OUTCOME BASED CURRICULUM 2016

Program

Diploma in Electrical Engineering



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Mission of Institute

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M4 : To enhance the skills of faculties and staff through industry institute collaboration

OUTCOME BASED CURRICULUM 2016

Program: Diploma in Electrical Engineering



by

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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 vias 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- 31stMarch, 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.

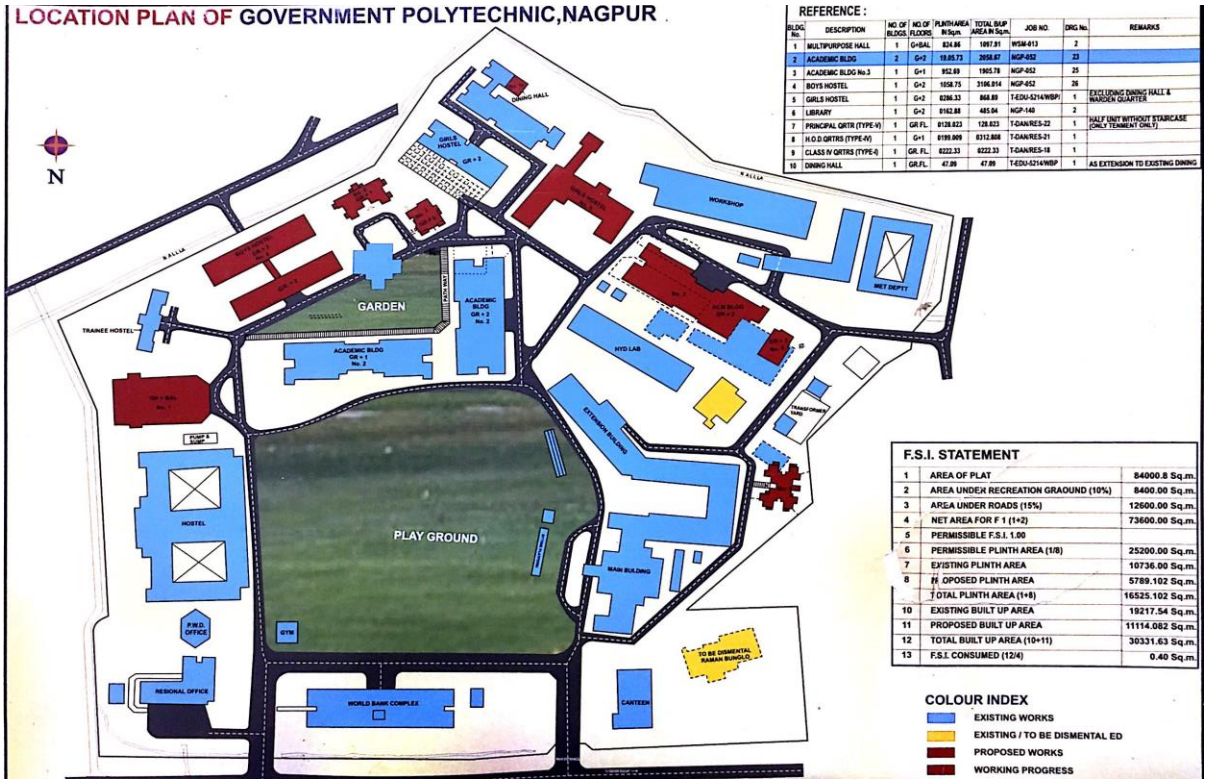


Figure 1.2. Government Polytechnic, Nagpur Campus

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.

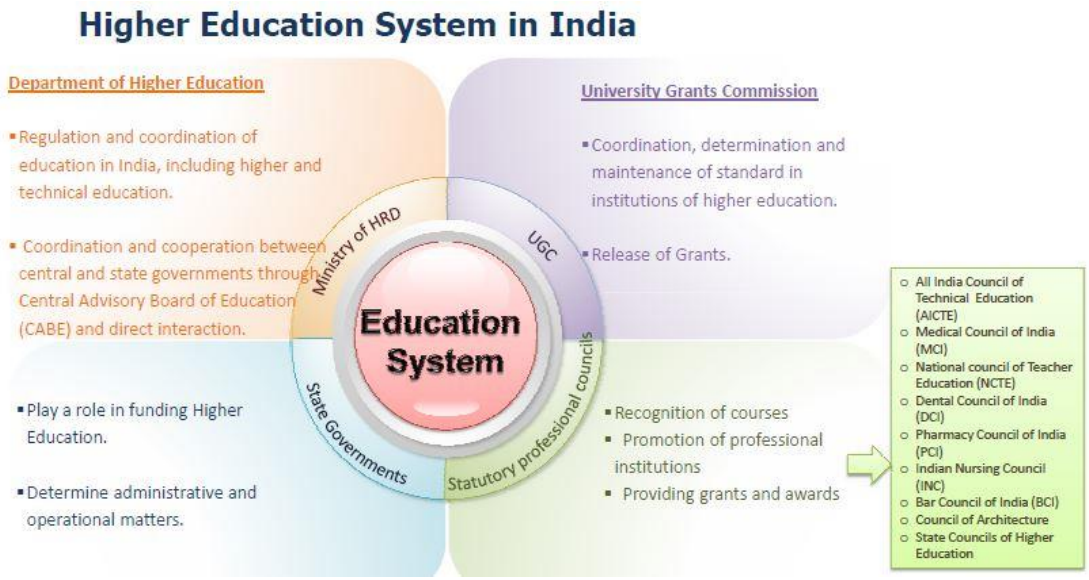


Figure 2.1. Higher Education System in India

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

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 aim of any country's higher education system is sustainable development and achieving

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

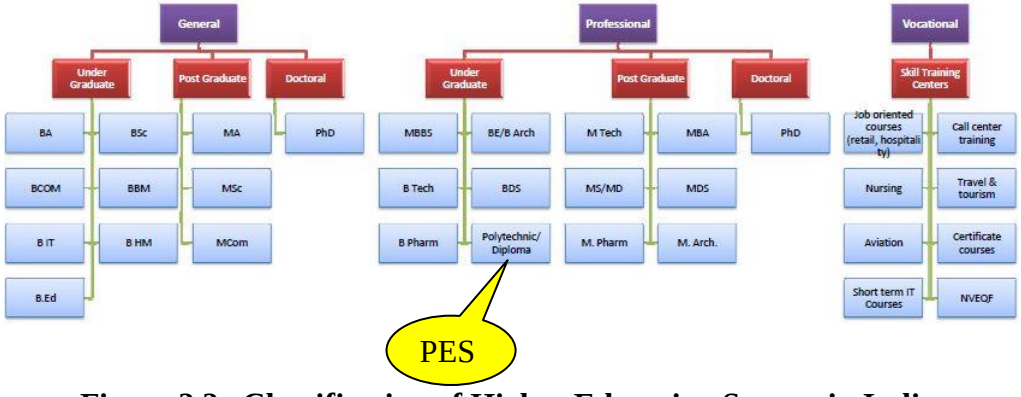


Figure 2.2. Classification of Higher Education System in India

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-31stMarch, 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.

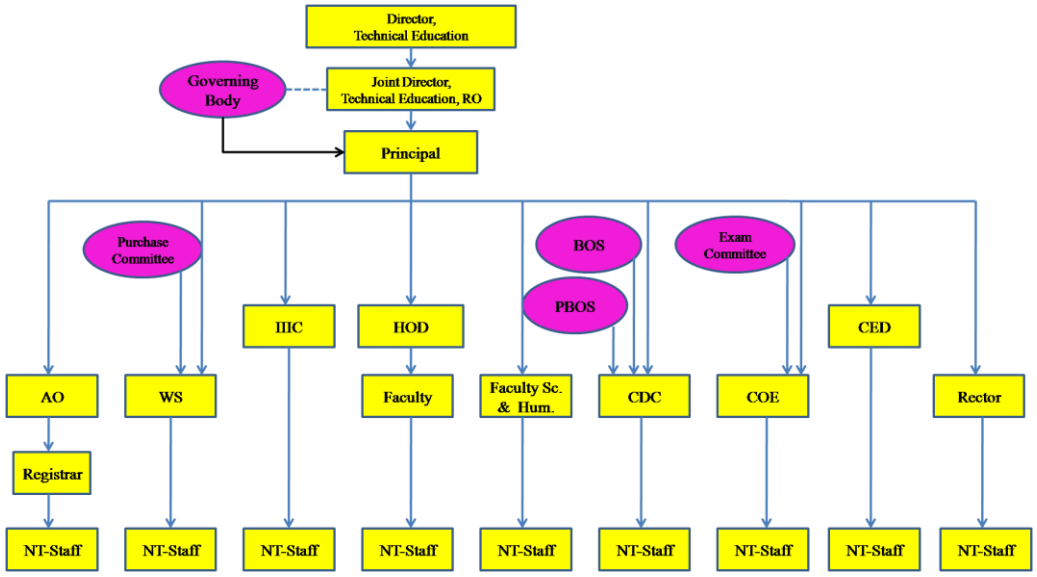


Figure 3.1. Organizational Structure of GPN

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.

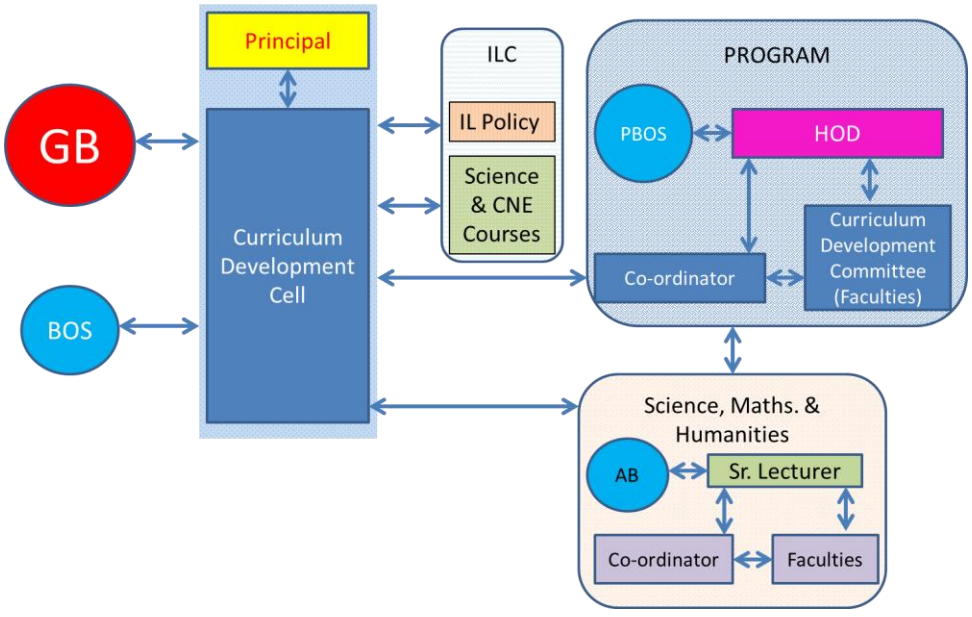


Figure 3.2. Curriculum Development System

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 course wise.
3. Analyse of personnel development.
4. Formation of Programme objectives.
5. Selection of contents.
6. Design of student's evaluation.
7. To decide resources required and development thereof.
8. To decide strategy of implementation.
9. Recommend equivalence for granting exemptions.

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?

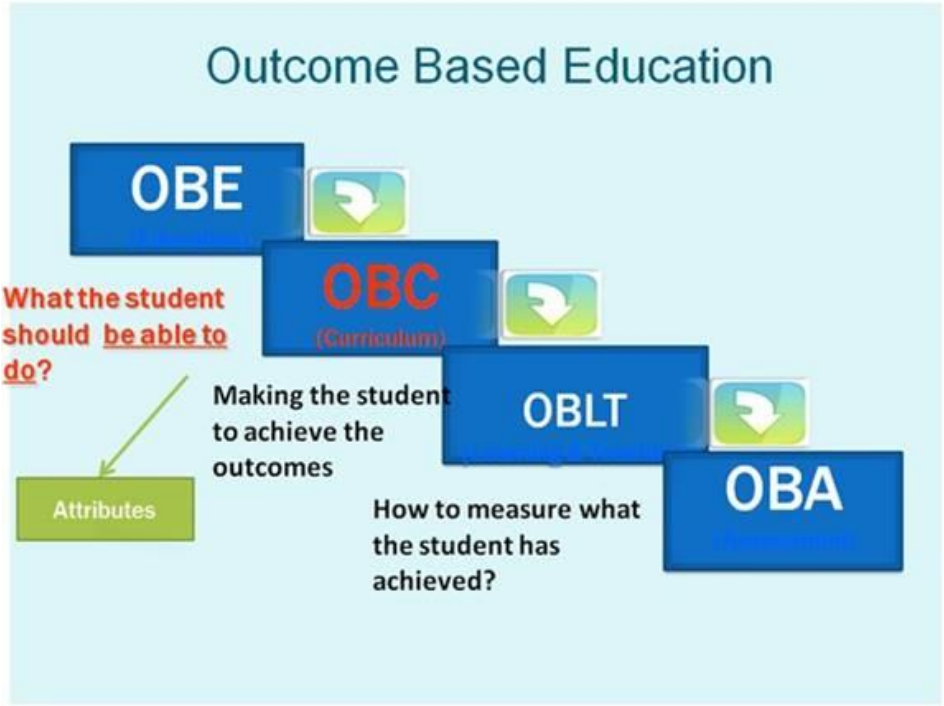


Figure 4.1. Outcome Based Education Framework

4.2 KEY constituents of OBE

Figure 4.2 shows the key constituent of OBE.

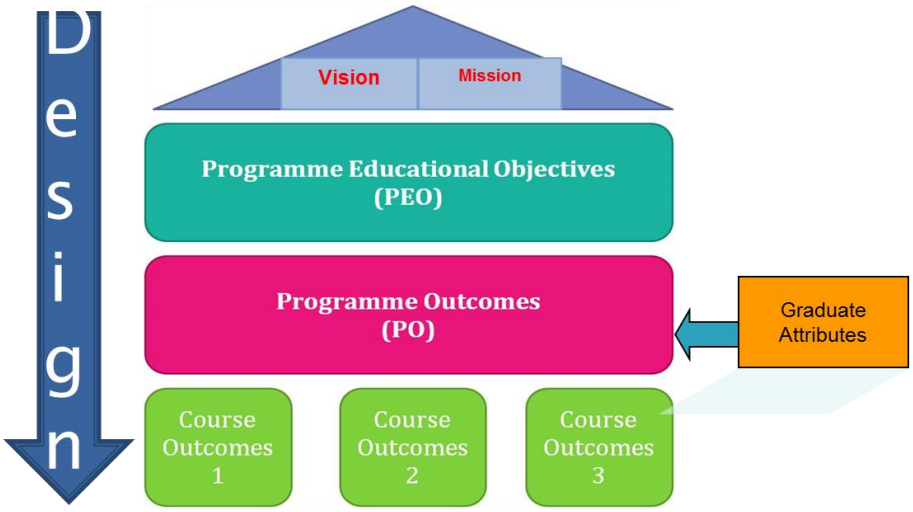


Figure 4.2. Key Constituents of OBE

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.

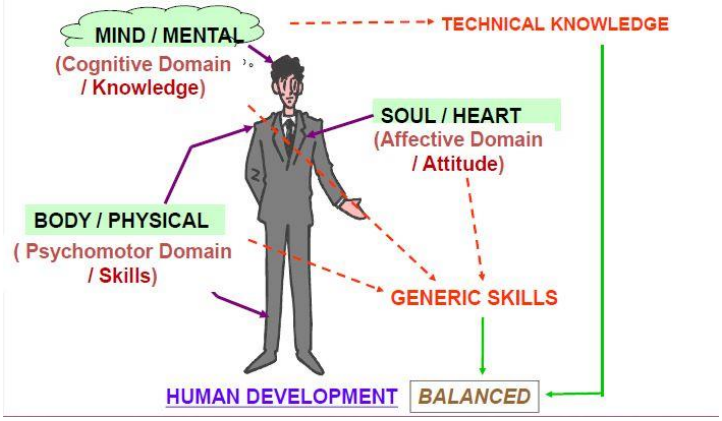


Figure 5.1. Human Being and Domains of Learning

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.

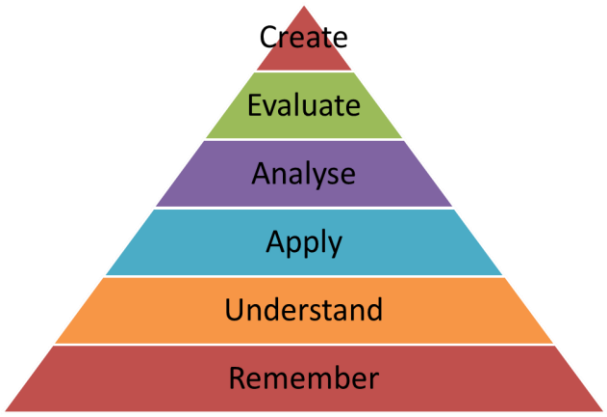


Figure 5.2. Revised cognitive hierarchy Levels

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.

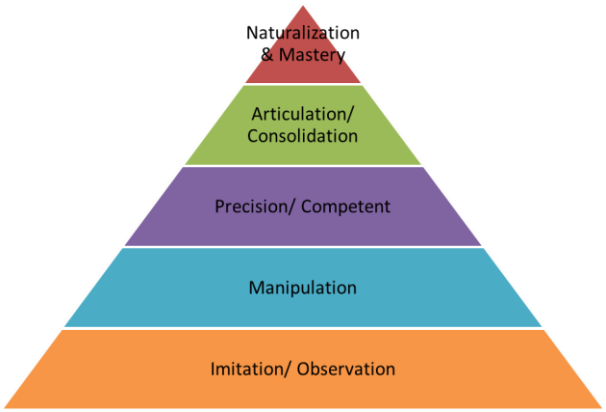


Figure 5.3. Psychomotor hierarchy Levels

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.

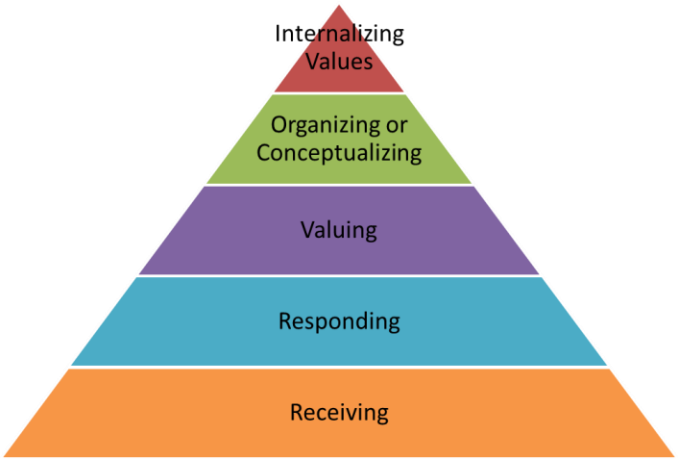


Figure 5.4. Affective Domain hierarchy Levels

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

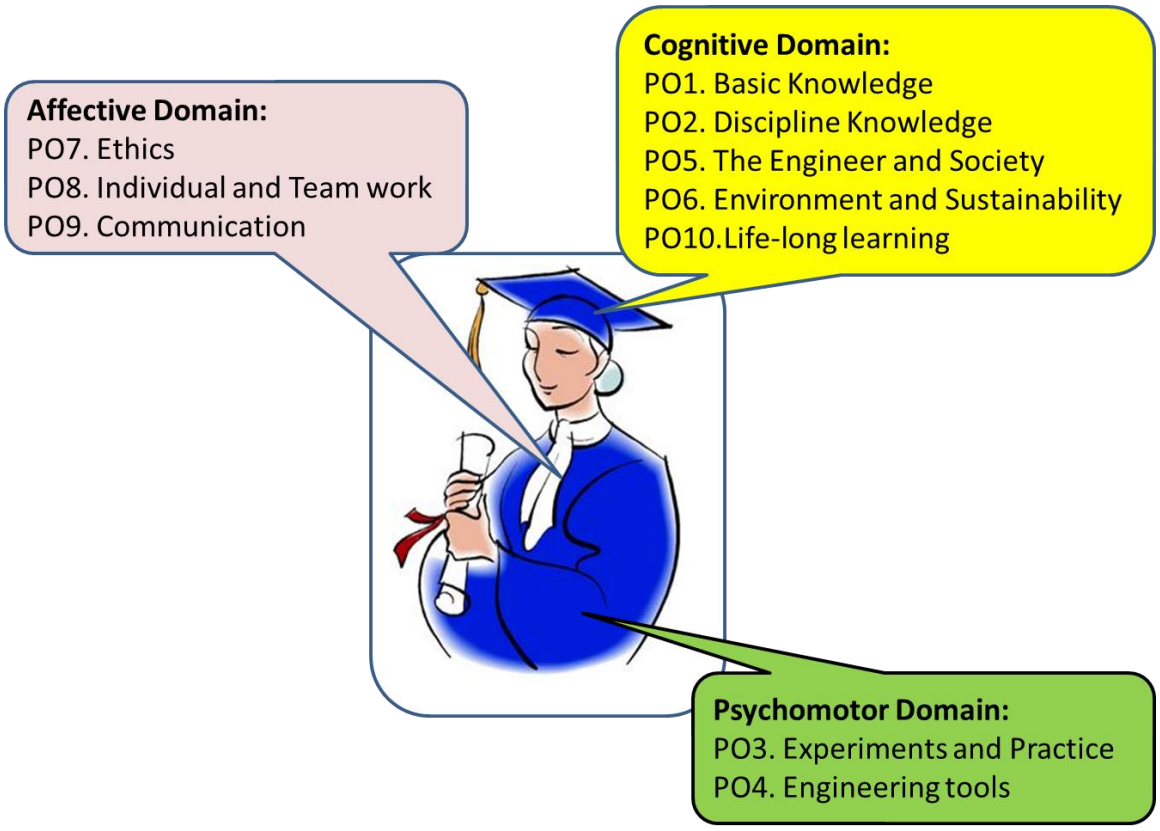


Figure 5.5. Program Outcomes and Domains of Learning

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:

- **A**wareness : Awareness of the need for change
- **D**esire : Desire to participate and support the change
- **K**nowledge : Knowledge on how to change
- **A**bility : Ability to implement required skills and behaviors
- **R**einforcement : 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.

