Note down the classification. - Identify the material/ materials of the packages. - Measure the physical parameters/ characteristics of the packages/ packaging material such as dimensions, weight, thickness, size, etc. - Prepare a power point presentation on it. - Attach the print out of above presentation in the Journal.	Packaging Materials	12
3.	Identify the product properties/ characteristics and estimate packaging functions. - Select appropriate number of products from the collection. - Identify various physical/ physiochemical properties of the products influencing its packaging. - Predict the functions of the packaging material and the package. - Classify predicted functions into Technical/ Primary and Commercial/ Secondary functions of packaging. - Prepare a brief report on it and attach in the Journal.	Product Characteristics	10
4.	Identify the fitness for use of the product contain by its packaging.		

	• Collect at least one package each of – one Perishable food and one Pharmaceutical Product. • Examine the date of manufacture, expiry/best before. • Note down above information and collect the information on usage of unfit products.	Packaging Communication	04
5.	Judge the hazards of handling, warehousing and transportation. • Observe the printed communication on the package and find out the manufacturer and its geographical location. • Trace out the method of handling, warehousing and transportation. • Outline the distribution channel. • Estimate the hazards to the products and packaging due to of handling, warehousing and transportation. • Interpret material handling instructions as printed on the packaging. • Write a report.	Packaging Hazards	12
6.	Carryout following tests on packaging materials and dummy packages. • Drop test. [IS : 7028 (Part 4) – 1987] • Puncture resistance test. (T 803 om-88) • Rolling test [IS : 7028 (Part 5) – 1987] • Vibration test. IS : 7028 (Part 2) - 2002 • Box compression test. (T 804 om-89) • Analyse the test results.	Package Testing	10
7.	Conduct a Survey/ Case study on environmental burdens caused by Packaging. • Select a Packaging Industry. • Visit to the industry or search information through web resources. • Gather information on different operations performed by the industry. • Study the impact of those operations on environment. • Appreciate 3-R concept (Reduce, Reuse and Recycle) • Prepare presentation.	Survey	12
Skill Assessment			02
Total			64

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2, 3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Identification	10
2	Drawing / flowchart/schematics/symbols	10
3	Procedure/involvement/performance	10
4	Viva voce	20
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	3	-	-	-	-	3	3	3	-	-
2	-	-	-	-	-	-	-	3	3	3	-	-
3	-	-	-	-	-	-	-	3	3	3	-	-
4	-	-	3	-	-	-	-	3	3	3	-	-
5	-	-	3	2	-	-	2	3	3	3	-	-
6	-	-	-	-	1	1	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Fundamentals Of Packaging	F.A. Paine, Newnes-Butterworth, 1973	13: 9780408001076
2.	Packaging users Handbook	F.A. Paine, Springer; 1991	13: 9780751401516
3.	The Packaging Media	F.A. Paine, Blackie Academic & Professional, 1977	13: 9780216901919
4.	Packaging In The Environment	edited by Geoffrey M. Levy	13: 9780751400915
5.	The Wiley Encyclopedia of Packaging Technology.	Marilyn Bakker, John Wiley & Sons Inc. Canada	0471-80940-3
6.	Fundamentals of Packaging Technology	S. Natrajan, M. Govindrajan, B. Kumar, 2E, PHI LPL, Delhi, 2014	978-81-203-5054-0

❖ **E-REFERENCES:**

1. <http://www.iip-in.com/site/default.aspx>
2. <https://books.google.co.in/books?isbn=0470541385>
3. <http://pkt.jinakarn.com/ept.pdf>
4. <http://www.boschpackaging.com/en/pa/homepage/homepage.html>
5. <https://www.youtube.com/watch?v=LbxXpP9ysjo>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Bursting Strength tester
2. Box compression strength tester
3. Drop tester
4. Universal testing machine
5. Puncture testing machine
6. Edge compression tester

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Prof. R.S.Raool	I/C, Head of Packaging Technology	Government Polytechnic, Nagpur.
2.	Prof. A.S.Bhagat	Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
3.	Prof. Imran K.Syed	Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
4.	Prof. A.P.Pardey	Lecturer in Paper and pulp	Government Polytechnic, Nagpur.
5.	Prof. S.N.Madhugiri	Academician, Ex Principal & Retired Head of	Dharmapeth Polytechnic Nagpur & Dept. Packaging Technology G.P.Nagpur
6.	Prof. P.P Sargaonkar	Consultant & Retired Lecturer in Packaging Technology	Government Polytechnic, Nagpur.
7.	Prof. M.S.Deshpande	BTE Repetitive & Lecturer in Mechanical Engineering	Government Polytechnic, Bramhapuri.
8.	Shri. Suresh Thakur	Industry Expert, Managing Director,	Palekar Food Products, MIDC, Amravati.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN CE/ME/EE/EC/CM/IT/AE/PK/TX
LEVEL NAME : ELECTIVE COURSES
COURSE CODE : FE506E
COURSE TITLE : INDUSTRIAL METALLURGICAL PRACTICES
PREREQUISITE : NIL
TEACHING SCHEME : TH: 00; TU: 00; PR: 04(CLOCK HRS.)
TOTAL CREDITS : 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM : NIL
PR. TEE EXAM : 02 HRS (Internal)
PT. EXAM : NIL