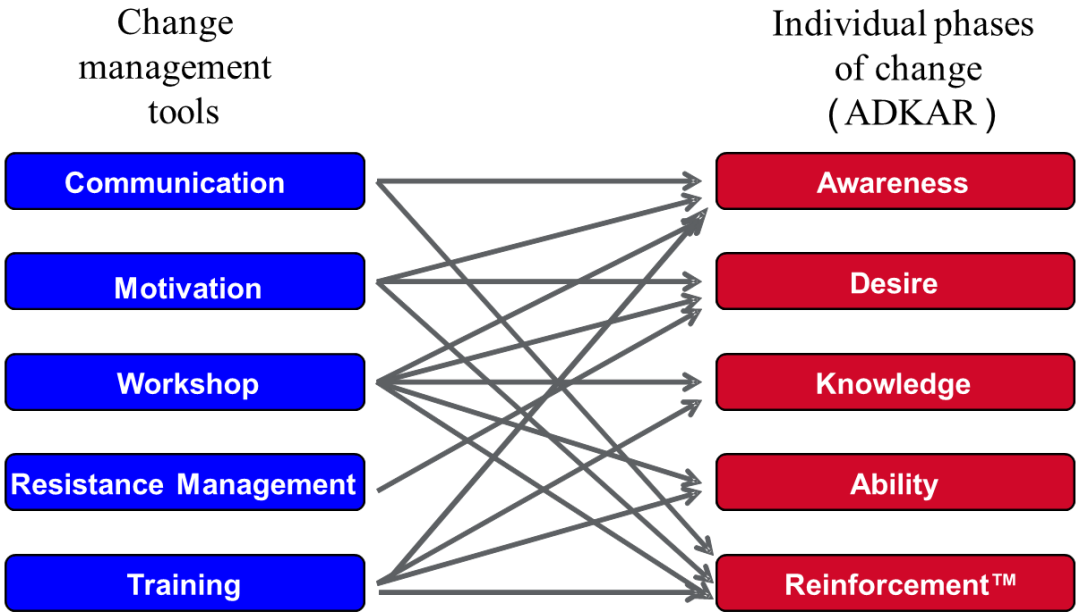


Figure 6.1. Mapping of change management tools with ADKAR

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 arrange 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 Basic Knowledge	PO2 Discipline Knowledge	PO3 Experiments and Practice	PO4 Engineering tools	PO5 The Engineer and Society	PO6 Environment and Sustainability	PO7 Ethics	PO8 Individual and Team work	PO9 Communication	PO10 Life-Long Learning	PSO1 Maintain Electrical Equipment's	PSO2 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 360^0 approach model. Based on this 360^0 CDC developed our own model based on the study of described above. Government Polytechnic, Nagpur model is named as GoPoNa Model. The model is as shown in figure 6.2.

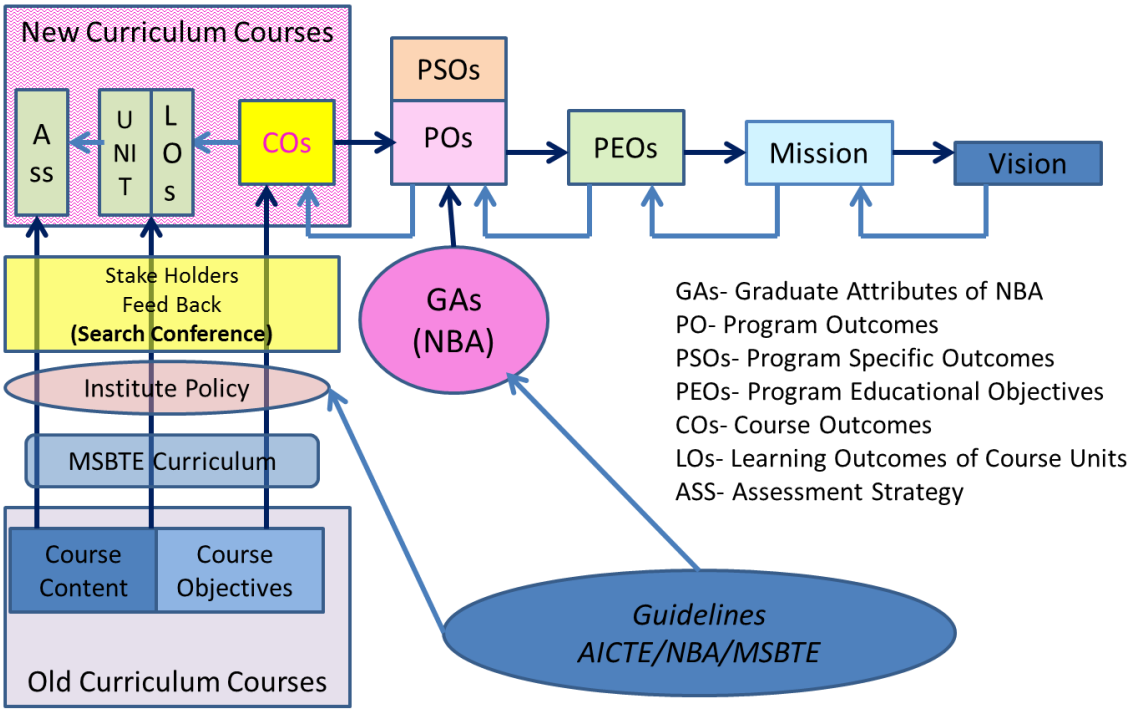


Figure 6.2. GoPoNa Model

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 360^0 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 (shown in table 6.15) and draft curriculum of Basic Electrical Engineering is developed (described in chapter 7) 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)				
								Theory		Practical		Total Marks
				TH	TU	PR		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 PBOS 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.

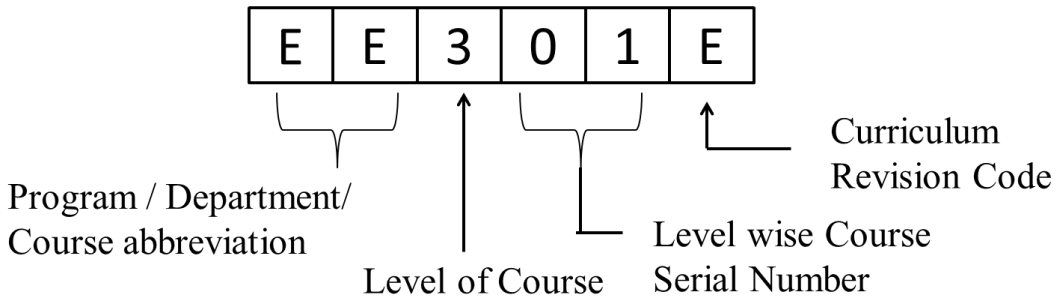


Figure 7.1. Course Code

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

In 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 **Electrical 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 Electrical Engineering Program:

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

8.4 Mission of Program

Mission of the Electrical Engineering Program:

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

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

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

M4: To inculcate moral values & professional ethics.

8.5 Program Educational Objectives (PEOs)

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

PEO1: To provide solid fundamentals in science and humanity.

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

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

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

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

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 aassess 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 preperation and the ability to engage in independent and life-long learning in context of technological changes.

8.7 Program Specific Outcomes (PSOs)

PSO1: Maintain Electrical Equipment

PSO2: Maintain Electrical Power Systems

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 Electrical Engineering Diploma Students

T1. Maintain different types of 1-phase and 3-phase transformers
T2. Troubleshoot of motorized and non-motorized domestic appliances
T3. Troubleshooting of various electrical machines
T4. Acquaint with the performance of sub-stations operation & testing of sub-stations
T5. Use different types of test and measuring instruments used to measure various electrical/electronic parameters
T6. Select cables as per construction & application of cables.
T7. Implement the schedule for preventive maintenance as per I.S. for electrical equipment using appropriate hand tools
T8. Maintain Storage Battery
T9. Design & Estimation of LT distribution systems of overhead lines and underground cables
T10. Calibrate various types of electrical meters
T11. Interpret circuit diagrams and specifications of electrical systems given in technical/service manuals.
T12. Operation of different analog and digital electronic circuits associated with electrical installation and instruments
T13. Estimate the quantity and cost of electrical work/installations
T14. Design and estimation of multi storied electric systems.
T15. Select proper industrial heating, welding ,electrolytic ,refrigeration& Air conditioning processes.

T16. Installation & test of domestic and industrial wiring as per IE & IS & perform Earth test & insulation test.
T17. Use & test different measuring, indicating and recording electrical and electronic instruments and its error analysis
T18. Evaluate the electrical performance of transmission lines
T19. Acquaint with the Operation of Electric generating stations and sub-stations
T20. Acquaint with Operation & control of Electric Traction Systems
T21. Use computer based software for simplle applications in Electrical Engg.
T22. Construction & Operation of wind turbines.
T23. Construction & Operation of solar photo voltaic (PV) systems and storage batteries
T24. Construction & Operation of solar heating systems
T25. Construction & Operation of ocean energy systems
T26. Use PLCs, SCADA, microprocessor and Micro-Controllers for various applications
T27. Selection of Electric drives for different industrial application
T28. Prepare a report on technical visits.
T29. Operating Testing & maintenance of electrical machines
T30. Energy conservation methods, techniques & energy audit
T31. Construction & operation of Relays, CBs.
T32. Selection of cts & PTS
T33. Testing of relays & CTs, PTS.
T34. Selection of material swith specification for street lighting
T35. Selection of accessories required for electrification.
T36. Read electrical circuit diagram network & electrical drawing
T37. Draw an electrical engineering drawing plan for given installation system
T38. Calculate the length of wire & conduit required for electrification
T39. Prepare a switch board
T40. Install PVC surface conduit & casing capping wiring.
T41. Rewinding of chokes, transformers & single phase motor.
T42. Specify the types of ACSR conductors
T43. Select the type of conductor & insulator for installation of LT/HT line
T44. Make energy conservation in any field.
T45. Installation of solar panel
T46. Testing of solar panel
T47. Handle different drives
T48. Installation of IM
T49. Select modern luminaries for residential application

T50. Calculate the no of lamps required for uniform illumination
T51. Specify different sources of pollution
T52. Mention the % of GHG gases in environment
T53. Prevent water pollution, air pollution, sound pollution.
T54. Prepare tenders & contract documents.
T55. Illustrate the atomic structure of conductor, insulator, and semiconductor**.**
T56. Design PCB
T57. Prepare different electronic circuit.
T58. Develop working model for project.
T59. Prepare the layout for substation.
T60. Draw single line, Multiline, schematic diagram
T61. Sketch the part of any machine.
T62. Solve problem of society, industry.
T63. Analyse the faults & remedies.
T64. Explain the protection system fot particular machine of power system
T65. Calculate Fault KVA at particular fault point.
T66. Simplify & solve the circuit by using network theorem
T67. Interpret phase relation in current & voltage for any elct. Circuit.
T68. Compare three phase & single phase system
T69. Develop attitude for enterprenureship.
T70. Draw electrical drawing using computer
T71. Prove the relationship in line & phase values
T72. Describe methods of cable laying.
T73. Select proper wiring system for particular application
T74. Select protective switches with specification for domestic.
T75. Identify & select proper materials for electrical engg. appliances.
T76. Prepare automatic working system of any day to day problem
T77. Record reading of electrical parameters measuring meters/instruments.
T78. Measure active & reactive power in electrical circuit.
T79. Observe the parts of ammeter, voltmeter, and wattmeter
T80. Select & connect any measuring instrument in circuit
T81. Co-ordinate physical quantities with electrical quantities
T82. Read digital & analog quantities
T83. Test the efficiency of different machines.
T84. Locate & diagnose faults in electrical wiring & installations.
T85. Write about different wielding systems.

T86. Assemble & dismantle of different parts of M/C as well as domestic appliances.
T87. Audit the system for energy conservation
T88. Survey of market & analysis of Market prices
T89. costing of given Material
T90. Use of microcontrollers in the ckt.
T91. Prepare technical report.
T92. Work on lathe machine
T93. Installation of Transformer
T94. Analyse the different electrical laws with examples.
T95. Draw & describe block diagram of Smart grid system .
T96. Theft of electrical energy in LT & HT network.
T97. Acquainted with power supply arrangements & train lighting systems in AC Traction systems.
T98. Select proper turbines in generating power plant.

8.9.2 Generic skills for Electrical Engineering Diploma Holder

G1.Communicate effectively in English in oral and written form with superiors, Subordinates and peers
G2. Manage people at work
G3. Work as a group leader & as a team member to achieve goals
G4. Lead group discussions and meetings independently
G5.Use all resources like media, market survey, technical literature etc. to gather Information for taking decisions
G6. Prepare detailed project proposals and reports for identified products/services.
G7. Prepare tender documents & comparative statements
G8. Use insulators for various applications
G9. Select appropriate advanced materials for specific applications in engineering
G10. Follow safety practices & pollution control measures
G11. Develop mathematical & reasoning ability
G12. Deliver seminar on any selected topic
G13. Develop economical systems for rural development.
G14. Maintain the bonding with society.
G15. Maintain the ethics & values in professional practices
G16. Co-ordinate the science & technology

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	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
EN1101	English	X	-	X	-	-	-	-	X	X	X	-	-
EN1102	Communication Skills	X	-	X	-	-	-	-	X	X	X	-	-
IT1101	I.T.Applications	X	-	X	X	-	-	-	X	X	X	-	-
ME1101	Industrial Organization & Management	X	-	-	-	X	X	X	-	-	X	-	-
EV1101	Environmental Science	X	-	-	-	X	X	X	X	X	X	-	-
PH1201	Engineering Physics	X	-	X	X	-	-	-	X	-	X	-	-
CH1201	Engineering Chemistry	X	-	X	-	-	-	-	X	-	X	-	-
MH1201	Basic Engineering Mathematics	X	-	X	-	-	-	-	X	-	X	-	-
MH1202	Engineering Mathematics	X	-	X	-	-	-	-	X	-	X	-	-
MH1204	Applied Mathematics	X	-	X	-	-	-	-	X	-	X	-	-
AM1301	Engineering Mechanics	X	-	X	X	-	-	-	X	-	X	-	-

WS1302	Workshop Practice	X	-	X	X	-	-	X	X	X	X	-	-
ME1301	Engineering Graphics	X	X	X	X	X	X	X	X	-	X	X	X
CM1308	C-Programming	X	-	X	X	-	-	-	X	-	X	-	-
ME1303	Elements Of Mechanical Engineering	X	-	X	X	-	-	-	X	X	X	-	-
EE1301	Basic Electrical Engineering	X	X	X	X	-	-	-	X	X	X	X	X
EC1310	Elements Of Electronics Engineering	X	-	X	-	-	-	-	X	-	X	-	-
EE1401	Electrical Circuit & Network	X	X	X	X	-	-	-	X	-	X	X	X
EE1402	Electrical Measurement	X	X	X	X	X		X	X		X	X	X
EE1403	Instrumentation	-	X	X	X	-	-	-	X	-	X	X	X
EE1404	Electrical Machine Fundamentals	-	X	X	X	-	-	-	X	X	X	X	X
EE1405	Electrical Machine Operation	-	X	X	X	-	-	-	X	-	X	X	X
EE1406	Electrical Wiring	-	X	X	X	-	-	X	X	X	X	X	X
EE1407	Generation Engineering	-	X	-	-	-	X	X	-	-	X		X
EE1408	Renewable Energy Sources	-	X	-	-	X	X	-	-	-	-	-	X
EE1409	Transmission & Distribution	-	X	X	X	-	X	X	X	-	X	-	X
EE1410	Switchgear & Protection	-	X	X	X	-	-	-	X	X	X	X	X
EE1411	Inst. Testing & Main. Of Elect. M/C	-	X	X	X	-	-	X	X	-	X	X	X
EE1412	Electrical Installation System	-	X	X	X	X	X	X	X	X	X	X	X
EE1413	Electrical Utilization & Traction	-	X	-	-	X	X	-	-	-	-	-	X

EC1411	Industrial Electronics	-	X	X	X	-	-	-	X	-	X	-	-
EE1414	Electrical Materials and Domestic Appliances	X	X	X	X	-	-	-	X	X	X	X	X
EE1415	Electrical Drawing	-	X	X	X	-	-	-	X	-	X	-	-
EE1416	Electrical and Electronics Workshop	-	X	X	X	-	-	-	X	X	X	X	-
EE1417	Computer Aided Electrical Design	-	X	X	X	-	-	X	X	-	X	X	-
EE1418	Seminar	-	X		X	X	-	-	X	X	X	X	X
EE1419	Project	-	X	X	X	X	-	X	X	X	X	X	X
EE1501	Microprocessor & Microcontroller	-	X	X	X	-	-	-	X	-	X	-	-
EE1508	Energy Conservation & Audit		X	X	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 Electrical Drawing
2. Software's in Electrical Engineering

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
G1. Communicate effectively in English in oral and written form with superiors, subordinates and peers	1.English
G1. Communicate effectively in English in oral and written form with superiors, subordinates and peers G2. Manage people at work G3.Work as a group leader & as a team member to achieve goals G4.Lead group discussions and meetings independently G5.Use all resources like media, market survey, technical literature etc. to gather information for taking decisions	2.Communication Skills
T54. Prepare tenders & contract documents T69. Develop attitude for entrepreneurship T88. Survey of market & analysis of Market prices G2. Manage people at work G3.Work as a group leader & as a team member to achieve goals G4. Lead group discussions and meetings independently G5. Use all resources like media, market survey, technical literature etc. to gather information for taking decisions G7. Prepare tender documents & comparative statements	3.Industrial Organization & Management

T51. Specify different sources of pollution T52. Mention the % of GHG gases in environment T53. Prevent water pollution, air pollution, sound pollution. G14. Maintain the bonding with society.	4.Environmental Science
T62. Solve problem of society, industry. G13. Develop economical systems for rural development. G14. Maintain the bonding with society.	5.Rural Development
T70.Draw electrical drawing using computer	6.Computer Application
T55. Illustrate the atomic structure of conductor, insulator, and semiconductor. G9. Select appropriate advanced materials for specific applications in engineering G16. Co-ordinate the science & technology	7.Engineering Physics
G16. Co-ordinate the science & technology.	8.Applied Chemistry
To fulfill program Outcomes	9.Engineering Mathematics
To fulfill program Outcomes	10.Applied Mathematics
To fulfill program Outcomes	11.Engineering Graphics
T92.Work on lathe machine	12.Workshop Practice
To fulfill program Outcomes	13.Engineering Mechanics
T94. Analyse the different electrical laws with examples, G6. Co-ordinate the science & technology G10. Follow safety practices & pollution control measures.	14.Basic Electrical Engineering
T12. Operation of different analog and digital electronic circuits associated with electrical installation and instruments	15.Elements of Electronics Technology
T2. Troubleshoot of motorized and non-motorized domestic appliances, T5. Use different types of test and measuring instruments used to measure various, T16. Installation & test of domestic and industrial wiring as per IE & IS & perform Earth test & insulation test. T63. Analyse the faults & remedies, T74. Select protective switches with specification for domestic, commercial, industrial, T75. Identify & select proper materials for electrical engg. appliances. T86. Assemble & dismantle of different parts of M/C as well as domestic appliances.	16.Electrical Material & Domestic Appliances
T98 Select proper turbines in generating power plant	17.Elements of

	Mechanical Engineering
T36.Read electrical circuit diagram network & electrical drawing T66. Reduced & solve the circuit by using network theorem T67. Interpret phase relation in current & voltage for any elct. Circuit. T68. Compare three phase & single phase system T71. Prove the relationship in line & phase values T77.Record reading of electrical parameters measuring meters/instruments. T80. Select & Connect any measuring instrument in circuit.	18.Electrical Circuit & Network
T5. Use different types of test and measuring instruments used to measure various electrical/electronic parameters T10. Calibrate various types of electrical equipment. T17. Use different measuring, indicating and recording electrical and electronic instruments and its error analysis T32. Selection of CT& PT T36. Read electrical circuit diagram network & electrical drawing T77. Record reading of electrical parameters measuring meters/instruments T78. Measure power of any electrical circuit. T79. Observe the parts of ammeter, voltmeter, wattmeter T80. Select & connect any measuring instrument in circuit T82. Read digital & analog quantities.	19.Electrical & Electronics Measurement
T77. Record reading of electrical parameters measuring meters/instruments T81. Co-ordinate physical quantities with electrical quantities T82. Read digital & analog quantities.	20.Instrumentation
T27. Selection of Electric drives for different industrial application T47. Handle different drives	21.Industrial Electronics
T6. Select cables as per construction & application of cables. T16. Installation & test of domestic and industrial wiring as per IE & IS & perform Earth test & insulation test. T35. Selection of accessories required for electrification. T36. Read electrical circuit diagram network & electrical drawing T37. Draw an electrical engineering drawing plan for given installation system T38. Calculate the length of wire & conduit required for electrification T39. Prepare a switch board	22.Building Electrification

T40. Install PVC surface conduit & casing capping wiring. T49. Select modern luminaries for commercial application T60. Draw single line, Multiline, schematic diagram T73. Select proper wiring system for particular application T74. Select protective switches with specification for domestic, commercial, industrial T84. Locate & diagnose faults in electrical wiring & installations.	
T11. Interpret circuit diagrams and specifications of electrical systems given in technical/service manuals. T36. Read electrical circuit diagram network & electrical drawing T60. Draw single line, Multiline, schematic diagram T70. Draw electrical drawing using computer.	23.Computer Aided Electrical Drawing
T36. Read electrical circuit diagram network & electrical drawing T61. Sketch the part of any machine. T77. Record reading of electrical parameters measuring meters/instruments T80. Select & Connect any measuring instrument in circuit T83. Test the efficiency of different machines T94. Analyse the different electrical laws with examples.	24.Electrical Machine Fundamentals
T19. Acquaint with the Operation of Electric generating stations and sub-stations T28. Prepare a report on technical visits T51. Specify different sources of pollution T53. Prevent water pollution, air pollution, sound pollution. T95.Smart grid system analysis overall technical knowledge. T98 Select proper turbines in generating power plant.	25.Generation Engineering
T9. Design & Estimation of LT distribution systems of overhead lines and underground cables T13. Estimate the quantity and cost of electrical work/installations T14. Design and estimation of multistoried electric systems. T34. Selection of materials with specification for street lighting T35. Selection of accessories required for electrification. T37. Draw an electrical engineering drawing plan for given installation system T38. Calculate the length of wire & conduit required for electrification T42. Specify the types of ACSR conductors T43. Select the type of conductor & insulator for installation of LT/HT line	26.Electrical Installation System

T54. Prepare tenders & contract documents T60. Draw single line, Multiline, schematic diagram T74. Select protective switches with specification for domestic, commercial, industrial T89. Costing of given Material.	
T6. Select cables as per construction & application of cables T18. Evaluate the electrical performance of transmission lines. T42. Specify the types of ACSR conductors T43. Select the type of conductor & insulator for installation of LT/HT line T72. Describe methods of cable laying. T95. Draw & describe block diagram of Smart grid system	27.Transmission & Distribution
T29. Operating, testing & maintenance of electrical machines T80. Select & connect any measuring instrument in circuit T83. Test the efficiency of different machines.	28.Electrical Machine Operation
T15 Select proper industrial heating, welding ,electrolytic ,refrigeration& Air conditioning processes T20. Acquaint with Operation & control of Electric Traction Systems T27.Selection of Electric drives for different industrial application T85. Write about different wielding systems. T96. Theft of electrical energy in LT & HT network	29.Utilization & Traction
T31.Construction & operation of Relays, CBs. T32.Selection of CTs & PTs T33.Testing of relays & CTs, PTs. T64.Explain the protection system for particular machine of power system T65.Calculate Fault KVA at particular fault point. T74.Select protective switches with specification for domestic, commercial, industrial	30.Switchgear & Protection
T1.Maintain different types of 1-phase and 3-phase transformers T3. Troubleshooting of various electrical machines T7. Implement the schedule for preventive maintenance as per I.S. for electrical equipment using appropriate hand tools T8. Maintain Storage Battery T16. Installation & test of domestic and industrial wiring as per IE & IS & perform Earth test & insulation test. T29. Operating Testing & maintenance of electrical machines T48. Installation of IM T63. Analyse the faults & remedies T80. Select & connect any measuring instrument in circuit T83. Test the efficiency of different machines	31.Electrical Testing and Maintenance

T93. Installation of Transformer	
T41. Rewinding of chokes, transformers & single phase motor. T86. Assemble & dismantle of different parts of M/C as well as domestic appliances. T56. Design PCB T57. Prepare different electronic circuit.	32.Electrical & Electronic Workshop
T21. Use computer based software for simple applications in Electrical Engg.	33.Software's in Electrical Engineering
T58. Develop working model for project. T69. Develop attitude for entrepreneurship T76. Prepare automatic working system of any day to day problem T88. Survey of market & analysis of Market prices T89. Costing of given Material T91. Prepare technical report. G4. Lead group discussions and meetings independently G5. Use all resources like media, market survey, technical literature etc. to gather information for taking decisions	34.Industrial Project
G12. Deliver seminar on any selected topic	35.Seminar
G14. Maintain the bonding with society G15. Maintain the ethics & values in professional practices	36.Industrial Practices / Industrial Training
T26. Use PLCs, SCADA, microprocessor and Micro-Controllers for various applications T90. Use of microcontrollers in the ckt.	37.Industrial Automation
T4. Acquaint with the performance of sub-stations operation & testing of sub-stations T8. Maintain Storage Battery T16. Installation & test of domestic and industrial wiring as per IE & IS & perform Earth test & insulation test. T19. Acquaint with the Operation of Electric generating stations and sub-stations T59. Prepare the layout for substation.	38.Substation practice
T22. Construction & Operation of wind turbines. T23. Construction & Operation of solar photovoltaic (PV) systems and storage batteries T24. Construction & Operation of solar heating systems T25. Construction & Operation of ocean energy systems T45. Installation of solar panel T46. Testing of solar panel	39.Renewable Energy Sources
T49. Select modern luminaries for commercial application T50. Calculate the no of lamps required for uniform illumination	40.Illumination Engineering

T88. Survey of market & analysis of Market prices	
T27. Selection of Electric drives for different industrial application T47. Handle different drives	41.Electrical Drives & control
T30. Energy conservation methods, techniques & energy audit T44. Make energy conservation in any field. T51. Specify different sources of pollution T52. Mention the % of GHG gases in environment T53. Prevent water pollution ,air pollution, sound pollution T62. Solve problem of society, industry. T87. Audit the system for energy conservation T88. Survey of market & analysis of Market prices T91. Prepare technical report. T96. Theft of electrical energy in LT & HT network	42.Energy Conservation & Audit
G2. Manage people at work G3.Work as a group leader & as a team member to achieve goals G8. Maintain the ethics & values in professional practices G14. Maintain the bonding with society.	43.Finishing School
To fulfill program Outcomes	44. Free Electives

8.12 Program Structure

The program structure of the Electrical 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 ELECTRICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
								Theory		Practical		Total Marks
				TH	TU	PR		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.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 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 ELECTRICAL ENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
								Theory		Practical		Total Marks
				TH	TU	PR		TEE	CA	TEE	CA	
1	CA201E	Computer Application	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	CH202E	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	MH203E	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

DIPLOMA IN ELECTRICALENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
								Theory		Practical		Total Marks
				TH	TU	PR		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	EE301E	Basic Electrical Engineering	Nil	04	00	02	05	70	30	50@	25	175
5	EC305E	Elements of electronics technology.	Nil	04	00	02	05	70	30	50@	25	175
6	EE302E	Electrical Material & Domestic Appliances	EE301E	03	00	04	05	70**	30	50@	25	175
7	ME304E	Elements of Mechanical Engineering	Nil	03	00	02	04	70	30	50@	25	175
			Total	**19**	**01**	**20**	**30**	**350**	**150**	**300**	**200**	**1000**

8.12.4 Program Structure Level IV: Professional Courses

Table 8.9. Program Structure Level IV: Professional Courses

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)				
								Theory		Practical		Total Marks
				TH	TU	PR		TEE	CA	TEE	CA	
a) Core Courses												
1	EE401E	Electrical Circuit & Network	EE301 E	04	00	02	05	70	30	50#	25	175
2	EE402E	Electrical & Electronics Measurement	EE301 E	03	00	02	04	70	30	50#	25	175
3	EE403E	Instrumentation	EE301E	03	00	02	04	70	30	50#	25	175
4	EC420E	Industrial Electronics	EC305E	03	00	02	04	70	30	50#	25	175
5	EE404E	Building Electrification $	EE301E	03	00	04	05	70	30	50#	25	175
6	EE405E	Computer Aided Electrical Drawing	EE301E	00	00	04	02	Nil	Nil	50#	25	075
7	EE406E	Electrical Machine Fundamentals $	EE301E	03	00	04	05	70	30	50#	25	175
8	EE407E	Generation Engineering	EE301E	04	00	00	04	70	30	Nil	Nil	100
9	EE408E	Electrical Installation Systems $	EE404E	03	00	04	05	70	30	50#	25	175
10	EE409E	Transmission & Distribution $	EE301E	03	00	02	04	70	30	50#	25	175
11	EE410E	Electrical Machine Operation $	EE406E	03	00	04	05	70	30	50#	25	175
12	EE411E	Utilization & Traction Systems $	EE301E	03	00	02	04	70	30	50#	25	175
13	EE412E	Switchgear & Protection $	EE301E	04	00	02	05	70	30	50#	25	175
14	EE413E	Electrical Testing and Maintenance $	EE406E	03	00	04	05	70	30	50#	25	175
Sub Total (a)				**42**	**00**	**38**	**61**	**910**	**390**	**650**	**325**	**2275**

8.12.5 Program Structure Level IV: Professional Courses (Project Courses)

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

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)				
								Theory		Practical		Total Marks
				TH	TU	PR		TEE	CA	TEE	CA	
b) Project Courses												
15	EE414E	Electrical & Electronic Workshop $^{\$}$	EE301E	00	00	04	02	Nil	Nil	50$^{\#}$	50	100
16	EE415E	Software's in Electrical Engineering	CA201E	00	00	04	02	Nil	Nil	50$^{@}$	50	100
17	EE416E	Industrial Project $^{\$}$	100 credits	00	00	04	02	Nil	Nil	100$^{\#}$	50	150
Sub Total (b)				**00**	**00**	**12**	**06**	**Nil**	**Nil**	**200**	**150**	**350**
c) Seminar courses												
18	SE401E	Seminar	60 credits	00	00	02	01	Nil	Nil	50$^{@}$	50	100
Any one from followings												
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)				**42**	**00**	**54**	**69**	**910**	**390**	**950**	**575**	**2825**

8.12.6 Program Structure Level V: Elective Courses

Table 8.11. Program Structure Level V: Elective Courses

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)				
								Theory		Practical		Total
				TH	TU	PR		TEE	CA	TEE	CA	Marks
a) Professional Electives (Any one from Each group)												
Group 1												
1	EE501E	Industrial Automation	EC305E	03	00	02	04	70	30	50#	25	175
2	EE502E	Substation Practice	EE301E	03	00	02	04	70	30	50#	25	175
Group 2												
1	EE503E	Renewable Energy Sources $	EE407E	03	00	02	04	70	30	50#	25	175
2	EE504E	Illumination Engineering $	EE404E	03	00	02	04	70	30	50#	25	175
Group 3												
1	EE505E	Electrical Drives and Control $	EE 406E	03	00	02	04	70	30	50#	25	175
2	EE506E	Energy Conservation & Audit $	EE 402E	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**	**00**	**00**	**50**	**25**	**75**

8.12.7 Program Structure Level V: Elective Courses

Table 8.12. Program Structure Level V: Elective Courses

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)				
								Theory		Practical		Total Marks
				TH	TU	PR		TEE	CA	TEE	CA	
c) Free Electives Technical (Any one)			% Not offered for Program									
1	FE501E	Basic Building Drawing	Nil	00	00	04	02	Nil	Nil	50@	25	75
2	FE 502E	RAC Maintenance	Nil	00	00	04	02	Nil	Nil	50@	25	75
	FE503E	Electrical Maintenance %	Nil	00	00	04	02	Nil	Nil	50@	25	75
3	FE504E	Hobby Electronics	Nil	00	00	04	02	Nil	Nil	50@	25	75
4	FE505E	Basic Packaging Technology	Nil	00	00	04	02	Nil	Nil	50@	25	75
5	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 & 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

DIPLOMA IN ELECTRICALENGINEERING											
Sr. No	Level	Course Title Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
							Theory		Practical		Total Marks
			TH	TU	PR		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	19	01	20	30	350	150	300	200	1000
4	IV	Professional Courses	42	00	54	69	910	390	950	575	2825
5	V	Elective Courses	09	00	14	16	210	90	250	125	675
Total			**97**	**4**	**102**	**152**	**2030**	**870**	**1800**	**1050**	**5750**

Above program structure is approved in PBOS meeting held on 12th April, 2016 for implementation from Academic session 2016-17.

8.13 Award of Class Courses

Table 8.14. Award of Class Courses

DIPLOMA IN ELECTRICALENGINEERING												
Sr. No	Course Code	Course Title	Prerequisite courses/credits	Teaching Scheme (TH,TU,PR Hrs./Week)*			Total Credits*	Examination Scheme (Max. Marks)				
								Theory		Practical		Total Marks
				TH	TU	PR		TEE	CA	TEE	CA	
1	EE404E	Building Electrification $	EE301E	03	00	04	05	70	30	50#	25	175
2	EE406E	Electrical Machine Fundamentals $	EE301E	03	00	04	05	70	30	50#	25	175
3	EE408E	Electrical Installation System $	EE404E	03	00	04	05	70	30	50#	25	175
4	EE409E	Transmission & Distribution $	EE301E	03	00	02	04	70	30	50#	25	175
5	EE410E	Electrical Machine Operation $	EE406E	03	00	04	05	70	30	50#	25	175
6	EE411E	Utilization & Traction $	EE301E	03	00	02	04	70	30	50#	25	175
7	EE412E	Switchgear & Protection $	EE301E	04	00	02	05	70	30	50#	25	175
8	EE413E	Electrical Testing and Maintenance $	EE406E	03	00	04	05	70	30	50#	25	175
9	EE503E	Renewable Energy Sources $	EE407E	03	00	02	04	70	30	50#	25	175
	EE504E	Illumination Engineering $	EE404E									
10	EE505E	Electrical Drives and Control $	EE406E	03	00	02	04	70	30	50#	25	175
	EE506E	Energy Conservation & Audit $	EE402E									
11	EE414E	Electrical & Electronic Workshop $	EE301E	00	00	04	02	Nil	Nil	50#	50	100
12	EE416E	Industrial Project $	100 credits	00	00	04	02	Nil	Nil	100#	50	150
			Total	**31**	**0**	**38**	**50**	**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	**54**
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	**2/11**
11	No. of Project Courses	**3**
12	No. of Seminar Courses	**2/3**
13	Total Credits (1 Th Hr = 1Credit & 2 Pr Hr = 1Credit)	**152**
14	Total Marks	**5750**
15	Proportion of Hours (Periods), Th : Pr	**50:50 (approx.)**
16	Proportion of Credits, Th : Pr	**66:34 (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	**2000**

8.15 Courses Flow Diagram

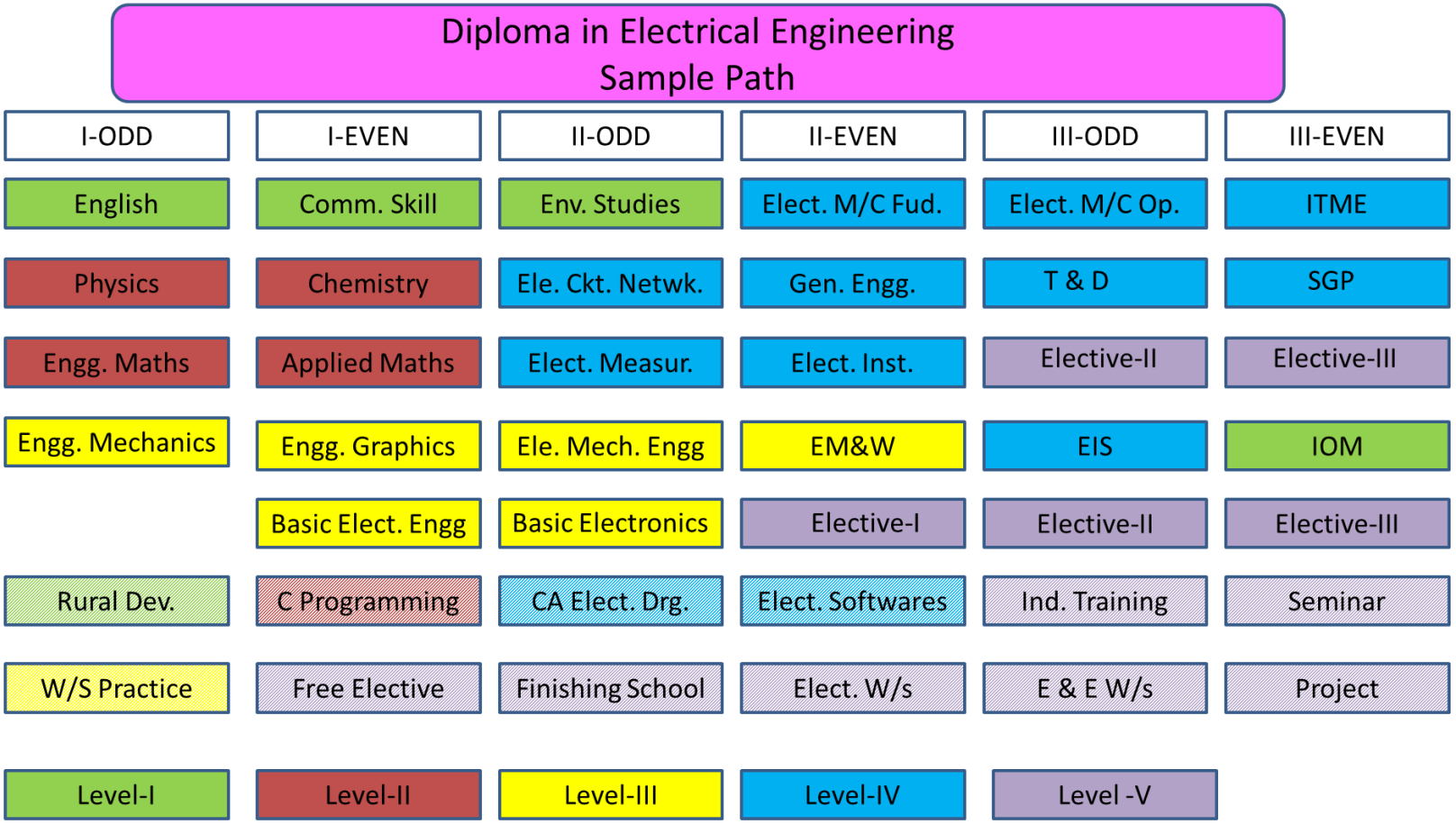


Figure 8.1. Courses Flow Diagram (Sample Path)

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. 4. Ask pertinent question as well as to answer them.	3.1 Success stories:(selected Two success stories from text) 1.”It happed 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 Kalamm '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 2.2Speaking 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	5.1Letters: 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:

Practical'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, Bendar, Macmillan Publication	0333937139
5.	Technical communication principles and practices	Meenakshi Raman, Prakash Singh, Oxford University Press,	0-19-567695-5
6	Effective English Communication	Krishna Mohan, Raman Tata 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.

(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/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 BOO1KS:

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], 6th , 1979	09-322-3849-1
4.	Industrial Management	I.K.Chopde & A.M.Sheikh, S.Chand & Co. Ltd, Delhi, 2nd, 1999	81-219-1480-9
5.	Industrial engineering: Organization and management	Tara Chand, Publisher: Nem Chand, 5th, 1982	B0007BSSB0
6.	Engineering Economics	Tara Chand, Publisher: Nem Chand, 14th, 2014	81-85240-82-5
7.	Entrepreneurial Development	S.S.Khanka, S.Chand & Co. Ltd, Delhi, 1st , 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

(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	**:**	**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_incidents, accessed on 20Janaury 2016
2. ww.legalserviceindia.com/articles/noip.htm accessed on 18 March 2016
3. https://prezi.com/8mnz--ldkybc/apes-unit-1-earth-systems-resources/ accessed on 23March 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 programes** (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 cast 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

❖ **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, 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 linksin 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

30/03/2016https://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/openofficeaccessed on 29th April, 2016

www.tutorialsforopenoffice.orgaccessed 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 tunning 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 5th Edition, 2014	13:978-8-12-190163-5
2.	Engineering Physics	V.Rajendran, The McGraw Hill Education Pvt. Ltd,1st Edition, 2010	13: 978-0-07-107014-0
3.	Conceptual Physics	P.G.Hewitt, San Francisco Addison Wesley- 10th Edition, 2006	13: 9780321909107
4.	Engineering Physics	R.K.Gaur And S.L.Gupta, Dhanpatrai Publication New Delhi,1987	97-8-18-992822-3

❖ 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=KjUlKF6_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. Tunning 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 solider 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 EE/EC/IT/CM**
LEVEL NAME	**:**	**BASIC SCIENCE COURSES**
COURSE CODE	**:**	**CH202E**
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 EXAM.	**:**	**03 HRs**
PR. TEE EXAM	**:**	**02 HRs (Internal)**
PT. EXAM	**:**	**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 different polymers, insulators or dielectrics, adhesives and their chemical behavior will be useful in their applications in electrical appliances and electronics industries. This will be gateway for development of reasoning capacity of students and understanding new technology as well and capabilities in solving challenging problems at various level of working in the electronic and computer industry.