❖ RATIONALE:

A technician comes across the various problems in metallurgical industries. Also, at the work place, it is always necessary, to tackle the problem so that the sound metallurgical product can be obtained by application of suitable metallurgical engineering techniques. Hence, the basic knowledge of various industrial metallurgical practices is necessary for a technician. This course helps to impart the basic knowledge to technician for increasing the productivity and a sound metallurgical product.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Draw sketches of different tools/machines in metallurgical shops/labs
2. Use of tools and machinery in different metallurgical labs/shops.
3. Operate different equipments/machineries used in basic Metallurgical labs/shops
4. Perform inspection and testing of metallurgical products.
5. Prepare sample for microscopic examination.
6. Choose proper tool for different metallurgical processes.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Observe the demonstration of hand tools, machine Tools and equipments used in pattern making and mouldings shops and draw the sketches and write specifications, details, applications of above tools.	Pattern making and Moulding	02
2.	Prepare sand mould by using any one pattern (mould to be prepared by group of 2 to 4 students depending on volume of work)		08
3.	Observe the demonstration of hand tools, machine Tools and equipments used in casting shop and draw the sketches and write specifications, details, applications of above tools.	Casting	02
4.	Prepare one casting related to mould prepared. (any one type of casting to be prepared by group of 2 to 4 students depending on volume of work)		08
5.	Observe the demonstration of hand tools, machine Tools and equipments used in metal working operations (rolling, wire drawing, etc) and draw the sketches and write specifications, details, applications of above tools.	Metal working	02
6.	Perform practical related to any one metal working operations		08
7.	Observe the demonstration of hand tools, machine Tools and equipments used in heat treatment Shop and draw the sketches and write specifications, details, applications of above tools.	Heat treatment	2
8	Prepare sample for Performing heat treatment operation and conduct any one heat treatment to steel/cast iron sample		8
9	Observe the demonstration of hand tools and equipments used in testing and inspection lab and draw the sketches and write specifications, details, and applications of above tools.	Testing and inspection	2
10	Carry out various necessary testing and write the test report for any one metallurgical product.		8
11	Observe the demonstration of hand tools, machine Tools and equipments used in metallographic lab and draw the sketches and write specifications, details, applications of above tools.	Metallography	2
12.	Prepare one sample for metallographic examination and examine the sample under metallurgical microscope and draw the structure.		8
Skill Assessment			4
Total Hrs.			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Nil

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Nil

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
	Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6
End Of Course		End Of The Course	Questionnaires					

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagram/ selection of equipment's/ writing procedure etc.	10
2	Performance	20
3	Calculation/Result/ Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	-	3	-	-	-	3	-	3	-	-
2	-	-	3	3	-	-	-	3	3	3	-	-
3	-	-	3	3	-	-	-	3	3	3	-	-
4	-	-	3	3	-	-	-	3	3	3	-	-
5	-	-	3	3	-	-	-	3	3	3	-	-
6	-	-	3	3	-	-	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Principles of metal castings	Dr. P.C. Mukharjee	81-20300716-X
2.	Foundry Engineering	Shrinivasan	81-7409-026-6
3.	Introduction to Physical Metallurgy	Sidney H. Avner McGraw-Hill international edition, 2 nd edition	0-07-085018-6
4.	Testing of materials by	Prof. A.V.K. Suryanarayana.	81-20300716-X
5	The Testing & Inspection of Engineering materials,	H. E. Davis, G. E. Troxell, McGraw Hill	81-7409-026-6
6	Mechanical Metallurgy	George Dieter, McGraw Hill,	0-07-084453-4
7	Heat treatment Principles and techniques	T.V. Rajan , C.P. Sharma, Prentice Hall of India Pvt. ltd, 12 th edition	81-20300716-X

❖ **E-REFERENCES:**

<http://books.google.co.oin/books/isbn=9380026757> , assessed on

17th March 2016

<http://www.youtube.com/watch?v=101M1kaZIFg> , assessed on 27th April 2016

http://www.youtube.com/watch?v=1HuxDVpy_iv , assessed on 27th April 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Patterns
2. Foundry tools
3. Welding Transformer (Oil Cooled) Three Phase
4. Pit type furnace
5. Mould boxes
6. Crucibles
7. Muffle furnace
8. Mould shaking machine
9. Draw bench
10. Rolling mill
11. Grinder
12. Polishing machine
13. Hardness tester
14. Microscopes
15. NDT equipments

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	K.L.Meshram	Head of the Dept Department of metallurgical Engineering	Government Polytechnic, Nagpur.
2.	Ms. V.C. Humney	Lecturer in Metallurgical Engineering	Government Polytechnic, Nagpur.
3	S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4.	Y.Y. Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Y. K. Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

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(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/AE/MT/PK/TX
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: FE507E
COURSE TITLE	: COMPUTER NETWORK
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02(TH/TU CREDIT = 00 CLOCK HR., 1PR CREDIT = 2 CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT.	: NIL

❖ RATIONALE:

The world in the information era has become network centric. A Computer networks has been growing with rapid technological progress. Computer communication through networking becomes essential part of our life. We can manage many application like Air Line Reservation, Railway Reservation, E-banking, E-Governance, On-Line shopping, E-learning etc. by clicking mouse button from our own place. Because of this, world become the global village. By considering importance of networking towards all aspects of our life, we here introduce basic concept of networks, network classification, network topologies, network devices, Transmission media, Network reference models, concept of TCP/IP.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify network and network topologies.
2. Connect and handle different networking devices.
3. Identify network architecture and physical media used to connect computers in network.
4. Identify E-Commerce and E-Governance website on the internet.
5. Use and share Network Recourses.
6. Use various Internet and Intranet Applications

❖ **COURSE DETAILS:****A. THEORY: NIL**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify different types of network.	1.Introduction to Computer network and topologies	2
2.	Identify different network topologies.		2
3.	Connect and identify different Transmission Media.		4
4.	Connect and identify different network controlling devices like hub, switches etc.		4
5.	Connect computers in star topology by using wired media and with any network device (eg. Hub)		4
6.	Install and configure LAN card.	2.Local Area Network	4
7.	Prepare a Straight Cable and Network Cross over Cable and test by Line Tester.		4
8.	Share different devices like printer, scanner etc. over LAN network.	3.Applications & Uses of Computer network	2
9.	Share a printer on a network & print a document on it from a different computer on a network		2
10.	Share files and directories from one computer to other computer on the network.		2
11.	Install Win Messenger on LAN network.		2
12.	Create ID on Win messenger.		2
13.	Communicate through Win Messenger over LAN network.		4
14.	Connect through WAN network	4.Wide Area Network	4
15.	Create Email-ID on any WAN software like Gmail, Rediff, Yahoo etc.		4
16.	Communicate through any WAN software.		4
17.	Search information on the internet.		2
18.	Identify different E-commerce website on the internet like amazon.com, ebay.com etc.	5.Concepts of E-Commerce	2
19.	Connect through any E-commerce website on the internet and learn the procedure to buy books.		2
20.	Identify different E-Governance website on the internet like irctc.co.in etc.	6. Introduction to E-Governance	2
21.	Connect through E-governance railway website on the internet and learn the procedure for online railway reservation.		2
Skill Assessment			4
Total Hrs.			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:NIL**❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:NIL**

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection, writing steps, installation etc.	10
2	Connection and configuration.	10
3	Performance	20
5	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	3	-	-	-	-	3	3	3	-	-
2	-	-	3	3	-	-	-	3	3	3	-	-
3	-	-	3	3	-	-	-	3	3	3	-	-
4	-	-	3	-	-	-	-	3	3	3	-	-
5	-	-	3	3	-	-	-	3	3	3	-	-
6	-	-	3	3	-	-	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Computer Networks	Andrew S Tannenbaum, Tata McGraw-Hill Edition, 2012	9780132126953
2.	Fundamentals of computer	E Balaguruswamy, Tata McGraw-Hill Education Pvt. Ltd., 2009	9780070141605
3.	Computer Basics	Micheal Miller, Tata McGraw-Hill Edition, 2012	0789734206
4.	Complete Reference Networking	Craig Zacker, Tata McGraw-Hill Edition	0132126958

❖ **E-REFERENCES:**

<http://www.pcworld.com/article/116583/article.html> , assessed on 20th April 2016

<http://www.computerstepbystep.com/computer-maintenance.html> , assessed on 20th April 2016

<https://www.youtube.com/watch?v=a0rEXzyX0-8>, assessed on 20th April 2016

❖ **LIST OF MAJOR COMPONENTS/DEVICES WITH THEIR SPECIFICATION.**

1. Operating System(Windows 98/2000/XP/7/8/8.1/10)
2. CPU Intel core i3/i5/i7
3. Hub(4 port USB hub, TB-226)
4. Switches
5. Connectors(RJ45/BNC/AUI/FIBER)
6. Printers(INK JET/LASER)
7. Scanner(FLAT BED)
8. Crimps, Strips and cut tools(HT-200R, HT-2008R)

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Mr. S.P. Lambhade	Head of Computer Engineering	Government Polytechnic, Nagpur.
2	Dr. Mrs. A.R. Mahajan	Head of Information Technology	Government Polytechnic, Nagpur.
3.	Ms. Shifa S. Sayyed	Lecturer in Information Technology	Government Polytechnic, Nagpur.
4.	Mrs. V A Raje	System Analyst(Lecturer in Computer Engineering)	Government Polytechnic, Nagpur.
5.	Ms. Gayatri B. Chavan	Lecturer in Computer Engineering	Government Polytechnic, Nagpur.
6.	Shri. Atul Upadhyay	COE	Vista computers, Ramnagar, Nagpur
7.	Shri N. V Chaudhri	Asst. Professor (CSE)	DBACEO ,Wanadongri, Nagpur
8.	Shri Manoj Jethawa	HOD, Computer Science	Shri DattaMeghe Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME	: DIPLOMA INCE/ME/EE/EC/PK /TR/AE/TX/MT
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: FE508E
COURSE TITLE	: PC ARCHITECTURE AND MAINTENANCE
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT = 02 CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT.	: NIL

❖ RATIONALE:

As computers are heavily used for most of the activities like office automation, database management etc, the repair and maintenance of computer and its peripheral devices is becoming an essential part of the information technology. This course will enable the student to assemble different types of computer system and maintenance of different supporting equipments like printer, scanner, etc.