❖ 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 cells and batteries on the basis of properties and construction.
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. Write all steps of formation of molecules. 5. Review the filling up orbital by Aufbau principle and Hunds 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). **Valency:** 1.5 Definition& types of valency (Electrovalency & Covalency). 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_2O, NH_3, C_2H_2. 1.9 Distinction between electrovalent & covalent compounds.	
2. Metallurgy and Alloys	1. Describe the process of extraction of copper and aluminum from its ore. 2. State different properties of copper and aluminum metal. 3. Select proper alloy as per their composition, properties and uses. 4. Write Engineering applications of Al and Cu.	**Metallurgy** **2.1Metallurgy of Copper** Definitions of metallurgy. 2.2 Extraction process: Ores of copper, extraction of copper from copper pyrite by physical concentration by Froth floatation process and chemical concentration by roasting. 2.3 smelting, bessemerisation, electrolytic reefing. 2.4 Engineering Applications of copper. **Metallurgy of Aluminum** 2.5 Extraction process : ores of Aluminum, extraction of aluminum, purification of bauxite by Hall's process, electrolytic reduction of alumina, 2.6 electrolytic refining of aluminum. 2.7 Engineering applications of aluminum **Alloy** 2.8 Brass ,Bronze, duralumin, Alnico composition ,properties and applications 2.9 Solders -Composition, properties and applications of ,rose metal and wood's metal	
3. Non-Metallic Engineering	1. Distinguish between thermo softening and thermosetting plastics.	**Polymers (Plastics, Rubber)** 3.1 Definition of Plastic, Formation of Plastic by Addition & Condensation	

Materials	2. List the properties of Rubber. 3. State the applications of thermal insulators, and Adhesive. 4. Describe applications of Phenol formaldehyde resin, urea formaldehyde resin and epoxy resin.	3.2 Polymerization, types of polymerization, thermosetting and thermosetting plastic. 3.3 Definitions, examples and applications of conducting polymers, photoconductive polymers, electrically insulating polymers, liquid crystal polymer(LCP) 3.4 **Rubber**: Types of Rubber. Natural Rubber: Its Processing, Drawbacks of Natural Rubber, Vulcanisation 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 and Adhesives** Definition & Characteristics of Thermal insulators. Preparation, Properties & Applications of Thermocole & glasswool. 3.8 Definition, characteristics, advantages of adhesive, Properties and application of Phenol formaldehyde resin, urea formaldehyde resin and epoxy resin.	
4. Electro chemistry	1. Describe the mechanism of electrolysis. 2. Identify the role of electrodes in application of electrolysis. 3. Define terms involved in electrochemistry. 4. Calculate the problems based on Faradays I, Faradays II law and PH. 5. Apply the knowledge of electrolysis in Electroplating and Electro refining.	**Basic concepts of electrolysis**: 4.1 Electrolyte, type of electrolyte- strong and weak electrolyte, their difference. 4.2 Ionization and electrolytic dissociation, Arrhenius theory of electrolytic dissociation, degree of ionization, factors affecting degree of ionization. 4.3 Definitions of electrolytic cell, electrodes- cathode, anode, electrode potential- oxidation potential and Reduction potential. **Electrolysis** 4.4 Mechanism of electrolysis- Electrolysis, electrochemical series for cations and anions. 4.5 Mechanism of electrolysis of $CuSO_4$solution by using Platinum electrode and Copper electrode. 4.6 Applications of electrolysis- Electroplating of Silver, Electro refining of Blister copper. 4.7 Faraday's laws of electrolysis: Faraday's First and Second law, relation between electrochemical equivalent and chemical equivalent, numerical. **P^H and P^{OH}:** 4.8 Definition of P^H, P^{OH}, P^H scale, numerical.	

5. Cells and batteries	1. Define basis terms involved in electrochemical cell and battery. 2. Write construction and working of different types of cells. 3. Differentiate Primary and Secondary cells. 4. describe the engineering applications of Lead-acid 5. Storage cell, Ni-Cd Cell, Hydrogen- oxygen fuel cell.	**Electrochemical cells/ batteries:** 5.1 Basic concepts: Definition of electrolyte, conductivity of electrolytes, cell, battery, electrolytic cell, electrochemical cell, charging, discharging. 5.2 Classification of electrochemical cells: Primary and secondary cells. 5.3 Primary cells: construction, working and applications of - Dry Cell, Daniel cell, 5.4 Secondary cells: construction, working and applications of - Lead-acid storage cell, Ni-Cd Cell 5.5 Fuel cell : Definition, construction, working, advantages, limitations and 5.6 applications of Hydrogen- oxygen fuel cell.	
6.Corrosion	1. Write 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, Types, Atmospheric or Chemical Corrosion, Mechanism, Factors Affecting Atmospheric Corrosion] 6.2 Definition, Types, Atmospheric or Chemical Corrosion, Mechanism, Factors Affecting Atmospheric Corrosion 6.3 Immersed Corrosion or Electrochemical Corrosion, mechanism of electrochemical corrosion absorption of oxygen gas, Evolution of Hydrogen gas. 6.4Factors Affecting Electrochemical Corrosion, 6.5Application of Protective Coatings like metal coating by -Galvanizing, Tinning, Sherardizing Metal Spraying, Metal Cladding, Cementation or Diffusion Method. 6.6Application of non metallic coatings: paint-definition, characteristics, constituents of paint and their functions.	
		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	2
2	Determine the percentage of copper in the given brass alloy or copper ore.	Metallurgy and Alloys	2
3	Find the relation between loss in weight of aluminium strip in acidic and alkaline medium and rate of corrosion.	Corrosion	2
4	Determine the strength of given hydrochloric acid solution by titrating it against Sodium hydroxide solution.	Corrosion	2
5	Determine thinner content in oil paint.	Corrosion	2
6	Prepare urea formaldehyde resin used in manufacturing of sun mica Plastic.	Electrochemistry	2
7	Determination of P^H value of given solution by using P^H paper, universal indicator and P^H meter.	Electrochemistry	2
8	Find the Electrochemical equivalent (ECE) of copper.	Cells and Battery	2
9	Perform electro refining process of copper metal.	Electrochemistry	2
10	Prepare Phenol formaldehyde resin used in manufacturing of Bakelite Plastic.	Non-Metallic Engg.Materials	2
11	Analyse basic and Acidic Radicals of known salt solution-1 (Confirmatory Test) using qualitative analysis method.	Chemical Bonding	2
12	Analyse basic and Acidic Radicals of known salt solution-2 (Confirmatory Test) using qualitative analysis method.	Chemical Bonding	2
13	Analyse basic and Acidic Radicals of known salt solution-3 (Confirmatory Test) using qualitative analysis method.	Chemical Bonding	2
14	Analyse basic and Acidic Radicals of known salt solution-4 (Confirmatory Test) using qualitative analysis method.	Chemical Bonding	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	
1	Chemical Bonding:	06(04)	04(04)	00(00)	**10(08)**
2	Metallurgy and Alloys	02(00)	04(06)	06(00)	**12(06)**
3	Non-Metallic Engineering Materials	06(00)	04(04)	00(00)	**10(04)**
4	Electrochemistry	02(04)	10(02)	06(04)	**18(10)**
5	Cells and Battery	02(00)	08(00)	00(06)	**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.15 edition	10092
2	Engineering Chemistry	S. S. Dara , S. Chand Publication,15 edition	
3	Engineering Chemistry	R. Sivakumar N. Sivakumar and Tata McGraw-Hill, edition10.	9780745-328896
4	Polytechnic Chemistry	Vedprakash Mehta ,Jain brothers,edition6	13-9788183600134
5	Industrial chemistry	Goel Publication,edition-8	81877224002

❖ **E-REFERENCES:**

http://www.substech.com/dokuwiki/doku.php?id=full_index_of_articles_on_polymers- , assessed on 2 Feb. 2016
http://www.substech.com/dokuwiki/doku.php?id=full_index_of_articles_on_fluids- , assessed on 2 Feb. 2016
http://www.ausetute.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. Digital PH meter

❖ **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

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(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 threevariables.
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 expansionformula of determinantof order 2 and 3. 2. Find the value ofdeterminant of order 2 and3. 3. Define various typesof matrices. 4. Perform all algebraicoperations on matrices. 5. Solve simultaneousequations in two andthree 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 ($2\theta$and 3θ) sub-multiple angle ($\frac{\theta}{2}$). 3. Verify trigonometricidentities. 4. Solve examples usingallied angle, compound angle, multiple	4.1 Trigonometric ratios of any angle 4.2 Fundamental identities 4.3Trigonometric 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 ofinverse 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 ofmean, combined mean,mean deviation andstandard 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 consistence	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, 5th Edition 2015	9352030605
2	Plane Trigonometry	S L Loney, Publisher: Arihant, 5th Edition 2015	9352030540
3.	Basic Statistics	B L Agarwal, Publisher: Anshan	1848290675
4.	Engineering Mathematics	S.S .Shastry,Prentice Hall Of India, 4th Edition 2008	978-81-203-3616-2
5.	Fundamental of Statistics	S C Gupta, Himalaya Publishing House, 7th 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 EE/EC/IT/CM

LEVEL NAME : BASIC SCIENCE COURSES

COURSE CODE : MH203E

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, 1PR CREDIT = 2 CLOCK HRs)

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. Applymathematical 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 andLimits	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 byparts theorem. 2. Integrate functionusing different method. 3. Solve examples of definiteintegral using properties. 4. Determine Meanand R.M.S. values.	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: Mean and R.M.S. values.	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	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,	08

	using differential equations.	exact differential equation. 4.6 Linear and Bernoulli equations.	
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 simultaneousequations 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 Simultaneousequations containing 3 unknowns. 5.2.1 Gauss elimination method. 5.2.2 Iterative methods: Gauss-Seidal& Jacobi's method.	14
		Total Hrs.	**64**

BLIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Find value of any given function.	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.	Derivatives and Applications of derivative	01
5	Find dy/dx of implicit functions.		01
6	Find dy/dx of parametric functions and 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	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		01
13	Solve D.E. using variable separable method and reducible to variable separable.	Differential equations	01
14	Solve homogenous,linear and Bernoulli D.E.		01
15	Find the approximate root of algebraic equation.	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

❖ 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	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 VidyarthiGrihaPrakashan	4567155742
2.	Calculus of one variable	IA Maron, Publisher: Arihant, 5th edition 2015	9352030559
3.	Engineering Mathematics	S.S .Shastry, Prentice Hall Of India, 4th edition 2008	9788120336162
4.	Engineering Mathematics	D.T.Gaikawad, S Chand Publication, 1st edition 2010	8121933560
5.	Higher Engineering Mathematics	B S Grewal, Publisher: S Chand, 43rd edition 2014	9788174091955

❖ E-REFERENCES:

- **http://www-math.mit.edu/~djk/calculus_beginners/, assessed on 3rdMarch, 2016**
- **https://en.wikibooks.org/wiki/Calculus, assessed on 3rdMarch, 2016**

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

S.N.	Name	Designation	Institute / Industry
1.	Mr. M. Sayyed	I/C HOD, MathsDeptt.	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.

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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 1	PSO 2
	1	2	3	4	5	6	7	8	9	10		
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 1	PSO 2
	1	2	3	4	5	6	7	8	9	10		
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.oin/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. Equillibrium	1.Define terms related to Equillibrium 2. State analytical conditions of equilibrium. 2.State Lamis theorem 3. Define terms related to Beam 4. Solve Problems related to Lamis theorem and beam reaction.	4.1Definition 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). 4.3Equilibrium 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	5.1Definition 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). 5.2Locating centroid of compound figures, having combination of two different geometric areas only. 5.3Centre of gravity of solid bodies like cylinder, cone, sphere and hemisphere. 5.4Locating 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	6.1Concept 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.	Equillibrium	**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 13:978-938159558
3.	Engineering Mechanics	Basu, Tata Mcgraw Hills, 2013	10:125906266X 13:978-1259062667
4.	Engineering Mechanics	S Ramamrutham, S Chand & Co. New Delhi, 2008	8187433515 9788187433514
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=4VIhh6sGkrI, **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. **F**orce 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. **C**o-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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES**
COURSE CODE	**:**	**EE301E**
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., 2 PR CREDIT = 1 CLOCK HR.)**
TH. TEE EXAM	**:**	**03 HRs**
PR. TEE EXAM	**:**	**02 HRs (Internal)**
PT. EXAM	**:**	**01 HR**

❖ RATIONALE:

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

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply electrical safety concept
2. Apply principles 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.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1.Electrical Safety	1. Apply electrical safety rules while working 2. Describe the procedure to 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. Describe the procedure to operate 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**
2.Fundamentals of electricity	1. Define the various electrical parameters 2. State different effects of electric Current 3. Define the terms work, power and energy 4. State joules law and its applications. 5. Calculate the temperature coefficient of resistance 6. Identify and draw different electrical engineering symbols 7. Describe line diagram of power system 8. State types of sources and loads.	2.1 Atomic structure of an atom and concept of free electron, Concept of electric charge, current, voltage drop, EMF, potential difference, Direction of current and their SI units. 2.2 Different effects of electric current. 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 Concept of Conductors, insulators, semiconductors with examples. 2.5 Work, power, energy and their SI units, Joule's law, Relation between H.P and watts, Kwh and Kcal, cost of electrical energy. (No derivations, Numerical problems based on 2.5) 2.6 BIS symbols as per IS:2032 related to circuit elements, variable resistors, rotating	**14**

		machines, transformers, electrical meters and miscellaneous apparatus. 2.7 Concept of generation, transmission and distribution of electrical power, line diagram of AC power flow in supply systems, voltage levels at various stages in power system. 2.8 Types of sources and loads.	
3. DC Circuits	1. State properties of series, parallel and series- parallel resistive circuits 2. Solve series, parallel and series- parallel resistive circuits 3. Perform source transformation 4. Describe open circuit and short circuit	3.1 Concept of DC voltage & current. 3.2 Resistance in series, properties of series circuit, voltage distribution in series circuit, equivalent resistance of series circuit, Applications of series circuits. 3.3 Resistance in parallel, properties of parallel circuit, current distribution in parallel circuit, equivalent resistance of parallel circuit, Applications of parallel circuits. 3.4 Series-parallel combination, Equivalent resistance of series-parallel combination. Application of ohm's law for simple DC circuits (Numerical problems based on 3.4) 3.5 Types Of DC Electric Current source, Ideal voltage source, Practical Voltage Source, Ideal current source, Practical current Source, Source transformation. 3.6 Concept of Open circuit and short circuit.	**10**
4. Electrostatics	1. Define terms related to electrostatics 2. Describe parallel plate capacitor 3. Describe charging and discharging of capacitor 4. Solve series, parallel capacitor circuits 5. State types of capacitors	4.1Coulombs law of Electrostatics, Absolute and relative permittivity, Concept of electric field, electric flux, electric intensity, electric flux density, electric potential, potential gradient, dielectric strength. 4.2Capacitance, dielectric constant, capacitance of parallel plate	**10**

		capacitor, 4.3capacitance in series and parallel and source of capacitance in electrical systems. Charging & discharging of capacitor, Dielectric loss. (Numerical problems based on 3.7& 3.8) 4.4Types of capacitor and their application.	
5. Magnetism and Electromagnetism	1. Define terms related to magnetism and electromagnetism 2. State laws related to magnetism and electromagnetism 3. Describe B-H curve 4. Solve problems related to magnetism and electromagnetism	5.1 Laws of magnetic force, magnetic field, Absolute and relative permeability of a medium, concept of lines of force, Magnetic flux and magnetic flux density and field intensity. Relation between B and H. 5.2 Concept of MMF, Reluctance, Magnetic circuits, Comparison between electric and magnetic circuits, concept of leakage flux and leakage coefficient, calculation of ampere-turns for simple series magnetic circuit, B-H curve, hysteresis loop & hysteresis loss, Steinmetz hysteresis law. (Numerical problems based on 5.2) 5.3Magnetic effect of electric current, Dot & cross conventions, Right hand thumb rule, Interaction between magnetic fields, force on current carrying conductors, Fleming's left hand rule. 5.4 Faraday's Laws of electromagnetic induction. 5.5 Direction of induced EMF and current, Lenz's Law, Fleming's right hand rule, Induced EMF, Dynamically induced EMF, statically induced EMF, self Inductance (L), Mutual Inductance, co-efficient of coupling. (Numerical problems based on 5.4&5.5) 5.6 Inductances in series and parallel rise and decay of current in an inductive circuit,	**12**

		Energy stored in a magnetic field, Behavior of inductor on AC & DC, lifting power of magnet. 5.7 Eddy current loss, Steinmetz formula for eddy current loss.	
6. AC Fundamentals	1. Define terms related to AC fundamentals 2. Compare terms time period and frequency, angular velocity and frequency, frequency and speed. 3. Perform addition and subtraction of alternating quantities 4. Solve problems related to pure resistive, inductive and capacitive circuit	6.1 Generation of alternating voltage- single phase and three-phase. 6.2 Equation of sinusoidal alternating voltage and current, important terminology such as- waveform, instantaneous value, cycle, time period, frequency, amplitude, Relation between time period and frequency, angular velocity and frequency, frequency and speed. 6.3 Maximum, average and R.M.S. value of sinusoidal waveform, form factor and peak factor. (Numerical problems based 6.2& 6.3). 6.4 Phase and phase difference, phasor representation of sinusoidal voltage and current, addition and subtraction of alternating quantities. 6.5 A.C. Voltage applied to pure resistor, pure inductor, and pure capacitor. Concept of reactance, Impedance and power factor, power in single-phase circuits. (Simple problems)	**12**
			Total Hrs. **64**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	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 in an electric circuit using ohms law.		**2**
5	Find temperature coefficient of materials.		**2**
6	Calculate equivalent resistance of series circuit.	**3.**DC Circuits	**2**
7	Calculate equivalent resistance of parallel circuit.		**2**
8	Plot charging and discharging curves of capacitor.	**4** Electrostatics	**2**
9	Measure capacitance of capacitor using LCR meter and Calculate equivalent capacitance in series and parallel circuit.		**2**
10	Plot the B-H loop of a Ferro-magnetic core material.	5. Magnetism and Electromagnetism	**2**
11	Measure the inductance of a given coil.		**2**
12	Operate CRO to measure amplitude, time period, frequency, phase difference for sinusoidal wave forms.	**6.** AC Fundamentals	**2**
13	Find current response of pure resistive circuit.		**2**
14	Find current response of pure Inductive/capacitive circuit.		**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	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

❖ 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	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**

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	3	-	-	2	-	-	-	-	3	3	3
2	3	3	-	-	2	-	-	-	-	3	3	3
3	3	3	-	-	2	-	-	-	-	3	3	3
4	3	3	2	3	2	-	2	3	2	3	3	3
5	3	3	2	3	2	-	2	3	2	3	3	3
6	3	3	2	3	2	-	2	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.	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

❖ **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**

❖ **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

❖ **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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES**
COURSE CODE	**:**	**EC305E**
COURSE TITLE	**:**	**ELEMENTS OFELECTRONICS TECHNOLOGY**
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:

Study of electronics for electrical engineering students is important in industrial perspective. It includes knowledge of semiconductor materials, fundamental electronic devices, digital electronics &integrated circuits. In order to meet these industrial prerequisites, this course focuses on fundamental concepts that are pillars of electronics technology.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Select proper semiconductor devices for electronic circuits.
2. Analyze the analog and digital circuits by using principle and basic laws.
3. Apply principles of diodes, transistor, Amplifiers, rectifiers, voltage regulators, oscillators& basic digital circuits for particular applications.
4. Connect electronic measuring instruments &equipments in the circuit for measurement and testing.
5. Draw VI characteristics / wave forms of electronic devices / circuits .
6. Assemble & test different electronic circuits.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1Semiconductor theory	1. State the importance of electronics 2. Define terms relate to semiconductors. 3. Draw atomic structure of semiconductor material. 4. Illustrate the concept of doping 5. Describe the concept of P & N type semiconductor	1.1 Definition & importance of Electronics 1.2 Bohr's atomic model, atomic structure of Si and Ge, Energy level diagram, energy band diagram, Comparison of insulators, semiconductors and conductors on the basis of energy bands. 1.3 Elements, Properties, types and crystalline structures of semiconductors. Effect of temperature on conductivity of intrinsic semiconductor. 1.4 Types of extrinsic semiconductors. Trivalent and Pentavalent impurity elements, majority and minority carriers, working of P&N types of semiconductors. Doping and diffusion	**04**
2.Diodes and Special Diodes	1. Draw symbols of diodes & special diodes. 2. Describe the working principle of PN junction diode , Zener diode & special diodes. 3. Sketch the constructional diagram with relevant VI characteristics of diode. 4. Define voltage ,line & load regulation 5. Identify various blocks of a RPS 6. Describe zener diode ,ICs 78XX &79XX as voltage regulator	2.1Construction, symbol, working, forward and reverse bias characteristic, effect of forward and reverse bias on barrier potential of P-N junction. 2.2 Specification of P-N junction. 2.3 Symbol , working principle and characteristic of Zener diode. 2.4 Zener Effect, Avalanche Effect. 2.5 Symbol , working principle and characteristic of LED, Photodiode and Phototransistor 2.6 Definition of Voltage Regulation, line & load regulation ,demerits of unregulated dc power supply, necessity of voltage regulator, block diagram of regulated power supply, Zener diode as simple regulator, voltage regulator IC -78XX & 79XX pin diagram & basic concept only	**08**

3. Rectifiers and filters	1. Describe diode as rectifier in different configuration 2. Sketch the circuit diagram with relevant waveforms for rectifiers and filters. 3. Compare various rectifiers & filters 4. Choose specific rectifier as per requirement	3.1 Rectifier specifications and types of rectifiers. Diode as a Rectifier 3.2 Circuit diagram, working, waveform advantages, disadvantages, specifications of 3.2.1 Half wave rectifiers 3.2.2 Full wave rectifiers 3.2.3 Center tap full wave rectifier. 3.2.4 Bridge rectifiers 3.3 Definition of rectifier efficiency, transformer utilization factor, comparison of above rectifiers. 3.4 Definition of ripple factor, necessity of filter, types of filters – circuit diagram and working of series inductor filter, shunt capacitor filter, Pi filter, LC filter. Comparison of LC and Pi filter	**06**
4.BJT and UJT	1. Draw constructional diagram of BJT &UJT 2. Describe the working of BJT & UJT 3.Draw & identify types , symbols of BJT 4. Describe different modes of operation of transistor 5. Plot I/P & O/P characteristics of CE, CB, CC transistor configuration 6. Compare the working of different Types of transistor configuration 7. Describe UJT as relaxation Oscillator	**4.1BJT**- 4.1.1 Construction of NPN & PNP transistor, symbols, identification of transistor terminals. 4.1.2 Working mode of operation of transistor – active, cutoff, saturation regions. 4.1.3 Application of Transistor as an amplifier& switch. 4.1.4 Configuration of transistor as CE, CB, CC. I/P and O/P characteristic of transistor in CE, CB, CC Configuration 4.1.5 Definition of Transistor parameters, relation between alpha and beta. Comparisons of above Configuration **4.2 UJT**- Construction, symbol, working, characteristic& application of UJT as relaxation Oscillator	**08**
5. BJT Amplifiers & Oscillators	1. State application of BJT as amplifier 2. State need of Transistor biasing &stabilization 3. Classify multistage amplifiers	**5.1 BJT Amplifiers** 5.1.1 Definition of amplifier, BJT as amplifier, faithful amplification, Q operating point, condition for faithful amplification	**18**

	4. Plot frequency response of different multistage amplifiers 5 . Compare different amplifiers 6. Describe the working of different power amplifiers 7. State Barkhausen's criterion 8. Define positive & negative feedback 9. Draw the circuit of various oscillators. 10. Describe the working of different oscillators..	5.1.2 Transistor biasing, bias stabilization, stability factor, list of methods of biasing, circuit diagram and working of voltage divider bias with emitter resistance 5.1.3 Circuit diagram, working and frequency response of single stage, two stage common emitter RC coupled amplifier 5.1.4 Circuit diagram, working, frequency response and applications of cascading of amplifier, transformer coupled amplifier, direct coupled amplifier. 5.1.5 Power amplifiers – Classification of power amplifiers &Operation of Class A, Class B **5.2 Oscillators** 5.2.1Barkhausen's Criteria, positive and negative feedback, merits of negative feedback. 5.2.2 Circuit diagram and working of Hartley oscillator and Colpitt oscillator 5.2.3Applications all above oscillators	
6. Basics of Digital Circuits	1. Convert numbers into different number system 2. Perform different binary arithmetic operation 3. Draw the symbol for various logic gates. 4. Analyze the truth table for various logic gates and combinational circuits. 5. Differentiate between combinational and sequential logic circuits. 6. Verify Boolean laws 7. Prepare K-map& realize circuit using gates	**6.1 Number Systems** 6.1.1 Introduction to digital Systems **,** 6.1.2 Number Systems – Binary, decimal, octal &hexadecimal conversion of one number system to other 6.1.3 Binary addition, subtraction use of 1's & 2's complements in binary arithmetic, types:- combinational, sequential **6.2 Logic Gates** 6.2.1 Classification of gates: NOT, AND, OR **,**symbols, truth table **,**logic equations 6.2.2 Universal logic gates – NOR &NAND **,**symbols, truth table 6.2.3 Basic logic gates using universal gates 6.2.4 Exclusive OR/ NOR gates 6.2.5 Boolean Algebra-Basic laws:	**20**

		cumulative associative, distributive 6.2.6 De Morgan's theorem & Duality theorem ,numerical Examples 6.2.7 Standard form of Boolean function SOP & POS 6.2.8 Conversion between SOP & POS 6.2.9 K- map reduction method for SOP and POS representation for 2& 3 variables , Realization of Half adder & full adder	
		Total Hrs	**64**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Set voltage & current limit with controls on a regulated power supply / Use digital multimeter for different measurement such as -DC and AC voltage measurement, DC and AC current measurement, Different resistance measurement, Component testing.(diode, capacitor, transistor) & continuity Test.	General Electronic Measurement techniques	2
2	Operate function generator for different functions.		2
3	Operate Cathode Ray Oscilloscope and measure amplitude and frequency.		2
4	Plot Forward and reverse characteristics of PN junction diode / Zener diode .	Diodes and special diodes	2
5	Assemble Zener diode /IC78XX/IC79XX as a voltage regulator and Draw V-I characteristic of Zener diode in reverse bias mode**.**		2
6	Plot the I/P and O/P waveforms of half wave rectifier.	Rectifiers and filters	2
7	Plot the I/P and O/P waveforms of full wave rectifier.		2
8	Measure frequency of UJT relaxation oscillator.	BJT and UJT	2
9	Plot the Frequency response of single stage /RC coupled Amplifier	BJT amplifiers & oscillators	2
10	Plot the input and output characteristics of BJT in CE mode and find input resistance, output resistance and current gain.		2
11	Measure frequency of Hartley's / Colpitt's oscillator and determine the frequency of oscillation.		2
12	Test 74 series ICs to verify various logic gates.	Basics of digital circuits	2
13	Realize basic gates using NOR / NAND gate and to verify truth table.		2
14	Test different ICs to verify De Morgan's theorem.		2
15	Use logic gates to construct Half adder / Full adder		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	Semiconductor Theory	02(02)	04(00)	00(00)	**06(02)**
02	Diodes and special diodes	04(00)	04(04)	00(00)	**08(04)**
03	Rectifiers and filters	04(00)	04(04)	00(00)	**08(04)**
04	BJT and UJT	02(02)	10(04)	00(00)	**12(06)**
05	BJT amplifiers & oscillators	02(00)	10(06)	04(04)	**16(10)**
06	Basics of digital circuits	04(04)	06(06)	10(04)	**20(14)**
	Total	**18(08)**	**38(24)**	**14(08)**	**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	4	R	2	5	R	2	6	R	2	6	R	2	1	R	2	**5/7**
	4	R	2																
02	2	R	4	3	R	4	1	U	4	6	R	4	2	U	4				**3/5**
03	2	U	4	3	U	4	4	U	4	3	U	4	4	U	4				**3/5**
04	5	U	4	5	A	4	6	A	4	5	A	4	6	A	4				**3/5**
05	4	U	6	5	U	6	5	U	6										**2/3**
06	6	U	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	Drawing circuit diagram, selection of components/equipment's. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs / waveforms (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	-	-
2	3	-	-	-	-	-	-	-	-	3	-	-
3	3	-	-	-	-	-	-	-	-	3	-	-
4	3	-	2	2	-	-	2	2	-	3	-	-
5	3	-	2	2	-	-	2	2	-	3	-	-
6	3	-	2	2	-	-	2	2	-	3	-	-

H – High Relationship M- Moderate Relationship L-Low Relationship

❖ REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1	Textbook of Applied Electronics	R. S. Sedha, S. Chand Limited, Revised Edition, 2008	8121927838, 9788121927833
2	Basic Electronics	V. K. Mehta, S. Chand Limited,	9780470499832
3.	Electronics Devices and Circuits	Allen Mottershed,	9788120301245
4.	Modern Digital Electronics	R. P. Jain, McGraw Hill Education (India) Private Limited, 2009	10: 0070669112 13: 9780070669116
5.	Digital Principles and Application	Malvino, Albert Paul; Leach, Donald P., Mcgraw-Hill, 1986	10: 0070398836 13: 9780070398832
6.	Digital Electronics	William Gothman,	9788120303485

❖ E REFERENCES

- http://www.electrical4u.com/ assessed on 4.05.2016
- http://www.explainthatstuff.com/ assessed on 4.05.2016
- http://nptel.ac.in/courses/117103063/ assessed on 4.05.2016
- http://nptel.ac.in/video.php?subjectId=117106086 assessed on 4.05.2016
- http://nptel.ac.in/video.php?subjectId=117106086 assessed on 4.05.2016

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1. Digital Multimeter
2. Regulated power supply
3. Function Generator
4. CRO
5. Circuit Board / Bread board

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

S.N.	Name	Designation	Institute / Industry
1	Mr. S. S Tadas	HOD, Electronics &Telecomm Engineering	Government Polytechnic, Nagpur.
2.	Mrs. U. M. Ramteke	Lecturer in Electronics Engineering	Government Polytechnic, Nagpur.
3.	Mrs. M N Bawane	Lecturer in Electronics & telecomm Engineering	Government Polytechnic, Nagpur.
4.	Mrs. H. R. Bhusari	Lecturer in Electronics & telecomm Engineering	Government Polytechnic, Nagpur.
5.	Mr. D A Brahmankar	Lecturer in Electronics & telecomm Engineering	Government Polytechnic, Nagpur.
6.	Ms. K.G. Giri	Lecturer in Electronics & telecomm Engineering	Government Polytechnic, Nagpur.

(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ELECTRICAL ENGG.

LEVEL NAME : ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES

COURSE CODE : EE302E

COURSE TITLE : ELECTRICAL MATERIALS AND DOMESTIC APPLIANCES

PREREQUISITE : EE301E

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 EXAM : 01 HR (Objective Type online Examination)

PR. TEE EXAM : 02 HRs (Internal)

PT. EXAM : 30 Minutes. (Objective Type offline Examination)

❖ RATIONALE:

This course is basic technology course. Knowledge of materials used in the manufacturing of electrical machines / goods, is essential. Electrical materials and domestic appliances subject is intended to teach techniques of electrical, repairs, faultfinding, testing, fabrication and manufacturing of various items used in electrical field. This will help the students to acquire skill and attitudes to discharge the function of supervisor in industry and can start his own small-scale enterprise.

❖ COURSE OUTCOMES:

1. Describe properties and applications of electrical engineering materials
2. Select various electrical engineering materials for particular application
3. Describe construction of electrical domestic appliances
4. Test domestic appliances
5. Identify the faults of domestic appliances
6. Repair and install electrical domestic appliances using workshop tools.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Conducting Materials	1. Classify electrical engineering materials. 2. Define the resistivity. 3. State the effect of temperature on resistivity of various materials. 4. Identify various conducting material. 5. Describe the concept of superconducting material. 6. Choose different conducting material as per requirement.	1.1 Classification of material:- conductor, insulator, semi-conductor, magnetic material their energy band diagram. 1.2 Resistivity, effect of temperature, impurities, stress on Resistivity of conductor. 1.3 Requirements of high/low conducting material 1.4 Low resistivity conductor, copper, copper-zinc alloys, cadmium-copper alloy, chromium-copper alloy, bronze, reinforced copper, aluminum and aluminum alloys. Steel-cored aluminum galvanized iron and steel, classification of steel and their applications-carbon steel, alloy steel, stainless steel & tool steel, effect of carbon on conductivity- their properties and applications. 1.5 Low resistance material- contacts materials. Classification of contact materials, important alloys for contacts in various electrical equipments, sintered material. - their properties and applications. 1.6 Resistivity, effect of temperature, impurities, stress on Resistivity of conductor 1.7Materials of low conductivity; Materials used in making a. Precision electrical measuring instruments b. Standard resistances c. Resistance elements for rheostats and similar control devices d. Carbon, construction of carbon elements depending on the requirements as per use their properties and applications 1.8 Concept of super conducting materials 1.9 Use of super conducting materials for various engineering applications	**8**

2.Insulating Materials	1. State properties of insulating material. 2. Identify insulating materials. 3. Use insulating material as per applications. 4. Describe the different classes of insulation. 5. Select insulating material for proper application.	2.1 Electrical properties- volume, Resistivity, breakdown voltage, dielectric strength, Different effects of electric current. 2.2 Mechanical properties- thermal properties, chemical properties and physical properties 2.3 Insulation classes 2.4 Physics of dielectrics, the dielectric as an electric field medium, polarization, electrical conductivity of gases, liquids, solid dielectrics 2.5Gaseous dielectrics-Air, Nitrogen, Sulphurhexa-fluoride- their properties and applications. 2.6 Liquid dielectric: their properties and applications. a. Petroleum insulating oils Insulating oils for transformers and switchgears 2.7 Solid insulating materials classification- their properties and applications. a. Fibrous material impregnating coating, Filling and bonding materials 2.8 Resins: Synthetic and natural, varnishes, impregnated fibrous material. - their properties and applications. 2.9 Rubber- Types, their properties and applications. 2.10 Mica and mica base materials- their properties and applications. 2.11 Ceramic materials- their properties and applications. 2.12 Glasses- their properties and applications.	**8**
3.Magnetic Materials	1. Define various terms related to magnetic material. 2. Describe the different theories of magnetization. 3. Classify the magnetic material. 4. Select material according to requirement of core.	3.1 Introduction-magnetic field strength, flux, magnetic circuit, magnetic force, permeability, reluctance, MMF, flux density, residual magnetism or remenance, coercive force, retaintivity. Relation between magnetic flux intensity and flux density. 3.2 Spontaneous magnetization curve, hysteresis loop, effect of temperature, frequency on magnetization Curie-Weiss law 3.3 Concept of Magnetization, Theories of magnetism-Molecular theory, domain theory	**8**

		3.4 Classification of magnetic materials-Paramagnetic, Ferromagnetic, diamagnetic material. 3.5. Soft and hard magnetic materials-their properties and applications.	
4. Special Purpose Materials.	1. Select materials used for special purpose devices. 2. State the properties of special purpose material. 3. State the applications of specials purpose devices. 4. Select material for fuse.	4.1 Thermocouple-Introduction, principle, material used and their properties & application. 4.2 Bimetals (or thermostats) material-Introduction, working, material used, properties & application. 4.3 fuse material-definition of fuse, function of fuse, desirable characteristics of fuse material, factors on which fuse rating depends, metals & alloy used for fuse wire, their properties and application. 4.4 Thermistors-Introduction, material used properties and application. 4.5 Varistors (non linear resistors)-Introduction, material used, properties, and application. 4.6 Soldering materials-Introduction, types of solders, material used, properties and use. 4.7 Structural materials-Introduction, factors for selecting a structural material, Materials used for making, a) Tower and poles b) RCC poles c) Steel poles. 4.8 Fluorescent material-Introduction, properties, material used, application.	**6**
5. Electrical Workshop & Testing Tools	1. Use various tools. 2. Identify different tools. 3. Test the appliances. 4. Use testing tools and equipment for different tests	5.1 Introduction to various tool used in the electrical workshop, their application, care and maintenance. 5.2 Introduction to following testing tool used in the electrical workshop, their application, care and maintenance. a) Tester b) Test lamp c) Series test board d) Multi-meter e) Megger f) Earth tester.	**6**
6. Home Appliances	1. Describe the construction and working of appliances. 2. Identify the faults in appliances.	**6.1 C**onstructional details and operations with electrical wiring diagram and their installation, Testing and Faultfinding. a) Electric Iron (Automatic)	**12**

	3. Sketch the wiring diagram of appliances.	b) Steam Iron c) Electric Toaster d) Electric Room Heater e) Electric Geyser f) Electric Mixer-grinder g) Electric Washing Machine h) Electric Hot Plate/ segari i) Air Cooler j) Air Conditioner k) Vacuum Cleaner l) Ceiling fan/Table fan/Exhaust Fan m) OTG (Oven-Toaster-Grill) n) Microwave oven o) Haire drier	
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify different conducting materials using resistivity test.	Conducting materials	**4**
2.	Identify different resinous materials using burning test.	Insulating materials	**4**
3.	Identify different magnetic materials.	Magnetic materials	**4**
4.	Use test lamp and series test board for various tests.	Electrical workshop & testing tools	**4**
5.	Measure earth resistance of earth electrode using earth tester		**4**
6.	Test, find faults and repair Automatic iron/ steam iron.	Home appliances	**4**
7.	Test, find faults and repair Electric toaster/room heater.		**4**
8.	Test, find faults and repair Electric geyser.		**4**
9.	Test, find faults and repair Electric Mixer-grinder.		**4**
10.	Test, find faults, repair and install Ceiling fan.		**4**
11.	Testing and fault finding of Air cooler.		**4**
12.	Assemble and install Exhaust Fan.		**4**
13.	Assemble and install Air cooler.		**4**
14.	Assemble and install Air conditioner.		**4**
15.	Test, find faults and repair Hair drier.		**4**
16.	Test, find faults and repair hot plate/induction heater.		**2**
	Skill Assessment		**2**
	Total Hrs.		**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)	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.	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			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Conducting materials	04	08	00	**12**
02	Insulating materials	06	04	00	**10**
03	Magnetic materials	06	08	00	**14**
04	Material for special purpose device.	04	02	00	**06**
05	Electrical workshop & testing tools	02	08	00	**10**
06	Home appliances	00	06	12	**18**
	Total	**22**	**36**	**12**	**70**

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	2	R	2	2	R	2	3	R	2	**35/35**
	3	R	2	3	R	2	4	R	2	4	R	2	5	R	2	1	U	2	
	1	U	2	1	U	2	1	U	2	2	U	2	2	U	2	3	U	2	
	3	U	2	3	U	2	3	U	2	4	U	2	5	U	2	5	U	2	
	5	U	2	5	U	2	6	U	2	6	U	2	6	U	2	6	A	2	
	6	A	2	6	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

❖ SCHEME OF PRACTICAL EVALUATION:

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment's. writing procedure etc.	10
2	Performance(i.e. assembling, dismentalling, testing & fault finding)	20
3	Skills and Results	10
4	Viva voice	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	2	3	-	-	-	-	-	-	-	-	-	-
2	-	3	-	-	-	-	-	-	-	-	-	-
3	2	3	-	-	-	-	-	-	-	-	-	-
4	-	3	3	3	-	-	-	3	3	3	3	-
5	-	3	3	3	-	-	-	3	3	3	3	2
6	-	3	3	3	-	-	-	3	3	3	3	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.	Electrical Engineering Materials	N. Alagappan, N T Kumar, Tata McGraw-Hill Publishing Company Ltd. 1988	978-0-07-460420-5
2.	Electrical Engineering Materials	Basak T.K., New Age International Publisher, First, 2010.	978-81-224-2773-8
3.	Engineering Materials	R.K. Rajput, S.Chand & Co.Ltd., First Edition, 2000.	81-219-1960-6
4.	Study of Home Appliances	K. B. Bhatiya, Khanna publication, 2010	1234567146703
5.	Basic Shop Practical's in Electrical Engineering	M.L.Anwani, Dhanpat Rai publication 2016	EBK 18759-71
6.	Electrical Engineering Material	Dr. Rakesh Dogra, S. K. Kataria & Sons, 2010	81-88458-48-1
7.	Electrical Engineering Materials & Semiconductor Devices	J.B.Gupta, Renu Gupta, S.K. Kataria & Sons, 2012	13-978-93-5014-300-1 10-9350143003
8.	Electrical Engineering Objective Type	M.Handa, A.Handa. Satya Prakashan, First Edition:1985, Reprint:2004-2005	81-7648-043-2

❖ E-REFERENCES:

- http://nptel.ac.in/courses/108108076/1 , assessed on 18th January 2016
- www.electrical4u.com/electrical-engineering-materials/ , assessed on 16thMar 2016
- https://www.youtube.com/watch?v=A9KSGAnjo2U, assessed on 18th January 2016
- www.vssut.ac.in/lecture_notes/lecture1426861925.pdf , assessed on 16 mar 2016
- www.springer.com › Home › New & Forthcoming Titles ,assessed on 16 mar 2016
- https://www.youtube.com/watch?v=Md2vDpD5eWU , assessed on 16 mar 2016
- https://www.youtube.com/watch?v=EAudT9QOZzY, assessed on 16 mar 2016
- https://www.youtube.com/watch?v=BXgpqLLXz0U , assessed on 16 mar 2016.

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1. Digital Multi-meter
2. Megger 500/1000 V
3. Digital Earth Tester / Earth tester 3 spikes.
4. Standard Wire gauge
5. Outside micrometer 0-25 mm
6. Electric Mixer-575 watt,230 V
7. Electric Iron-1100 watt,230 V.
8. Semi-Automatic Electric Iron 750 watt,230 V
9. Steam Electric Iron 450 watt,230 V
10. Ceiling fan-Sweep-1200mm (48”),230V
11. Air Cooler with semi-exhaust fan- 450 mm, 230 V
12. Electric Toaster-1500W,230V
13. Electric Geyser-25L,230V
14. Electric Washing Machine- Washing Capacity 6.5Kg
15. Electric Hot Plate/ segari
16. Air Conditioner-1.5 ton,230V
17. Electrician’s Tool Kit

❖ **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 ELECTRICAL ENGINEERING**
LEVEL NAME	**:**	**ENGINEERING SCIENCES AND TECHNICAL ARTS COURSES**
COURSE CODE	**:**	**ME304E**
COURSE TITLE	**:**	**ELEMENTS OF MECHANICAL TECHNOLOGY**
PREREQUISITE	**:**	**NIL**
TEACHING SCHEME	**:**	**TH: 03; TU:00; PR:02 (CLOCK HRs.)**
TOTAL CREDITS	**:**	**04 (1 TH/TU CREDIT = 1 CLOCK HR., 2 PR CREDIT = 1 CLOCK HR.)**
TH. TEE EXAM	**:**	**03 HRs**
PR. TEE EXAM	**:**	**02 HRs (Internal)**
PT. EXAM	**:**	**01 HR**

❖ RATIONALE:

This course is classified under engineering sciences and technical arts courses. This course describes the basic facts, concepts & principles for the understanding of basic elementary knowledge related to mechanical engineering, which are commonly used in any discipline of Engineering & Technology.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Select proper mechanical parts/ accessories of machines attached to electrical motor.
2. Select proper pumps, Engine and turbine for particular application.
3. Select proper drives for particular application.
4. Use proper maintenance tools
5. Assemble & dismantle pumps, engine and turbines.
6. Operate turbines.