❖ COURSE OUTCOMES:

After completing this course students will be able to –

1. Assemble and de-assemble computer system.
2. Perform different setting on various types of printers.
3. Install various types of software's.
4. Install operating system and device drivers in system.
5. Handle computer system hardware.
6. Maintain peripheral devices.

❖ **COURSE DETAILS:****A. THEORY:**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify all the peripheral devices.	1. Pc Motherboard And Its Components	2
2.	Identify all components mounted on motherboard.		2
3.	Perform Basic Input/output System (BIOS) setting and configuration setup using Complementary Metal Oxide Semiconductor (CMOS).		4
4.	Install CDROM drive to system.	2. Storage Devices And Interfacing	2
5.	Copy data on CD, DVD		2
6.	Install different types of cards such as Video Graphics Array (VGA) or Super Video Graphics Array (SVGA) display ,sound card ,LAN card, multimedia cards etc.	3.Display Devices And Interfacing	2
10.	Perform different printer settings on different types of printers. Write down the function of each switch.	4. Input And Output Devices	4
11.	Format, partition and install a Hard Disk Drive (HDD).		4
12.	Identify components of Hard Disk Drive (HDD) as a storage device.		2
13.	Connect scanner, scan documents and pictures on the scanner available in your lab. Sample printout be attached		4
14.	Install Internal and External Modem		4
16.	Per form Internet installation.		2
17.	Connect Switched Mode Power Supply (SMPS) and identify different parts of SMPS.	5. Power Supplies	4
18.	Connect Uninterrupted Power Supply (UPS) and write down function of it.		2
19.	Connect speakers and microphones to system.		2
20.	Assemble, de-assemble computer system.	6.Troubleshooting And Tools	4
21.	Identify installed computer peripherals and test their working using diagnostic software		4
22.	Find faults related to Monitor, CPU, Hard disk, Printer and other peripherals.		4
23.	Form a pico based net using Bluetooth devices and transfer data.		4
24.	Create bootable CD and Install an operating system		2
Skill Assessment			4
Total hours			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:NIL**❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:NIL**

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
	Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6
End Of Course		End Of The Course	Questionnaires					

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Writing steps, selection, procedure	10
2	Performance	20
3	knowledge/block diagram/connection	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	3	3	-	-	-	3	3	3	-	-
2	-	-	3	3	-	-	-	3	3	3	-	-
3	-	-	3	3	-	-	-	3	3	3	-	-
4	-	-	3	3	-	-	-	3	3	3	-	-
5	-	-	3	3	-	-	-	3	3	3	-	-
6	-	-	3	3	-	-	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Upgrading and repairs PCS	Pearson, Scott Mueller, 20 th Edition, 2012	13: 9780789747103
2.	Troubleshooting Your PC	Mr. David Stone & Alfred Poor, Prentice Hall India, 2000	13: 9780735614901
3.	A+ Complete	David Groth, BPB Publication, 2006	13: 9780782128024
4.	Computer Installation and Servicing	Balasubramaniam, Tata McGraw Hill Education Pvt. Ltd, Reprint, 2011	13: 9781259082467

❖ **E-REFERENCES:**

<http://www.pcworld.com/article/116583/article.html> , assessed on 26th April 2016

<http://www.computerstepbystep.com/computer-maintenance.html> , assessed on 26th April 2016

<https://www.youtube.com/watch?v=a0rEXzyX0-8>, assessed on 26th April 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Operating System(Windows 98/2000/XP/7/8/8.1/10)
2. CPU Intel core i3/i5/i7
3. Fiber optics cable(LSFH Polymer)
4. Unshielded Twisted pairs cable(CAT 1 to CAT5)
5. Connectors(RJ45/BNC/AUI/FIBER)
6. Printers(INK JET/LASER)
7. Scanner(FLAT BED)
8. Crimps, Strips and cut tools(HT-200R, HT-2008R)

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr. Mrs. A.R. Mahajan	Head of Information Technology	Government Polytechnic, Nagpur.
2	Mr. S.P. Lambhade	Head of Computer Engineering	Government Polytechnic, Nagpur.
1.	Ms.I.G.Lokhande	Lecturer in Information Technology	Government Polytechnic, Nagpur.
2.	Mrs.V.A.Raje	Lecturer in Computer Engg.	Government Polytechnic, Nagpur.
3.	Mrs.D.P.Chanmanwar	Lecturer in Information Technology	Government Polytechnic, Nagpur.
4.	Shri. Atulupadhyay	COE	Vista computers, Ramnagar, Nagpur
5.	Shri N. V Chaudhri	Asst. Professor (CSE)	DBACEO ,Wanadongri, Nagpur
6	Shri Manoj Jethawa	HOD, Computer Science	Shri Datta Meghe Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/AE/PK/MT/EC/IT/CM /TR
LEVEL NAME	: FREE ELECTIVE COURSES
COURSE CODE	: FE509E
COURSE TITLE	: FABRIC SELECTION AND CARE
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 2 PR CREDIT = 1 CLOCK HR.)
TH. TEE EXAM	: NIL
PR. TEE EXAM	: 02 HRs (Internal)
PT. EXAM	: 01 HR

❖ RATIONALE:

Clothes are as important as food and shelter. You use them for covering, protecting and even decorating yourself. You must be having different types of clothes for different occasions like your casual attire, office wear, party dresses, and your night suit and so on. In this course technology and science behind selection of right fabric and its care is illustrated.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Judge the fibres by means of a physical test.
2. Select the yarn and fabric.
3. Illustrate and draw care labels in Textiles.
4. Identify the different methods for different stain removal from textiles.
5. Perform stain removal on fabric.
6. Suggest precaution for storage of textiles.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
NIL			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practic als	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Prepare textile fibre classification chart.	Fibre	4
2.	Detect the fibre type by means of physical test.		6
3.	Select the different types of yarn and fabric	Yarn	4
4.	Prepare chart of classification of yarn with their end uses.		6
5.	Identify different fabric formation methods.	Fabric	4
6.	Draw the plain and twill weaves on graph paper.		6
7.	Judge quality of textiles based on fibre, yarn and weave.	Selection of Textiles	4
8.	Prepare a chart of removal of different types of stain in a fabric and		6
9.	Perform stain removal on a given fabric.	Care of Textiles	4
10.	Draw care label symbols with instructions for fabrics.		6
11.	Collect 10 garment samples and note the care labels instructions	Maintenance of textiles	4
12.	Prepare the list of precautions necessary for storage of textiles.		6
Skill Assessment			4
Total Hrs.			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Nil

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Nil

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF JOB EVALUATION:**

S.N.	Description	Max. Marks
1	Chart preparation	10
2	Analysis of fabric samples	20
3	Draw symbols/diagrams / sketches	10
4	Viva voce	10
Total		50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	3	3	-	-	-	3	3	3	-	-
2	-	-	3	3	-	-	-	3	3	3	-	-
3	-	-	3	3	1	-	-	3	3	3	-	-
4	-	-	3	3	-	-	-	3	3	3	-	-
5	-	-	3	3	-	-	-	3	3	3	-	-
6	-	-	3	3	-	-	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1	Textile Fabrics:: Their Selection And Care From The Standpoint Of Use, Wear, And Launder ability,	George Henry Johnson : Harper & Brothers (1927)	B000863N32
2	Textiles	Sara J. Kadolph, Pearson Prentice Hall, 2007	0131187694, 9780131187696
3	Fabric Care	Noemia, D Souza : New Age international, 1998	978-81-224-1143-0
4	Fundamentals of Textile and their care	Sushila Dantiyagi : Orient Longman private limited, 2006	8125010270

❖ **E-REFERENCES:**

1. <http://www.textileassociationindia.org/> assessed on 20/9/2016
2. <http://www.fiber2fashion.org/>
3. <http://www.nift.ac.in/>
4. www.itamma.org/
5. <http://www.fabriclink.com/> assessed on 20/9/2016
6. <http://download.nos.org/srsec321newE/321-E-Lesson-22.pdf> assessed on 20/9/2016
7. <http://download.nos.org/srsec321newE/321-E-Lesson-26.pdf> assessed on 20/9/2016

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Mr. D. S. Kulkarni	Head of Textile Department	Government Polytechnic, Nagpur.
2.	Dr. S. B. Muttagi	Lecturer in Textile Technology	Government Polytechnic, Nagpur.
3.	Mr. S. G. Gaikwad	Lecturer in Textile Technology	Government Polytechnic, Nagpur
4.	Dr. C. P. Kapse	Lecturer in Textile Technology	Government Polytechnic, Nagpur.
5.	Mrs. L. S. Chakraborty	Lecturer in Textile Technology	Government Polytechnic, Nagpur.
6.	Prof. G.S. Kakad	Head of Textile Department	JDIT, Yavatmal
7.	Mr. R.N.Yadav	President	RSR Mohota Spinning and Weaving Mill

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/CM/TX/MT/PK/IT/TR
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: FE510E
COURSE TITLE	: TWO AND FOUR WHEELER TECHNOLOGY
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT.	: NIL

❖ RATIONALE:

Today majority of people using a vehicle and it becomes a common need of daily life. Therefore, it is felt that one must have knowledge about the various systems and their functional importance and working in the context of automobile and its maintenance. The course aims to impart basic skills and understanding of two and four -wheeler systems basic components their working principle and basic maintenance procedure. Hence, this course has been offered for student of various diploma programme as one of the Allied Courses as “Credit Non-Exam Course”

❖ COURSE OUTCOMES:

After completing this course students will be able to–

- Identify various systems of two wheeler.
- Identify various systems of four wheeler.
- Use different tools required for preliminary maintenance of vehicle.
- Practice to drive two and four wheeler vehicle or simulator.
- Practice various technique and procedure for finding general fault and repair them
- Prepare a report on Motor Vehicle Rules, Road Signals safety and precautions etc.