❖ **COURSE DETAILS:**

A. THEORY :

Units	**Specific Learning Outcomes (Cognitive Domain)**	**Topics and subtopics**	**Hrs.**
1 Maintenance	1. List basic mechanical tools. 2. State specification of maintenance tools. 3. Use maintenance tools. 4. List different coolants & lubricants. 5. Select coolant for applications.	1.1 Cutting tools- files, drills, chisels, hacksaws- their types, specifications, applications & precautions while handling 1.2 Hammering tools- hammers, mallets- their types, specifications, applications & precautions while handling. 1.3 Maintenance tools- screw drivers, pliers, spanners, wrenches- their types, specifications, applications & precautions while handling. 1.4 Necessity of coolants, its types & their applications for industrial machinery & I.C. engines.	**08**
2. Fastners	1. Identify fasteners. 2. Define metal joining processes. 3. State types of fasteners 4 .Select fasteners for particular applications.	2.1 Screws, Nut-bolts, studs, Cotters, keys, pin, rivets, solder. Their types, applications, selection for particular application, specification 2.2 Riveting, Welding, Brazing, Soldering Process, Their types, techniques, equipments required. 2.3Foundation bolts, locking devices, washers. Their types, applications, specification, selection for particular use.	**06**
3 Transmission of power	1. Define various power transmitting devices. e.g. shaft, bearing, belts, gears, cam. 2. Compare power transmitting drives. 3. Draw and describe various types of drives 4. Select proper drives for particular application.	3.1 Shafts- Function & its types, Couplings-Function, classification, election of coupling for particular application, Bearings- Function, classification, selection of bearing for particular application 3.2 Cam & Follower-Meaning, Types of Cam & Follower, Terminology. 3.3Belt drive & Chain Drive – Open and cross belt drive, sleep and creep in belts, comparison between	**10**

		belt and chain drive. 3.4Gear Drives-Types of Gears, Speed of gear, gear terminology, advantages of gear drive.	
4 IC Engines	1. State need of IC Engine 2. Classify IC Engine. 3. Describe SI/CI engines, its part and operation with neat sketch 4. Interpret two stroke-four stroke engine and comparison between SI and CI engines	4.1Internal combustion engine: Necessity, Classification & Fuels used for I.C. Engines. 4.2Construction, working principle & applications of-- Two stroke & four stroke engines. (Petrol & Diesel) 4.3Comparison between : i) Two stroke & Four stroke engine, ii) S.I. Engine & C.I. Engine	
5 Pumps	1. Define pump terminology. 2. State need of pump. 3. Calculate horse power & efficiency. 4. Select centrifugal / submersible pump for particular application 5. Compare Centrifugal pump & submersible pump. 6. Diagnose faults in pumps.	**5.1** Pumps : Necessity ,Classification, Terms related to pump- head, suction head, discharge head, total head, lift, capacity , pressure. **5.2** Calculation of water horse power (WHP) and efficiency of pump. **5.3** Centrifugal pump- Construction, functions of different parts, operation and its applications. Factors to be considered while selection of pump. **5.4** Submersible pumps- construction, operation and its applications. Selection of pump for particular use. (No numerical based on this topic) 5.5 Trouble shooting, causes and remedies	**08**
6 Turbines	1. Draw layout of Thermal and hydro power plant. 2. State function of turbine. 3. Classify turbines. 4. Select proper turbine as per head. 5. Compare different turbines.	6.1 Steam turbines- Layout of thermal power plant. Impulse and reaction turbine. 6.2 Hydro turbines- Layout of hydro power plant. Factors to be considered while selecting hydro turbine. 6.3 Pelton, Francis and Kaplan turbine (only figure & working).	**08**
		Total Hrs	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Use maintenance tool kit for various applications.	Maintenance	2
2	Prepare one job of riveting / soldering / brazing.		4
3	Remove and fit the bearing, coupling of Machines.	Transmission of power	4
4	Align coupled machines using proper tools.		4
5	Dismantle and assemble petrol / diesel engine.	IC Engines	4
6	Dismantle and assemble centrifugal pump and study its various components.	Pump	4
7	Operate Pelton wheel.	Turbine	4
8	Operate Francis turbine.		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	Maintenance Tools	04(02)	08(04)	00(00)	**12(06)**
02	Fasteners	04(00)	08(06)	00(00)	**12(06)**
03	Transmission of power	04(00)	08(04)	00(06)	**12(10)**
04	IC Engine	02(00)	04(04)	06(00)	**12(06)**
05	Pumps	06(04)	00(02)	06(00)	**12(06)**
06	Turbines	04(04)	06(04)	00(00)	**10(08)**
	Total	**24(10)**	**34(24)**	**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	4	R	2	1	R	2	**5/7**
	5	U	2																
02	3	R	4	1	U	4	1	U	4	1	U	4	3	U	4				**3/5**
03	2	U	4	2	U	4	3	U	4	5	R	4	4	U	4				**3/5**
04	6	R	4	3	U	4	4	U	4	6	R	4	6	U	4				**3/5**
05	3	U	6	6	U	6	2	U	6										**2/3**
06	4	A	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			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 diagrams of tools, fasteners, drives, pumps, IC engines and turbines, 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	-	-
2	3	-	-	-	-	-	-	-	-	3	-	-
3	3	-	-	-	-	-	-	-	-	3	-	-
4	3	-	2	2	-	-	-	2	-	3	-	-
5	3	-	2	2	-	-	-	2	-	3	-	-
6	3	-	2	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.	A Course in Thermal Engineering	S. Domkundwar, C.P. Kothandaraman & A.V. Domkundwar, Dhanpat Rai and Co, 2004	10: 8177000217 13: 9788177000214
2.	Elements of Workshop Technology (Volume - 1)	Sk. Hajra Choudhury, Ak. Hajra Choudhury, Nirjhar Roy, Media Promoters,	10: 8185099146 13: 9788185099149
3.	A Text Book of Fluid Mechanics & Hydraulic Machines	Dr. R. K. Bansal, Laxmi Publications, 9th Edition, 2015	9788131808153
4.	Theory of Machine	J. K. Gupta, R.S. Khurmi, S. Chand & Company Ltd., 2015	10: 812192524X 13: 9788121925242

❖ **E-REFERENCES:**

- **https://www.youtube.com/watch?v=BaEHVpKc-1Q ,** assessed on 29th March, 2016

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

1. Two stroke and four stroke petrol engine
2. Two stroke and four stroke diesel engine
3. Pelton wheel/Francis Turbine.
4. Centrifugal pump and reciprocating pump.
5. Models of various power transmission drives

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

S.N.	Name	Designation	Institute / Industry
1.	Mr. O. V. Sarode	I/C Head, Mechanical Engineering	Government Polytechnic, Nagpur.
2.	Mr. V. S. Ikhar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
3.	Mr. A. V. Abhyankar.	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)**

LEVEL - IV

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

COURSE CURRICULUM

PROGRAMME	**: DIPLOMA IN ELECTRICAL ENGINEERING**
LEVEL NAME	**: PROFESSIONAL COURSES**
COURSE CODE	**: EE401E**
COURSE TITLE	**: ELECTRICAL CIRCUIT AND NETWORK**
PREREQUISITE	**: EE301E**
TEACHING SCHEME	**: TH: 04; TU: 00; PR: 02(CLOCK HR.)**
TOTAL CREDITS	**: 05(1TH/CREDIT=1CLOCKHR, 1PRCREDIT=2CLOCK HRS.)**
TH. TEE	**: 03 HRS**
PR. TEE	**: 02 HRS (External)**
PT. EXAM	**: 01 HR**

❖ RATIONALE:

This course describes the concepts and principles for solving electrical and electronic circuits. The knowledge of this course is useful for developing the concepts of the courses like switchgear and protection, Transmission and distribution, Electrical machines and Project

On the basis of this the drawing and interpretation of phasor diagram of any electrical circuit, transformer, machines and switchgear can be made.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Solve electrical networks by applying suitable theorem
2. Draw phasor diagram of R-L-C series and parallel electrical circuit.
3. Calculate equivalent resistance of series, parallel, star and delta connected networks.
4. Connect circuit elements and measuring instrument as per given circuits.
5. Interpret the response of R-L, R-C and R-L-C Series and parallel circuit to AC input.
6. Calculate line and phase values of current, voltage and power in star and delta connection.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1 Basic concepts of AC. circuits	1 Define cycle, time period, amplitude. conductor 2. Interpret phase relationship between two alternating quantities from waveform as well as from equations. 3.Find out resultant of two alternating quantities 4. State the sinusoidal equation in various forms. 5. Convert one form of alternating quantity in to other. 6. Illustrate the waveform for getting value of amplitude, time period. 7. Describe the generation of alternating quantity. 8. Perform addition and subtraction of two alternating quantities by Parallelogram method and method of components.	1.1 Sinusoidal A.C. voltage generation. 1.2 Definition of various terms like cycle, Time period, Amplitude, Angular velocity etc. 1.3 Sinusoidal voltages and Current equation and their different forms. Phase difference, lagging and leading phase relation. 1.4 Values of an alternating quantity- Peak, Average ,RMS and their derivation, Form and Peak Factor (Numerical) 1.5 Addition and subtraction of two alternating quantities-by Parallelogram method and method of components.(Numerical) 1.6 Significance of operator j, rectangular form, Trigono metrical form, polar form, Exponential form and Conversion from one form to other (numerical), Addition subtraction, division and multiplication of phasor .Complex conjugate.	
2 Single phase R-L-C circuits	1.Define the term impedance, inductive reactance , capacitive reactance and power factor 2.Draw the phasor diagram for R-L,R-C,R-L-C series circuit 3.Calculate the total impedance of R-L,R-C,R-L-C circuit 4.Illustrate the power triangle. 5.Interpret phase relationship for R-L,R-C,R-L-C circuit 6.State effects of series resonance	2.1 Ac applied to pure R,L,C only, Waveforms and phasor diagram, 2.2 R-L series circuit.- Phasor diagram and waveforms ,Impedance triangle, current & voltage equation ,power factor, ac power(.Numerical) 2.3 Power triangle, True power, apparent power, reactive power and their interrelation. 2.4 R-C series circuit- Phasor diagram and waveforms, Impedance triangle, current and voltage equation, power factor, ac power(.Numerical) 2.5 R- L-C series circuit- Phasor diagram for three conditions and waveforms, Impedance triangle,	**12**

	7 Draw the waveforms for R-L-C series and parallel circuit under resonance condition. 8 State condition of parallel Resonance. 9 State the effects of Resonance on voltage, current, impedance of series circuit. 10 Calculate R-L-C parallel circuit parameters by admittance methods. 11 Describe the phenomenon of series resonance. 12 Calculate resonant frequency of series circuit.	power factor, current and voltage equation, ac power (Numerical) 2.6 Series Resonance- Definition, condition, resonant frequency, effect of series resonance, resonance curve, Q factor, (Numerical) 2.7 Methods of solving R-L-C parallel Circuits. Admittance method, Meaning of admittance, susceptance, conductance, phasor diagram. Numerical on R and L and C in parallel and RL and C in parallel 2.8 Resonance in RL-C parallel circuit. Condition for resonance, Resonance curves, effect of resonance, Q factor ,Numerical 2.9 Application of series and parallel resonance circuit.	
3D.C.Circuit	1 Define linear and nonlinear circuit, active and passive circuit. 2 Compare ideal and practical current and voltage source. 3 Transform current to voltage source and vice – versa. 4 Derive the formula for equivalent resistance of series and parallel circuit. 5 Calculate equivalent resistance of series circuit. 6 Calculate equivalent resistance by star-delta transformation.	3.1Definition - circuit, linear and nonlinear circuit Bilateral ,unilateral circuit, Electrical network, Active and Passive network , Node ,Branch, Loop 3.2Concept of voltage source and current source.- Ideal and Practical voltage source, , Ideal and Practical current source, Internal resistance of source 3.3 Conversion of voltage to current source and vice-versa 3.4 Delta to Star and Star to Delta transformation, (No Derivation, direct formulae). 3.5 Series and parallel circuit 3.6 Equivalent resistance of different circuits by using star –Delta and Delta-Star transformation. Numerical based on this.	**12**
4Circuit Analysis**.**	1 State KCL and KVL 2 Describe the sign convention for voltage drop and EMF source. 3 Decide the sign of current for KCL 4 Calculate the branch current and branch voltage. 5 Calculate the nodal voltage of given circuit by nodal	4.1 Terms related to electrical network. 4.2 Kirchhoff's current and voltage law. Sign convention. Numerical based on KCL and KVL. 4.3 Application of Kirchhoff's laws for solving circuits. 4.4 Mesh current analysis. Steps to be followed for applying a mesh current analysis.	**08**

	analysis. 6 Calculate the mesh current of given circuit by nodal analysis 7. Calculate the current through inductor and capacitor of ac circuit.	4.5 Node voltage analysis. Steps to be followed for applying nodal voltage analysis. Super node technique. 4.6 Examples for explaining mesh and node analysis.	
5 Network Theorems	1 State different theorem. 2 State conditions for Maximum power transfer. 3 Compare Thevenin's and Norton's theorem. 4 Describe the superposition theorem 5 Calculate Thevenin's Equivalent resistance and voltage. 6 Calculate current through any branch by superposition theorem.	5.1Thevenin's Theorem, Derivation, Steps For applying theorem 5.2 Superposition theorem, ,Illustrate with example ,Procedure for solving problems 5.3 Norton's Theorem, steps to be followed for applying Norton's Theorem 5.4 Maximum Power Transfer theorem, Derivation of condition for maximum power transfer. (Numerical on all theorems)	**16**
6 Poly phase circuits**.**	1. State the advantages of three Phase system. 2. Compare balanced and unbalanced system. 3. Define line and phase values w.r.t. star and delta connection 4. Interpret the relationship between line and phase values of star and delta Connection 5 Draw the phasor diagram for star and delta connection. 6 Describe the generation of 3ph AC. 7 Calculate the power, impedance of three phase star connected system.	6.1 Advantages of three phase AC over Single phase AC. 6.2 Generation of 3 phase ac, Sinusoidal waveform, sinusoidal equation of ac quantities, phase sequence, Phase relationship. 6.3 Connection of 3 phases- star and delta connection. Meaning of line values, phase values, balanced and unbalanced load condition. 6.4 Star connected system-Phasor diagram relationship between Line and phase values of voltage and current,3ph power .Numerical 6.5 Delta connected system- Phasor diagram ,relationship between line and phase values of voltage and current,3ph power, (Numerical)	**08**
		Total Hrs	**64**

B LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Trace the response of sinusoidal voltage and Current of AC Circuits.	Basic concept of AC Circuits	**2**
2	Interpret the response of R-L series circuit.	Single phase R-L-C Series circuits	**2**
3	Interpret the response of R-C series circuit.		**2**
4	Find out the current, power factor of R-L-C series circuit and Interpret phase relationship by drawing phasor diagram.		**2**
5	Measure the conditional parameters of series resonance of R-L-C series circuit and draw the phasor diagram.		**2**
6	Determine the current and power factor in R-L-C parallel circuit. And Interpret phase relationship by drawing phasor diagram.		**2**
7	Measure currents at node in a given circuit by KCL and measure voltage across any branch of given circuits by KVL	Circuit analysis	**2**
8	Determine branch currents of a circuit containing two sources by superposition theorem.	Theorems	**2**
9	Determine the current through load resistance of a given circuit by Thevenin's theorem.		**2**
10	Calculate short circuit current in a branch of a given circuit by Norton's theorem.		**2**
11	Determine maximum power of a given circuit using maximum power transfer theorem for a given circuit.		**2**
12	Measure the line and phase values of voltage and current of three-phase star connected load and interpret relation between line and phase values.	Poly phase circuits	**4**
13	Measure the line and phase values of voltage and current of three-phase delta connected load and interpret relation between line and phase values.		**4**
		Skill Assessment	**2**
		Total Marks	**32**

❖ SPECIFICATION TABLE FOR THEORY PAPER

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Basic concept of AC Circuits	02(02)	10(04)	00(00)	**12(06)**
02	Single phase R-L-C Circuits	04(04)	08(04)	04(00)	**16(08)**
03	DC Circuits	04(02)	04(04)	00(00)	**08(06)**
04	Circuit analysis	02(00)	00(06)	06(00)	**08(06)**
05	Theorems	02(00)	10(04)	06(04)	**18(08)**
06	Poly phase Circuits	02(00)	06(00)	00(06)	**08(06)**
	Total	**16(08)**	**38(22)**	**16 (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	1	U	2	4	R	2	5	R	2	6	R	2	1	R	2	**5/7**
	3	R	2																
02	1	U	4	1	U	4	2	R	4	1	U	4	2	R	4				**3/5**
03	3	R	4	2	U	4	2	U	4	2	U	4	3	U	4				**3/5**
04	2	A	4	3	U	4	5	U	4	5	U	4	5	A	4				**3/5**
05	5	U	6	5	A	6	4	U	6										**2/3**
06	4	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
		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	2	3	-	-	-	-	-	-	-	-	3	3
2	-	3	-	-	-	-	-	-	-	-	3	3
3	-	3	-	-	-	-	-	-	-	-	3	3
4	-	3	2	2	-	-	-	2	-	2	-	3
5	-	3	2	2	-	-	-	2	-	2	-	3
6	-	3	2	2	-	-	-	2	-	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.	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, 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, P.K. Kharbanda, S. Chand & Company Ltd., Third, 1990	13: 978-8121901048
6	Circuits and Networks Analysis and Synthesis	A. Sudhakar, Shyammohan S. Palli, Tata McGraw-Hill Publishing Co. Ltd., , Third Edition, 2007	0-07-460394-9

7	Electric Circuit Analysis	S.R. Paranjothi, New Age International Publisher, Fourth Edition,2011	978-81-224-3154-4

❖ **E-REFERENCES:**

- http://www.electrical4u.com/norton-theorem-norton-equivalent-current-and-resistance/ assessed on 28th March2016.
- http://www.electrical4Nodal Voltage Analysis and Nodal Analysis - Electronics Tutorials assessed on17/09/2016
- u.com/single-and-multi-mesh-analys, assessed on10 th ,15th,17thApril2016
- http://www.allaboutcircuits.com/textbook/direct-current/chpt-10/mesh-current-method/ assessed on17/09/2016

❖ **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, Tong-tester.
5. Rheostat assorted sizes
6. Variable Inductor, Capacitor.
7. Dimmerstat 15A,300V
8. Variable rectifier100 A,300V DC
9. Computer.
10. Kits of theorems.

❖ **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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs.K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Shri. B. P. Bale	Dy. Ex. Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE402E

COURSE TITLE : ELECTRICAL AND ELECTRONIC MEASUREMENT

PREREQUISITE : EE301E

TEACHING SCHEME : TH: 03; TU: 00; PR: 02 (CLOCK HRs.)

TOTAL CREDITS : 05 (1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT = 2CLOCK HR.)

TH. TEE : 03 HRs

PR. TEE : 02 HRs (External)

PT. : 01 HR

❖ RATIONALE:

Electrical diploma holders have to work as technician in industries. They have to work as production, maintenance, testing engineer in various industries such as power generation, transmission, distribution, traction etc. They have to deal with different electrical machines and equipments. While performing above task they have to measure different electrical parameters and quantities. After completion of this course diploma engineering students will develop the skills required for the measurements and handling of different measuring instruments in the field of electrical engineering.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Describe working principles and constructional details of various electrical measuring instruments.
2. Select the method of measurement and ranges of instruments as per requirement.
3. Use various bridges for measurements of different parameters
4. Use measuring instruments.
5. Record the readings of different meters.
6. Calibrate and test the measuring instruments.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Fundamental of Measurement	1. Define different terms in measurement system 2. State the various effect of electric current used in measuring instruments. 3. State the desirable qualities of instruments. 4. Classify different types of errors. 5. Classify measuring instruments 6. State different torque and their necessity.	1.1 Need of measurement & significance of measurement 1.2 Effect of electric current used for measuring instruments 1.3 Qualities of instrument- sensitivity, accuracy, precision, stability, reliability, standards & calibration, resolution. 1.4 Types of errors-gross error, systematic error, random error. 1.5 Classification of instruments based on- construction, working principle and application. 1.6 Necessity of different torque in measuring instruments- Deflecting, controlling torque and damping torque.	**05**
2. Measurement of Current and Voltage	1. Describe construction and principle of various instruments 2. State the Principle of voltage and current measurements. 3. Identify different parts of measuring instruments. 4. Select proper meter for particular application 5. Draw the connection diagram of instrument transformer for extension of ranges. 6. Describe working principle of digital voltmeters. 7. Describe the process of calibration of voltmeter and ammeter. 8. Calculate range extension of ammeter & voltmeter-by shunt and series resistance	2.1 Construction & principle of following instruments– a) Permanent Magnet Moving Coil (PMMC) b) Moving Iron (MI) c) Dynamometer type 2.2 Principle of voltage and current measurements and production of their torque. 2.3 Range extension of ammeter & voltmeter-by shunt and series resistance, advantages and disadvantages of shunt and series resistor used for range extension. Numerical based on it. 2.4 Instrument transformer. Principle of current transformer (CT) and potential transformer (PT), their use in extension of ranges, precautions to be taken while using CT. 2.5 Calibration of voltmeter and ammeter using standard meter and potentiometer.	**08**

3. Measurement of Power and Energy	1. State types of power in A.C. Circuits 2. Describe construction & principle of dynamometer type wattmeter 3. List different errors & their compensation in wattmeter. 4. Describe measurement of power in three-phase circuit for balanced and unbalanced load by different methods. 5. Draw connection diagram of CT and PT for measurement of power 6. Calculate active and reactive power in three-phase balanced load by one wattmeter method and two-wattmeter method 7. State principle of electrical energy measurement. 8. Describe the process of calibration of energy meter.	3.1 Concept of power in A.C. Circuits – Active, reactive, apparent power and power triangle. 3.2 Principle and construction of dynamometer type wattmeter. 3.3 Errors and their compensation 3.4. Poly-phase wattmeter – construction, principle, 3.5. Calculation of Multiplying factor of wattmeter 3.6. Significance of power factor in power measurement 3.7 Measurement of power in three-phase circuit for balanced and unbalanced load 3.8 Measurement of active and reactive power in three- phase balanced load by one wattmeter method and two-wattmeter method 3.9 Difference between power and electrical energy. 3.10 Construction and working principle of Single phase and three phase induction type of energy meter 3.11 Calibration of energy meter.	**10**
4 Other Meters	1. Describe the construction and working of different meters. 2. Identify the applications of different meters 3. Measure current by Clip-on-ammeter 4. Measure frequency, power factor by different meters.	4.1 Construction and working principle of Single phase and three phase Power Factor meter, Electro-dynamometer type power factor meter. 4.2 Construction and working principle of Frequency meter, Weston and Ferro-dynamic type frequency meter. 4.3 Construction & working principle of Synchroscope , Weston type synchroscope 4.4 Construction and working principle of Phase sequence indicator, Rotating type phase sequence indicator 4.5 Construction and working principle of Clip-on-ammeter.	**10**
5. Measurement Of Circuit	1. Classify different types of resistances. 2. Select proper methods for different types of	5.1 Measurement of Resistance: Classification as low, medium and high resistance. 5.2 Methods used for measurement of	**10**

Parameters	resistances 3. State use of different meters for various applications. 4. State use of different bridges for various applications. 5. Describe the construction and working of different meters. 6. Calculate low, medium and high resistance by using different bridges.	each type of resistance. i. Low resistance- potentiometer, Kelvin double bridge method. ii. Medium resistance- Wheat stone bridge. iii. High resistance- Megger. 5.3 Megger – Construction, working principle and its application 5.4 Measurement of earth resistance by fall of potential method, earth resistance tester-construction, working principle and measurement of earth resistance. 5.5 Introduction to A.C. bridges- Anderson bridge for measurement of inductance, Schering bridge for measurement of capacitance , Bridge balance equation(No derivation & numerical) 5.8 Introduction and working principle of LCR meter.	
6. Measurement by Electronic Meters	1. State the need of electronic meters 2. Describe basic working principle of electronic meters 3. Describe working principle of digital energy meter 4. State application of digital multi meter. 5. Describe measurement of earth resistance by digital earth resistance tester	6.1 Need of electronic meters 6.2 Basic working principle of electronic meters 6.3 Introduction of CRO, block diagram of CRO. 6.4 Introduction of Function Generator, block diagram of Function Generator. 6.5 Digital Energy meter- Block diagram , working principle and its application 6.6 Digital multi meter- Block diagram working principle and its application 6.7 Digital Earth resistance tester - Block diagram, working principle and its application.	**05**
		Total Hrs.	**48**

B LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify the components of PMMC and MI instruments using cut section models.	Measurement of current and voltage	**4**
2.	Measure current and voltage using Current transformer and Potential transformer.		**2**
3.	a) Measure high value of DC current by a low range DC ammeter and shunt b) Measure high value of DC voltage by a low range DC voltmeter and multiplier		**2**
4.	Measure active & reactive power in three-phase balanced load by single wattmeter method.	Measurement of power and energy	**2**
5.	Measure active & reactive power in three-phase balanced load by two wattmeter method & observe the effect of power factor variation on wattmeter readings		**2**
6.	Calibrate energy meter at various power factor by- Standard energy meter /Meter test bench.		**2**
7.	Measure different electrical quantities using analogue and digital meters- a) Clip-on ammeter b) Power factor meter c) Frequency meter d) Phase sequence indicator.	Other meter	**6**
8.	Measure low resistance by Kelvin's double bridge.	Measurement of circuit parameters	**2**
9.	Measure medium resistance by wheat-stone bridge.		**2**
10.	Measure insulation resistance of AC/DC motor using megger.		**2**
11.	Measure different parameters using LCR meter		**2**
12.	Measure various electrical quantities using digital multi-meter.	Measurement by Electronic Meters	**2**
		Skill Assessment	**2**
		Total Hrs.	**32**

❖ 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			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Fundamental of measurement	04 (00)	04 (04)	00 (00)	08 (04)
02	Measurement of current and voltage	04 (02)	04 (00)	04 (04)	12 (06)
03	Measurement of power and energy	04 (04)	04 (00)	06 (04)	14 (08)
04	Other meters	04 (00)	10 (10)	00 (00)	14 (10)
05	Measurement of circuit parameters	00 (02)	08 (06)	06 (00)	14 (08)
06	Measurement by Electronic Meters	00 (00)	08 (04)	00 (00)	08 (04)
	Total	**16 (08)**	**38 (24)**	**16 (08)**	**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	3	R	2	3	R	2	6	U	2	2	R	2	5/7
	5	R	2																
02	2	R	4	1	U	4	2	U	4	1	U	4	6	U	4				3/5
03	4	R	4	3	U	4	5	U	4	3	R	4	4	U	4				3/5
04	4	U	4	5	U	4	2	A	4	2	A	4	3	A	4				3/5
05	4	U	6	3	A	6	5	U	6										2/3
06	6	U	6	5	A	6	4	U	6										2/3

T= Unit/Topic Number L= Level of Question M= Marks

R – Remember U – Understand A – Analyze / Apply

❖ SCHEME OF PRACTICAL EVALUATION:

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment's. writing procedure etc.	10
2	Performance(i.e. recording ,calibrating and testing)	20
3	Skills and Results	10
4	Viva voice	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
2	-	3	-	-	-	-	-	-	-	-	3	3
3	-	3	-	-	-	-	-	-	-	-	-	-
4	-	3	2	2	-	-	-	2	-	2	3	3
5	-	3	2	2	1	-	-	2	-	2	3	3
6	-	3	2	2	-	-	-	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.	Electric & Electronic Measurement & instrumentation	A. K. Sawhney, Dhanpat Rai & Sons, 18 th Edition, 2007	13:9788177000160
2.	Electrical Measurement & Measuring Instruments.	E. W.Golding, Pitman Publisher, 5 th Edition ,1968	13: 978-0273402022 10:0273402021
3.	Electrical Measurements & Measuring Instruments	N.V. Suryanarayna , S, Chand & Co. 1 st Edition ,2001	81-219-2011-6
4.	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

❖ **E-REFERENCES:**

- https://www.youtube.com/watch?v=8oJB1JlIC6A , assessed on 15th September, 2016
- http://www.electricaledition.com/2015/11/permanent-magnet-moving-coil-type-pmmc-instrument.html , assessed on 15th September, 2016
- http://www.electrical4u.com/moving-iron-instrument/ , assessed on 15th September, 2016
- http://www.electrical4u.com/electrical-measuring-instruments-types-accuracy-precision-resolution-speed/ , assessed on 15th September, 2016
- http://www.electrical4u.com/ohmmeter/ , assessed on 15th September, 2016
- http://www.electrical4u.com/what-is-low-power-factor-wattmeter/ , assessed on 15th September, 2016
- http://www.electrical4u.com/weston-type-frequency-meter/ , assessed on 15th September, 2016
- http://www.electronicshub.org/wheatstone-bridge/ , assessed on 15th September, 2016
- http://www.electrical4u.com/andersons-bridge/ , assessed on 15th September, 2016
- http://www.electrical4u.com/measurement-of-three-phase-power , assessed on 15th September, 2016
- http://www.electrical4u.com/ohmmeter/ , assessed on 15th September, 2016
- http://circuitglobe.com/two-wattmeter-method-of-power-measurement.html ,assessed on 15th September, 2016

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

1. Megger 500/1000 V Hand driven
2. Earth tester 3 spike-measuring range 0-1 ohms to 10000 ohms.
3. Single-Phase Energy Meter Accuracy Class 1.0 & Current Rating : 5-30
4. Three-Phase Induction Type Energy Meter. a) Voltage 3 x 240 V (Phase to a) neutral) b) Current i) Basic current (Ib) 10 A ii) Rated max. continuous current(Im) 100A(10Ib) c) Frequency 50 Hz d) Accuracy Class 0.5/1.0
5. Electronic Energy Meter. Accuracy Class 1.0 & Current Rating : 5-30 Amp
6. Single Phase & Three Phase P.F.Meter Accuracy **:** Class 1.0 as per ISS 1248/03 .scale **:** Almost linear from 1/10 to full scale in case of WATT/KW/MW, VA/KVA/MVA & VAR/KVAR/MVAR Meters & 0.5 (Lag)-1-0.5(Lead) in case of power factor meters
7. Tong tester ACA: 3/15/60A + 5% ACV: 300/600V + 5%, Size: 120x70x35mm.
8. Digital Multi-meter- 24V-250V AC/DC, Accuracy- 0.5% ± 1 digit

❖ **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 D. D. Lulekar	Head of Electrical Engineering	Government Polytechnic, Nagpur.
3	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mrs. A.P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. R. Y. Ghormade	Head of Electrical Engineering	Dharampeth Polytechnic, Nagpur
12	Mr. Bhashkar Bale	Dy. Executive Engineer,	MSTCL, Nagpur
13	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 ELECTRICAL ENGG.

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE403E

COURSE TITLE : INSTRUMENTATION

PREREQUISITE : EE402E

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:

In many Industries the measuring instruments and transducers are used for modern control. Atomization is a need of an hour for industry to maintain the quality and increase productivity with optimization. Measurement of various quantities and their precise controls the key factor in atomization. Students should be conversant with the basic principles of transduction of physical variables into electrical signals, signal conditioning circuits, basic data acquisitions systems.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1 Select various instruments used for measuring electrical and non-electrical quantities.

2 Select appropriate transducers/sensors for given application.

3 Identify signal conditioning system & telemetry system.

4 Measure non-electrical quantities using proper instruments.

5 Use op-amp as inverter, non-inverting mode, adder, differentiator, and integrator.

6 Convert the Digital to Analog and Analog to Digital data.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Concept of instrumentation.	1. State the need of Instrumentation. 2. Draw the block diagram of instrumentation. 3. Classify various types of switching devices. 4. Describe Construction and Principle of Switches. 5. State application of Switches.	1.1 Basic purpose of instrumentation. 1.2 Basic block diagram (transduction, signal conditioning, signal presentation) and their function. 1.3 Construction, working and application of switching devices- Push button, limit switch, float switch, pressure switch, thermostat, electromagnetic relay.	**02**
2.Transducer	1. Classify the transducer on the basis of their application. 2. Differentiate between two types of transducer. 3. State advantages and disadvantages of electric transducer. 4. State Factors affecting the choice of Transducers. 5. Describe, Construction and Principle of Transducer. 6. State application of Transducer. 7. Suggest the transducer for particular application.	2.1 Distinguish between Primary and Secondary, Electrical and Mechanical, Analog and Digital, Active and Passive. Mechanical devices pry. And sec. transducers 2.2 Advantages of electric transducers 2.3 Required characteristics of transducers. 2.4 Factors affecting the choice of transducers 2.5 Construction and principle of resistive transducer- Potentiometer –variac and strain gauges -No derivation. Only definition and formula for gauge factor 2.6 Types of strain gauges like unbonded, bonded and semiconductor. 2.7 Construction and principle of Inductive transducers-L.V.D.T. and R.V.D.T, their applications. 2.8 Construction, principle and applications of transducers – Piezo- Electric transducer, photoconductive Cells, photo voltaic cells.	**10**
3.Measurement of non-electrical quantity	1. Classify different types of Temperature, Pressure, Speed, Vibration, Flow, Liquid	3.1Temperature measurement – Construction & Working of RTD Thermistor & Thermocouple, radiation pyrometer, technical	**10**

	level and Thickness measurement method. 2. Compare between two types of Temperature, Pressure, Speed, Vibration, Flow, Liquid level and Thickness measurement method. 3. State advantages and disadvantages of measurement of non-electrical quantity. 4. Describe Construction and Principle of non-Electrical quantity. 5. State Application of non-Electrical Quantity. 6. Select the proper thickness measurement method. 7. Suggest the devices used for measurement of Radiation.	Specifications and ranges. 3.2 Pressure measurement – Construction and Working of bourdon tube, bellow, diaphragm and strain gauge, Combination of diaphragm and inductive transducer, bourdon tube and LVDT, bellow and LVDT, diaphragm capacitance and bridge Circuit. 3.3 Construction and Working of Speed Measurement by contacting and non- Contact type- DC tachometer, photo-electric tachometer, toothed rotor tachometer generator - magnetic pickup and Stroboscope. 3.4 Construction and Working of Vibration measurement by accelerometer-LVDT accelerometer, Piezo electric type. 3.5 Construction and Working of Flow measurement by electromagnetic and Turbine flow meter. 3.6 Construction and Working of Liquid level measurement by resistive, inductive, capacitive gamma rays and Ultrasonic methods. 3.7 Construction and Working of Thickness measurement by resistive, inductive, capacitive, ultrasonic and Nuclear methods.	
4. Signal Conditioning.	1. Draw basic block diagram of OP-AMP. 2. List properties of an ideal OP-AMP. 3. Compare open loop and closed loop configuration of OP-AMP. 4. Identify different Applications of OP-AMP in any circuit diagram. 5. Derive output equation of given OP-AMP in any	4.1BasicConcept of signal conditioning System. 4.2Draw pin configuration of IC 741. 4.3 Define Ideal OP-AMP& Electrical Characteristics of OP-AMP. 4.4DifferentParameters of op-amp:- Input offset voltage, Input offset current, Input bias current, Differential input resistance, CMMR, SVRR, voltage gain, output voltage, slewrate, gain	**08**

	Circuit diagram. 6. Show how op-amp is used as differential Amplifier. 7. State ideal characteristics of filter. 8. Sketch the circuit diagram with relevant waveforms for filter. 9. Describe the operation of sample and Hold Circuits.	bandwidth. output short circuit current. 4.5Use of op-amp as inverting, non-inverting mode, adder, subtractor, And Working of Differential amplifier and instrumentation amplifier. 4.7 Filters: Types of RC filters and frequency response -no derivation. 4.8 Samples and hold circuits operation and its application.	
5. Data Acquisition System.	1. Draw block diagram of DAS. 2. Describe DAS and its type. 3. List the factor that decides the configuration of DAS. 4. State working principle of Ana log-to-digital and digital-to – analog Conversion method. 5. State advantages and disadvantages of data Acquisition system. 6. State Application of data Conversion method. 7. Describe Data logger with block diagram. 8. Compare DAS and Data logger. 9. Justify the method for Digital to Analog Converter	5.1 Generalized DAS- Block diagram and description of Transducer, signal conditioner, multiplexer, converter and recorder 5.2 Draw Signal Channel and Multi-channel DAS- Block diagram only. 5.3 Difference between Signal Channel and Multi-Channel DAS. 5.3 Data conversion- Construction and Working of Analog to digital conversion- successive approximation method, ramp type method. 5.4 Digital to Analog conversion- Construction and Working of binary weighted resistance method. 5.5 Data logger- Block diagram and Basic operation of data logger. 5.6 Comparison between DAS and Data logger.	**08**
6. Data Transmission , Telemetry and Display Devices	1. Describe methods Of Data Transmission. 2 Describe the block diagram of telemetry System. 3 Describe working principle of Telemetry System. 4 Compare types of Modulation system. 5 Describe the operation of digital Display devices	6.1 Concept and methods of data Transmission Of Electrical and electronic transmission. 6.2 Construction and principle of telemetry system and its type - Electrical telemetering system- Voltage, current and frequency. 6.3 Comparison between Amplitude Modulation, Frequency Modulation and Phase Modulation systems with its application.	**10**

	7 Compare any two digital Display devices 8 Justify the use of LCD as a display device. 8.Suggest the need of Telemetry system used in process industries.	6.4Digital display device- operation and its application of seven segment display, dot matrix display and concept of 3½, 4½ digits. 6.5 Working principle of nixi-tube, LED LCD and its application.	
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify different switches used in instrumentation system.	Introduction to Instrumentation System	**2**
2	Measure linear displacement by L.V.D.T.	Transducer	**2**
3	Measure the strain with the help of strain gauge		**2**
4	Measure temperature by PT-100, thermistor, thermocouple along with simple resistance bridge. /	Measurement of non-electrical quantity	**2**
5	Use Thermocouple to control the temperature of a furnace/machine.		**2**
6	Measure pressure using pressure sensor kit.		**2**
7	Measure angular speed using stroboscope and tachometer.		**2**
8	Measure the flow using flow meter.		**2**
9	Measure the liquid level by using resistive method.		**2**
10	Use op-amp as inverter, non-inverting mode, adder, differentiator and integrator.	Signal Conditioning.	**4**
11	Convert digital data into analog data by using analog to digital converters and analog data into digital data by digital to analog converter.	Data Acquisition System.	**4**
12	Identify various digital display devices.	Data Transmission, Telemetry & Display Devices	**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 to Instrumentation system	02(02)	04(00)	00(00)	06(02)
02	Transducer	02(00)	04(00)	06(06)	12(06)
03	Measurement of non-electrical quantity	06(02)	08(08)	06(00)	20(10)
04	Signal Conditioning.	00(02)	04(04)	06(00)	10(06)
05	Data Acquisition System.	02(02)	08(00)	00(06)	10(08)
06	Data Transmission, Telemetry & Display Devices	02(00)	04(08)	06(00)	12(08)
	Total	**14(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	2	R	2	3	R	2	5	R	2	6	R	2	1	R	2	5/7
	3	R	2																
02	1	U	4	2	U	4	3	U	4	3	U	4	3	R	4				3/5
03	3	U	4	3	U	4	4	U	4	4	U	4	4	U	4				3/5
04	5	R	4	5	U	4	6	U	4	6	U	4	6	U	4				3/5
05	2	A	6	3	A	6	2	A	6										2/3
06	4	A	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 circuit diagram/ selection of equipment's/ writing procedure etc.	10
2	Performance/skill	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	-	-	-	-	-	-	-	-	3	-
3	-	3	-	-	-	-	-	-	-	-	3	2
4	-	3	2	2	-	-	-	2	-	2	3	-
5	-	3	2	2	-	-	-	2	-	2	3	2
6	-	3	2	2	-	-	-	2	-	2	3	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.	Electric & Electronic Measurement & instrumentation	A.K. Sawhney, Dhanpat Rai & Co. Author, Nineteenth revised edition 2011 reprint, 2014	10: 8177001000
3.	Instrumentation devices and system	C. S. Rangan, G. R. Sharma. &V. S. V. Mani -Pen ram International Publishing India Pvt. Ltd. Fifth edition	10: 0074633503
4.	Electronics and instrumentation	V. K. Mehata, S. Chand & Company Pvt. Ltd., Third Edition-Reprint, 2010	81-219-2729-3
5.	Industrial instrumentation & control.	S. K. Singh Edition, reprint. Publisher, Tata McGraw-Hill, 1987.	007451914X, 9780074519141.