❖ COURSE DETAILS:

❖ A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
NIL			

❖ **B. PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:**

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify the various systems of two wheeler and write report. Report includes- -Classification of two wheeler -Block diagram of various system of two wheeler -function of various systems.	Introduction to Automobile	04
2	Identify the various systems of four wheeler and write report. Report includes- -Classification of four wheeler -Block diagram of various system of four wheeler -function of various systems.		06
3	Use off hand tools and special tools required for maintenance of two and four wheeler vehicle.		06
4	Prepare a report on Motor Vehicle act and traffic signs. Reports includes- -Various motor act. -Driving license requirement. -Traffic signs. -Insurance of vehicle.	Motor Vehicle Act	10
5	Practice four wheeler driving training on simulator.		20
6	Identify below mention faults in two wheeler and repair them. 1) Starting Problem. 2) Mileage Problem. 3) Pick-up Problem. 4) Abnormal sound from Engine and Transmission System.	Fault finding and maintenance of Automobile	08
7	Identify below mention faults in Four wheeler and repair them. 5) Starting Problem. 6) Mileage Problem. 7) Pick-up Problem. 8) Abnormal sound from Engine and Transmission System.		08
Skill Assessment			02
Total hours			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:NIL**❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:NIL**

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing of Sketch, selection of equipment's, procedure etc.	20
2	Performance	10
3	Conclusion	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	-	-	-	-	-	3	3	3	-	-
2	-	-	-	-	-	-	-	3	3	3	-	-
3	-	-	-	3	3	-	-	3	3	3	-	-
4	-	-	3	3	3	-	3	3	3	3	-	-
5	-	-	3	3	3	3	-	3	3	3	-	-
6	-	-	-	-	3	3	3	3	3	3	-	-

1-Slight (Low) 2-Moderate (Medium) 3 –Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

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, 2013	97881801419669
2	Automotive Mechanics	S. Srinivisan,Tata McGraw – HILL, 2nd Edition, 2003	9780070494916
3.	Basic Automobile Engineering	Nakra CP , Dhanpat Rai Publishing Company (P) Limited,2009	9788187433224
4.	Automotive Mechanics	S. Srinivisan,Tata McGraw – Hill, 2 nd Edition, 2003	9780070494916
5	The Motor vehicle Act	Goverment Publication, 1989.	Government Publication

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS**

- ❖ Air compressor-1 HP 3 phase, Max Pressure: 4, 95 kg/cm², 70 ltr.
- ❖ Engine Crane –Hydraulic, 2 ton Capacity.
- ❖ Bottle/Floor/Scissor Jacks- 3 ton Capacity.
- ❖ Two Post Lift- Capacity 3.5 Ton, Max Lifting ht - 1830 mm, Min Lowering height - 110 mm, Post height - 3700 mm Lifting time - 55 Secs, Width between posts : 2800 mm, with 1 HP / 2 HP power pack 1 or 3 phase
- ❖ Air hydraulic press - Capacity: 30 Ton. Air pressure: 100-140 PSI. 2 Press plates included (designs may vary) Air inlet fitting: 1/4" NPT
- ❖ Socket/ Impact wrenches- 1/4", 3/8", 1/2" and 3/4"
- ❖ Torque wrenches- 3/8", 1/2" and 3 NM, Ratcheting type/Click-type.
- ❖ Driving simulator.
- ❖ Road signs.
- ❖ Vehicle with two paddle control.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr.K.S.Dixit	I/C, Head of Automobile Engineering	Government Polytechnic, Nagpur.
2.	Mr. S.D.Thakre	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
3.	Mr. R.B.Tirpude	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
4.	Mr. Syed J.M.	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
5.	Mr. V.S.Kumbhar	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
6	Mr. A.R.Yadgire	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN CE/ME/AE/PK/MT/EC/IT/CM /TX
LEVEL NAME : FREE ELECTIVES
COURSE CODE : FE511E
COURSE TITLE : ENERGY CONSERVATION AND MANAGEMENT
PREREQUISITE : NIL
TEACHING SCHEME : TH: 00; TU: 00; PR: 04(CLOCK HRS.)
TOTAL CREDITS : 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE : NIL
PR. TEE : 02 HRS (Internal)
PT. : NIL

❖ RATIONALE:

Energy conservation is a scientific and basic tool to make balance in different forms of energies. This course imparts the awareness, knowledge and practical skills/ techniques of energy conservation in various sectors. After completion of this course diploma engineering students must use various techniques and methods of energy conservation. Also they should be able to perform energy audit and its implementation.

COURSE OUTCOMES:

After completing this course students will be able to–

1. Determine losses in Mechanical System
2. Use different methods of energy conservation
3. Collect information related to star rating equipment
4. Use energy conservation equipment for energy audit
5. Design efficient illumination scheme for energy conservation
6. Prepare energy audit report.

❖ COURSE DETAILS:

THEORY:

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
Nil			

A. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs
1.	Use different dynamometers and tachometer for measurement of power of rotating shaft.	Mechanical Measurement	4
2	Use RDT PT100 thermal sensor and its module for measurement of temperature at different stages in IC engine.		2
3	Use anemometer and measure quantity of air supplied to IC Engine.		2
4	Determine Volumetric and overall efficiency of two stage reciprocating compressor by conducting trial on test rig.	Mechanical Performance Measurement	4
5	Determine overall efficiency of centrifugal pump and plot operating characteristics by using centrifugal test rig.		4
6	Calculate coefficient of performance by conducting trial on vapour compression refrigeration test rig.		4
7	Collect performance information of 5 stars and 2 stars, same brand split AC and compare the results in terms of energy consumption.	Basic of Energy Conservation	2
8	Calculate electric bill for electric water heating system. Compare it with cost of solar water heating system and calculate payback period of solar water heating system.		2
9	Connect voltmeter, ammeter and wattmeter in electric circuit to measure voltage, current and power required for energy audit.		2
10	Determine losses of single phase Transformer at No load, Half load and Full load by conducting load test.		2
11	Use power guard meter for measurement of different electrical quantities		2
12	Calculate payback period of energy efficient motor. Compare losses of energy efficient motor with similar capacity conventional motor.	Energy Conservation Methods	4
13	Calculate energy saving by using energy efficient equipments like automatic Star – Delta starter for three phase induction motor		4
14	Calculate energy saving in lighting system by retrofitting tube lights with LED lamps. Also calculate payback period.		4
15	Measure illumination level of different places with the help of Digital Lux Meter		4
16	Design illumination Scheme for any one of the following by using energy efficient luminaries; a) Flat b) Bungalow c) Independent House		4
17	Mini project Prepare Energy audit report of any institute/Industry/Hospital/Residence/small workshop.		4

18	Prepare report on visit to cogeneration system.		4
19	Prepare detail report and give presentation in the class on any one of the following topics , i) Energy conservation and Environmental issues ii) Market survey on energy efficient luminaries iii) Market survey on energy efficient motors and transformers. iv) Energy tariff system in India v) Energy conservation equipments vi) Energy Management vii) Energy Audit viii) Energy conservation act 2003		4
Skill Assessment			2
Total Hrs			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Not Applicable

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Not Applicable



❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6	
	End Of Course			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipments, writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs (if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	3	-	3	3	-	3	-	3	-	-
2	-	-	3	-	3	3	-	3	-	3	-	-
3	-	-	-	-	-	3	-	3	3	3	-	-
4	-	-	3	2	3	-	-	3	3	3	-	-
5	-	-	3	-	-	-	-	3	-	3	-	-
6	-	-	3	-	3	3	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Generation and Utilization of Electrical Energy	D.Srilatha S.Sivnagraju M.Balasubbareddy Pearson , New Delhi	8131798771, 9788131798775
2.	India – The Energy Sector	P.H. Hederson, University Press,	
3.	Energy management Handbook	W.CTurner, Wiley Press	10: 142008870X
4.	Efficient Use and management of electricity in industry.	B.G. Desai, J.S.Rana, A.V. Dinesh, R. Paraman, Devki Energy Consultancy PVT Ltd	
5.	Renewable Energy Technologies- A Practical guide for beginners	Chetan Singh Solanki, Prentice-Hall of India PVT. Ltd., First, 2008.	978-81-203-3434-2
6	Chetan Singh Solanki, Prentice-Hall of India PVT. Ltd., First, 2008.	Renewable Energy Technologies- A Practical guide for beginners	-978-81-203-3434-2-

7	Non-Conventional Energy Resources	D.S.Chauhan, S.K.Srivastava, New Age International (P) Ltd. Publishers, Second 2011.	13:978-81-224-1768-5
8	Renewable Energy Sources & Conversion Technology	N.K. Bansal, Kleemann, Meliss	0074600230, 9780074600238.
9	Illuminating Engineering	Kamlesh Roy, Laxmi Publication, 2006	9789380386553

❖ **E-REFERENCES:**

1. www.bee.india.nic.in , accessed on 11th November, 2016
2. www.mnes.nic.in , accessed on 11th November, 2016
3. www.energymanagertraining.com , accessed on 11th November, 2016
4. www.greenbusiness.com , accessed on 11th November, 2016
5. www.worldenergy.com , accessed on 11th November, 2016
6. www.mahaurja.com , accessed on 11th November, 2016

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

1. Lux meter
2. Ammeter MI 0-5-10 A
3. Voltmeter MI 0-150-300 V
4. Wattmeter 0-3000 W
5. Digital Multi-meter
6. Rheostat assorted sizes
7. PV Solar panel
8. Energy efficient motors
9. Energy efficient transformer
10. Energy efficient luminaries
11. Energy efficient Equipments /Devices
12. Power Guard Meter (For measurement of V, I, W, VA, PF, KWh)

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr. C.S.Thorat	Principal	Government Polytechnic, Nagpur.
2.	Mr. O. V. Sarode	I/C, Head of Mechanical Engineering	Government Polytechnic, Nagpur
3.	Mrs. K.M.Gaidhane	I/C, Head of Electrical Engineering	Government Polytechnic, Nagpur.
4.	Mr. A.R. Shaikh	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.

4.	Mrs.S.P.Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5.	Dr. R.S.Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr.G.V.Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mr.N.H.Adikine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Bhashkar Bale	Dy. Executive Engineer,	MSTCL, Nagpur
9	R.Y.Ghormade	Head of Electrical Engineering	Dharampeth Polytechnic, Nagpur
10	DR. S.S.Bharatkar	Lecturer in Electrical Engineering	Government Polytechnic, Amaravati.

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/AE/PK/MT/EC/IT/CM /TX/TR
LEVEL NAME	: ELECTIVE COURSES
COURSE CODE	: FE512E
COURSE TITLE	: LEARNING ABILITY DEVELOPMENT
PREREQUISITE	: NIL
TEACHING SCHEME	: TH: 00; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT =2CLOCK HR.)
TH. TEE	: NIL
PR. TEE	: 02 HRs (Internal)
PT.	: NIL

❖ RATIONALE:

Learning ability of an engineer or professional is essential through the level at which he/she has developed and persuades his/her hobby. It enhances the creativity. Hobby is integral and important part of human personality. Hobby is best for recreation which rejuvenates a person. To obtain maximum benefits from hobby the overall understanding and competency in performance is utmost important.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Develop learning ability through hobby.
2. Appreciate importance of hobby in developing learning ability.
3. Choose related equipments, consumables and gears.
4. Maintain related equipments.
5. Carry out setting of equipment.
6. Exhibit learning through performance.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Present following: Learning ability development through hobby.	Introduction	4
2	Collect information about present scenario of related field – Experts in India, Experts in your city	Awareness Development	4
3	Demonstrate different related equipments.	Demonstration	4
4	Demonstrate Performance.		4
5	Practice setting up related instruments	Practice	4
6	Practice performance –level I		20
7	Practice performance –level II		16
8	Practice tuning and preliminary maintenance of related instruments.		4
Skill Assessment			4
Total Hrs			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Not Applicable

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Not Applicable

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End Of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	1, 2, 3, 4,5,6
		Journal Writing		Continuous	05	--	Journal	1, 2, 3, 4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	50	20	Rubrics & Printouts	1, 2, 3, 4,5,6
	Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6
End Of Course		End Of The Course	Questionnaires					

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Practical on setting up / tuning related instruments	10
2	Performance –level I	20
3	Performance –level II	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	-	-	-	-	-	-	-	-	3	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	3	3	-	3	-	3	3	3	-	-
4	-	-	3	3	-	3	-	3	3	3	-	-
5	-	-	3	3	-	3	-	3	3	3	-	-
6	-	-	3	3	-	-	-	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
NIL			

❖ **E-REFERENCES:**

- ❖ <https://en.wikipedia.org/wiki/Hobby>
- ❖ www.justdial.com/Nagpur/Hobby
- ❖ nagpur.quikr.com

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION**

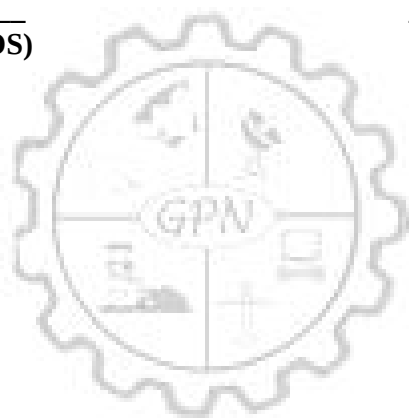
- ❖ As per requirement of related field.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1.	Dr. C.S.Thorat	Principal	Government Polytechnic, Nagpur.
2.	Dr. K.S.Dixit	Head of Automobile Engineering	Government Polytechnic, Nagpur.
3.	Mr. S.A.Telang	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
4.	Mr. R.B.Tirpude	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur
5.	Mr. J.M.Syed	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)



Vision of the Metallurgical Engineering Program

To produce excellent, self-motivated, creative and ethical metallurgical technicians for industries and society.

Mission of the Metallurgical Engineering Program

- M1 :** To develop and deliver quality academic programs in Emerging field of Metallurgical Engineering to empower the students to meet industrial needs with environmental concern.
- M2 :** To adopt the best Instructive methods to maximize knowledge transfer.
- M3 :** To provide the best facility, infrastructure and environment to the students and faculty members, creating an ambience conducive for excellence in Metallurgical Engineering education.
- M4 :** To impart quality education to inculcate moral values, professional ethics and Entrepreneurial qualities

Program Educational Objectives - PEOs

- PEO1** : To provide a strong background of science and humanities in order to use these tools in Metallurgical Engineering.
- PEO2** : To develop the ability to demonstrate technical and administrative competence.
- PEO3** : To develop innovative ideas of recent technology for benefits of society with environmental concern.
- PEO4** : To attain professional excellence through life-long learning and produce supervisors who ensure ethical and moral behavior.

Program Specific Outcomes - PSOs

- PSO1** : Select appropriate test method for inspection of castings and other metallurgical products.
- PSO2** : Engage in preparing charge for producing quality steel.

Program Outcomes

- PO1 : Basic Knowledge:** Ability to apply knowledge of basic Mathematics, Science and Engineering to solve the engineering problems.
- PO2 : Discipline Knowledge:** Ability to discipline specific knowledge to solve core and/or applied engineering problems.
- PO3 : Experiments and Practice:** Ability to plan and perform experiments and practices and use the results to solve engineering problems.
- PO4 : Engineering Tools:** Apply appropriate technologies and tools with understandings of limitations.
- PO5 : The Engineer and Society:** Demonstrate knowledge to assess the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.
- PO6 : Environment and Sustainability:** Understand the impact of engineering solutions in societal and environmental context, and demonstrate knowledge and need for sustainable development.
- PO7 : Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
- PO8 : Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.
- PO9 : Communication:** An ability to communicate effectively.
- PO10: Life-long learning:** Recognise the need for, and have preparation and the ability to engage in independent and life-long learning in context of technological changes.



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