❖ **E-REFERENCES:**

- www.electrical4u.com/transducer-types-of-transducer/, assessed on 21th sep 2016
- *www.physics.utah.edu/Phys5719/Temperature/*, assessed on 21th sep 2016
- https://www.youtube.com/user/BTCInstrumentation, assessed on 21th sep 2016.
- www.youtube.com/user/BTCInstrumentationassessed on 21th sep 2016.
- *energy.gov/sites/prod/files/2013/10/.../QSR-InstrumentationControl.pdf*assessed on 21th sep 2016

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

1. Switches:-SPST, 20VA.
2. **LVDT**-120V Single Phase Input with up to 140V Outputs
3. Strain gauge
4. Temperature by PT-100
5. Pressure sensor kit.
6. Flow meter.
7. Tachometer
8. Op-amp
9. Pneumatic controller-Air Compressor (optional) Pressure range 0 to 150psi and 0 to 10kg/cm supply.230V AC Motor power 0.5 HP, 1440RPM: 20 W LED light

❖ **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 D. D. Lulekar	Head of Electrical Engineering	Government Polytechnic, Nagpur.
3	Mrs.K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
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7	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mrs. A.P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. R. Y. Ghormade	Head of Electrical Engineering	Dharampeth Polytechnic, Nagpur
12	Mr. Bhashkar Bale	Dy. Executive Engineer,	MSTCL, Nagpur
13	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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**PROFESSIONAL COURSES**
COURSE CODE	**:**	**EC420E**
COURSE TITLE	**:**	**INDUSTRIAL ELECTRONICS**
PREREQUISITE	**:**	**EC305E**
TEACHING SCHEME	**:**	**TH: 03; TU: 00; PR: 02(CLOCK Hrs.)**
TOTAL CREDITS	**:**	**04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT =2CLOCK HR.)**
TH. TEE	**:**	**03 HRs**
PR. TEE	**:**	**02 HRs (External)**
PT. EXAM	**:**	**01 HR**

❖ RATIONALE:

This subject is classified as professional course and describes the fact, principle and technique of electronic devices like solid state power devices, and circuits and their applications in electrical systems, so that students can use knowledge in acquiring supervisory skill and prototype testing skill.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Illustrate the construction of power devices.
2. Use power devices in industrial circuits.
3. Construct electronics circuit using power devices.
4. Apply the testing skill of industrial system.
5. Assemble & test different electronics control circuits using thyristors.
6. Analyze the functioning of electronics control in industrial system.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Power semiconductor devices.	1. Describe the working principle of power diodes. 2. Describe the working principle of power transistors. 3. Draw symbol of various thyristors. 4. Describe the working principle of different types of thyristor. 5. State application of thyristors. 6. Describe the working of Unijunction transistor (UJT). 7. Analyze the working of SUS.	1.1 Introduction 1.2 Power diodes–symbol, working principle - General Purpose diodes, fast recovery diodes, schottky diode, MOS diodes 1.3 Power transistors-working principle -Power BJT,Power MOSFET. 1.4 Thyristors- symbol, working principle &characteristics - Schottky diode, SCR, GTO, IGBT ,MGT, ETO ,MTO, IGCT, Bidirectional devices- DIAC,TRIAC,RCT, 1.5 Devices used for firing circuit - symbol, working principle - Unijunction transistor -UJT, Programmable Unijunction transistor -PUT, Complementary Unijunction transistor -CUJT, Silicon Unilateral Switch -SUS, Silicon Bilateral Switch -SBS	**10**
2.SCRTriggering Methods	1. Describe the various types of SCR turn-on method. 2. Describe various firing circuits. 3. Describe DIAC Firing Circuit. 4. Analyze gate characteristics of SCR.	2.1 Introduction 2.2 SCR turn-on method -working principle, circuit diagram- High voltage turn-on, High temperature turn-on, Light turn-on, dv/dt turn-on, Gate turn-on 2.3 Gate characteristics of SCR 2.5 Firing Circuits– working principle, circuit diagram- Diode-Resistance Firing Circuit, Diode-Resistance-Capacitance Firing Circuit, UJT Firing Circuit, PUT Firing Circuit, Synchronized UJT Firing Circuit, Pulse Transformer Firing Circuit, DIAC Firing Circuit, Silicon Bilateral Switch Firing circuit, Light Activated Firing Circuit.	**08**

3.Commutation ar protection of SCR	1. Describe the various types of SCR Turn-off Method. 2. Describe working principle of Commutating Circuit. 3. State the application of Power devices. 4. Identify different methods of Commutation.	3.1 SCR Turn-off Method– working principle, circuit diagram- Line Commutation, Load Commutation, Forced Commutation, Gate Turn-off. 3.2 Commutating Circuit - working principle, circuit diagram- Voltage Commutation, Current Commutation, Pulse Commutation, Jones Commutation. 3.3 Protection Of Power Semiconductor Device - working principle, circuit diagram- Overvoltage Protection, Over current Protection, Gate Protection, Over temperature Protection.	**08**
4 Inverters and Choppers	1. Define Inverter. 2. State necessity of an inverter. 3. Describe the operation of series inverter and Parallel inverter. 4. State the advantages, disadvantages and applications of inverter. 6. Define chopper. 7. List applications of chopper. 9. List the features of chopper. 10. State the principle of basic chopper circuit. 11. State the necessity of chopper. 12. Analyze the operation of step down, step up, Morgan and Jones chopper with circuit diagram and waveform.	4.1 Necessity, Classification, Principle of operation of Inverters. 4.2 Circuit diagram, working and waveforms of Series Inverter, Parallel inverters. 4.3Advantages, Disadvantages and Applications of inverters. 4.4 Comparison between series and Parallel inverter. 4.5Necessity, Classification and Principle of chopper. 4.6 Circuit diagram, operation and waveforms of Basic chopper circuit, Step up, Step down, Morgan chopper, Jones chopper. 4.7Applications of chopper.	**08**

5 Power Converte	1. Describe with circuit diagram of 1-phase fully controlled half wave rectifier with RL load and freewheeling diode. 2. State importance of freewheeling diode. 3. Analyze circuit diagram of single phase full wave half controlled bridge rectifier for RL load with and without freewheeling diode. 4. State the effect of source inductance in control rectifier. 5. State the advantages of full control rectifier. 6. State applications of control rectifier.(Any 4pts) 7. Compare between controlled HWR and controlled FWR. 8. Define control rectifier. Classify them on the basis of input supply. 9. State the Principle of operation of cycloconverter.	5.1 Principle of phase angle control 5.2 Classification of controlled rectifiers. 5.3 Circuit diagram, working and waveforms of Half wave controlled rectifier (HWR) and Full wave controlled rectifier (FWR) with R , RL, RL with freewheeling diode - No derivation 5.4 Working and waveforms of three phase converter using power diode and SCR- HWR and FWR. 5.5 Necessity, Principle of cyclo converter-Concept only, Types of cyclo converter, Advantages, Disadvantages and application of cyclo converter.	**08**
6. Regulated Power supply.	1. Describe working of shunt regulators 2. Describe circuit diagram of series regulators. 3. Describe working of Transistor voltage regulator. 4. Identify various schemes of SMPS.	6.1Working principle - Shunt regulators, series regulators 6.2 Circuit diagram and working of Transistor voltage regulator Protection circuits, Crow bar protection. 6.2 SMPS - Concept of Switched Mode Power Supplies, Various schemes of SMPS, Design aspects of SMPS	**06**
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Collect the specification of different power electronics devices from the data sheet and Prepare a report for them.	Power semiconductor devices.	2
2	(a) Set the proper value of gate current of SCR, measure forward current for various forward voltage and plot V-I characteristics of SCR.		2
	(b) Find the value of Holding current, Latching current, Forward break over voltage.		2
3	Measure output current for input forward voltage and reverse voltage applied, Plot the V-I characteristics of DIAC, Find the breakdown voltage.		2
4	Set the proper value of gate current of TRIAC, measure forward current for various forward voltage ,measure reverse current for various reverse voltage and plot V-I characteristics of TRIAC.		2
5	Develop triggering circuit of SCR using UJT.	SCR Triggering Methods	4
6	Measure the output voltage of three phase half-wave rectifier and plot the input and output waveforms.	Power Converters	2
7	Measure the output voltage of three phase full-wave rectifier and plot the input and output waveforms.	Power Converters	2
8	Measure the value of load voltage by using series inverter circuit and plot the waveforms.	Inverters and Choppers	2
9	Measure the value of load voltage by using parallel inverter circuit and plot the waveforms.	Inverters and Choppers	2
10	Find the voltage and current of Step up chopper and plot the V-I characteristics of Step up chopper.	Inverters and Choppers	4
11	Develop a mini project using industrial electronics devices. Test the functioning of it. Write a report on it.		4
		Skill Assessment	**2**
		TOTAL	**32**

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Power semiconductor devices.	02(04)	04(00)	06(04)	**12(08)**
02	SCR Triggering Methods	02(02)	04(04)	06(00)	**12(06)**
03	Commutation and protection of SCR	00(00)	08(00)	04(06)	**12(06)**
04	Inverters and Choppers	04(00)	04(04)	06(06)	**14(10)**
05	Power Converters	00(00)	04(04)	06(00)	**10(04)**
06	Regulated Power supply	02(02)	08(04)	00(00)	**10(06)**
	Total	**10(08)**	**32(16)**	**28(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	4	R	2	4	R	2	6	R	2	2	R	2	**5/7**
	6	R	2																
02	1	U	4	2	U	4	3	U	4	1	R	4	2	U	4				**3/5**
03	4	U	4	5	U	4	6	U	4	4	U	4	5	U	4				**3/5**
04	3	U	4	3	A	4	6	U	4	6	U	4	1	A	4				**3/5**
05	1	A	6	2	A	6	3	A	6										**2/3**
06	4	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 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	-	-	-	-	-	-	-	3	-	-
2	-	3	-	-	-	-	-	-	-	3	-	3
3	-	3	-	-	-	-	-	-	-	3	-	-
4	-	3	2	2	-	-	1	2	-	3	2	3
5	-	3	2	2	-	-	-	2	-	3	2	3
6	-	3	2	-	-	-	1	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 & power electronics	H.C. Rai, Umesh Publisher- New. Delhi,2012	9788188114146
2.	Tyristors and their applications	Ramamurthy, East West Press, New,1991	8185336679, 9788185336671
3.	Power Electronics	P.C. Sen, TMH,New, Delhi,2012	0074624008, 9780074624005.
4.	Power Electronics and Its Applications	Alok Jain, Penram ,India,2008	818797222X, 9788187972228.
5.	Power Electronics	M D Singh, K B Khanchandani, McGraw Hill, New Delhi,2001	0070583897, 9780070583894

❖ E-REFERENCES:

1. http://www.completepowerelectronics.com/power-diode/accessed on 1st September, 2016
2. http://www.completepowerelectronics.com/scr-triggering-turn-on-methods/accessed on 1st September, 2016
3. http://www.electrical4u.com/thyristor-protection-or-scr-protection/accessed on 1st September, 2016
4. http://www.electrical4u.com/chopper-dc-to-dc-converter/accessed on 1stSeptember, 2016
5. http://www.electrical4u.com/gate-characteristics-of-scr-or-thyristor/accessed on 1st September, 2016

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1) Digital Multi-meter 3.5 digit with R, V, I measurements, diode and BJT testing
2) Cathode Ray Oscilloscope Dual Channel, 4 Trace CRT / TFT based Bandwidth 20 MHz/30 Mhz
3) Function Generator 1 MHz , sine, square, triangular, ramp and pulse generator Freq range 0.01 Hz to 1 Mhz, Output amplitude 20V open circuited, Output impedance 50 ohms.
4) Regulated Power Supply 0- 30 Volt, 2 A with digital display.

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

S.N.	Name	Designation	Institute / Industry
1.	Mr. S. S. Tadas	Head of Electronics & telecomm Engineering	Government Polytechnic, Nagpur.
2.	Ms. P. F. Dorlikar	Lecturer in Electronics	Government Polytechnic, Nagpur.
3.	Mr.D. A. Brahmankar	Lecturer in Electronics Engineering	Government Polytechnic, Nagpur.
4.	Mr. R .S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5.	Ms. K. P. Yenurkar	Lecturer in Electronics Engineering	Government Polytechnic, Nagpur.
6.	Mr. Sandip V Darwhankar	Director	Beta computronicspvt ltd , Nagpur
7.	Mrs. Gajala Ali	Head Electronics	Anjuman Polytechnic , Nagpur
8.	Mr. S M Kale	Lecturer Electronics	Government Polytechnic, Gadchiroli.

(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ELECTRICAL ENGG.

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE404E$

COURSE TITLE : BUILDING ELECTRIFICATION

PREREQUISITE : EE301E

TEACHING SCHEME : TH: 03; TU: 00; PR: 04 (CLOCK HRs)

TOTAL CREDITS : 05 (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:

Electrical engineering students should develop skills in the field of building electrification. This course imparts knowledge and skills of wiring and accessories use for different electrical installation systems in residential buildings. After completion of this course diploma engineering students will able to design, commission, test and maintain electrical installation system for residential installation. This course also generates self-employment in the field of electrical engineering.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Select accessories, wires, cables and wiring systems for electrification.
2. Design electrical wiring installation system for residential unit.
3. Design proper illumination scheme for residential unit.
4. Prepare wiring layouts on wiring board.
5. Locate and diagnose faults in electrical wiring installation.
6. Test residential electrical installations.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.Wiring tools and accessories	1. Describe various wiring tools. 2. State the BIS specification of various tools. 3. State procedure of care and maintenance of wiring tools. 4.Classify the electrical accessories 5. Describe different types of electrical accessories, its construction and working. 6. Identify different accessories.	1.1.Various tools required for wiring- screwdrivers, pliers, Try square, saws, hacksaw, chisel, hammers, mallet, rawl punch, hand drill machine, portable drilling machine, files, plumb bob, line thread, electricians knife, test lamp , tester and their BIS specifications, application, care & maintenance of tools. 1.2 Classification of electrical accessories- controlling, holding, safety, outlet, general etc, 1.3 Types, working, use and current, voltage rating and BIS symbols of following electrical accessories. • Switch – Their types according to construction such as surface switch, flush switch, and pull switch, rotary switch, knife switch, pendent switch, Main-switch (ICDP, ICTP). Their types according to working such as single pole, double pole, two-way, two-way center off, intermediate, series parallel switch etc. • Holders- Their types such as bayonet cap lamp holder, pendent holder, batten lamp holder, angle holder, bracket holder, tube light holder, screw type Edison and goliath Edison lamp holder, swivel lamp holder. • Socket outlets and plugs- two pin, three-pin, multi pin sockets, two-pin and three-pin plug. • Others- Iron connector, adaptor, and ceiling rose, distribution box, neutral link, bus-bar chamber etc. 1.4 Wooden/ mica boards, Moulded/ MS Concealed boxes of different sizes. Modular accessories.	8

2. Wires and Underground cables.	1.Name the various form of conductor. 2.Define the different terms related to wire 3.Describe & Select different types of wire for various applications 4.Identify the type of wire. 5.Determine the current carrying capacity of copper & Aluminium wire. 6.Describe the method of wire jointing. 7. Classify the cables according to voltage level and insulation use. 8. State various types of cable. 9. Identify various parts of the cable. 10. Describe cable jointing methods.	2.1 Conductors, common form of conductor- wire, cable, bus bar etc. 2.2 Terms related to wire- conductor, wire, stranded conductor, cable, armored cable, flexible cable, solid conductor etc. 2.3 Types of wires according to type of insulation- PVC wires, CTS wire, LC wire, VIR wire, FR (Fire retardant) wire. 2.4 Size of wire according to BIS. Tools used for measurement of wire size. 2.5 Selection of wire/ cable according to their current carrying capacity 2.6 Wire jointing methods 2.7 General construction of cables, cable insulation materials – vulcanized rubber (VIR), polyvinyl chloride (PVC), cross linked polythene (XLPE), impregnated paper. 2.8 Classification of cables, construction of cables- low tension, high tension, and extra high tension cables, solid, oil filled & gas filled type. 2.9 Factors determining selection of power cables. 2.10 Selection of suitable cable size & type from standard data. 2.11 Cable laying methods. 2.12 Cable jointing methods	8
3. Wiring Methods and wiring layout	1. Describe various types of wiring methods. 2. Select the wiring methods as per requirement of consumer. 3. State BIS rules of wiring. 4. Estimate the materials required for wiring. 5. Compare various wiring methods. 6. Draw various electrical circuits. 7. Represent and identify various symbols used in wiring	3.1 Factors determining the selection of wiring methods- Durability, safety, appearance, cost, accessibility and maintenance cost. 3.2 Classification of wiring methods- Cleat wiring, Batten wiring, wooden casing capping, conduit wiring and PVC casing capping wiring, their particular applications. 3.3 Conduit wiring- Types of conduit, size of conduit, difference between pipe and conduit, comparison between Metal & PVC conduit, types of conduit wiring (Surface/Concealed). Conduit wiring accessories, BIS rules for	6

	8. Represent electrical circuit in various forms. 9. Design electrical circuit according to user's requirement.	Metal & PVC conduit wiring. 3.4 PVC casing capping, size of casing capping, PVC casing capping accessories, BIS rules. 3.5 Comparison of various wiring systems. 3.6 General BIS rules for domestic installations. 3.7 Wiring Layouts- • Need of electrical symbols, Various BIS symbols used in electrical circuit and layout diagram and their representation. • Electrical diagrams, their Classification • Definition of wiring and circuit (Schematic) diagram according to IS: 2042(Part-I)-1962. • Methods of representation for wiring diagram- schematic diagram multiline and single line representation and layout diagram 3.8 Design, working and drawing of following electrical circuits. 1. Simple light and fan circuits. 2. Stair case wiring. 3. Go-down wiring circuit. 4. Bedroom lighting circuit. 5. Corridor lighting circuit. 6. Series parallel circuit. 7. Master switch control circuit. 8. Different lighting circuit using Intermediate switch. 9. Call bell circuit using bell indicator. 10.Design of wiring circuits according to user's requirement	
4. Residential building electrification	1. State the necessity building drawing, electrical installation & BIS symbols. 2. Classify different electrical diagrams. 3. Draw various diagrams of electrical installation. 4. Estimate material required for Residential building electrification 5. Describe various tests on	4.1 Domestic Dwellings/Residential Buildings, its classification, Necessity and reading of Civil Engineering building drawing. 4.2 Interpretation of electrical installation plan and electrical diagrams. 4.3 General requirements and inspection of electrical installation is according to IS: 732. 4.4 Electrical installation for residential building.	12

	wiring installation 6. Estimate material required for residential service connection.	• Guidelines on design and construction of wiring installations as per part I section 9 of NEC-2011-Difference between residential & industrial load, rules/requirements related to lighting load followed in electrical installation. • Positioning of equipments-Importance of plan and layouts in electrical installation. • Principles of circuit design in Lighting and power circuits- a) Light and fan circuit , b)Power circuit • Procedure for designing the circuits. • Load calculation and selection of size of conductor- a) Load assessment, b) Selection of size of conductor. • Selection of rating of main switch and protective switch gear. • Calculation of length of wire and other materials, Calculation of labour cost • Sequence to be followed for preparing estimate. • Design & drawing, estimation & costing of a residential installation having maximum 5 KW load. (Numerical based on above) 4.5 Testing of wiring installation as per IS: 732-1982. Testing insulation resistance - between earth and conductors, between conductors. Testing polarity test of single pole switches. Testing of earth continuity path. 4.6 Residential building Service Connection- types Underground and overhead. Calculation of Material required for service connection.	
5. Protection of electrical installation.	1. Define various terms related to fuses and earthing. 2. Identify the various types	5.1 Purpose of fuse in electric circuit, fuse symbols, placement of fuse. 5.2 Fuse terminology- fuse element, fuse carrier, fuse base, current	08

	of fuse. 3. State necessity of fuse. 4. Classify fuses. 5. Describe construction & working of fuse. 6. State the purpose of fuse. 7. Identify the various types of earthing. 8. Differentiate between System and equipment earthing 9. Select the type of earthing for particular application. 10. Describe procedure for measurement of earth resistance.	rating, fusing current, minimum fusing current, cut-off current, fusing factor etc. 5.3 Fuse material. Selection of fuse. 5.4 Types of fuses –Re-wirable and cartridge fuses (HRC and LRC). Their construction and particular use. 5.5 Comparison between re-wirable fuse and HRC fuse on the basis of rupturing capacity, rupturing speed (cutoff factor), discrimination, safety in operation, fusing factor and deterioration. 5.6 Miniature circuit Breaker (MCB)-Construction, Principle rating & uses. Difference between MCB and main-switch. 5.7 Earth Leakage circuit Breaker (ELCB)-Construction, Principle rating & uses. 5.8 Earthing- System and equipment earthing, Purpose of system earthing. 5.9 Equipment earthing-Terms related to earthing- Earth, earth electrode, earth current, earth terminal, earthing wire, earthing lead, fault current, leakage current etc. 5.10 Necessity of equipment earthing-earthing and electric shock, Magnitude of current flowing and its effect on human body, value of earth resistance for domestic installation. 5.11 Methods of earthing as per IS 3043 : 1987 and their procedure- Driven pipe, pipe and plate earthing, modern methods of earthing, 5.12 Methods of reducing earth resistance. 5.13 Measurement of earth resistance using earth tester.	
6. Illumination in residential installation	1. Define various terms related to illumination. 2. State laws of illumination 3. Describe various factors affecting the illumination 4. Describe different types of lighting arrangements and	6.1 Introduction, Terminology used in illumination such as- Luminous flux, Luminous intensity, Lumen, Illumination or illuminance, Lux, Space-height ratio, utilization factor, depreciation factor, luminous efficiency-definition &	06

	Design consideration of good lighting scheme 5. State the use of various lamps & their illumination levels. 6. Describe the construction & working of various lamps. 7. Calculate number of luminaries. 8. Design the illumination scheme for small installation.	values for different luminaries. 6.2 Laws of illumination-Inverse Square Law, Cosine Law, Numerical based on illumination received directly underneath, illumination received on horizontal screen and screen moved horizontally at certain distance 6.3 Factors affecting the illumination. 6.4 Different types of lighting arrangements, Design consideration of good lighting scheme. 6.5 Various types of lamps, their construction, Lumens per watt of different types of lamps, Lux level required for different places as per SP 72: 2010. 6.6 Calculation of average lux level. 6.7 Numerical based on design of illumination scheme for residential unit.	
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify different tools used in electrical wiring and state their specifications.	Wiring tools and Accessories	**2**
2.	Identify different wiring accessories and draw BIS symbols, and state their specifications.		**4**
3.	Prepare series testing board.		**6**
4.	Measure the wire size, state its specification and select the wire for particular applications.	Wires and Underground cables.	**4**
5.	Identify cables of different current ratings.		**4**
6	Prepare wiring installation on a board showing control of one lamp, one fan and one socket from one switch board in PVC surface conduit wiring system.	Wiring methods and Wiring layouts	**6**
7	Prepare wiring installation on a board. Control one lamp from two different places using PVC surface conduit wiring system.		**6**
8	Prepare wiring installation on a board. Control one lamp from three different places using PVC surface conduit wiring system.		**6**
9	Prepare wiring installation on a board. Perform go-down wiring for three blocks using PVC casing capping.		**6**
10	Design 2 BHK residential installation scheme and estimate the material required. And draw the details required for installation on A4 size sheet.	Residential building electrification	**6**
11	Test wiring installation using megger.		**2**
12	Measure earth resistance of existing earth electrode using earth tester.	Protection of electrical installation.	**2**
13	Do plate earthing or pipe earthing. Test it and measure its earth resistance. Reduce the electrode resistance using proper method, if found more than specified value.		**6**
14.	Measure Illumination level by lux meter.	Illumination in residential installation	**2**
		Skill Assessment	**2**
		Total	**64**

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Wiring Tools and Accessories	06(06)	04(00)	00(00)	**10(06)**
02	Wires and Underground Cables	04(02)	08(04)	00(00)	**12(06)**
03	Wiring Methods and Wiring Layouts	00(04)	04(00)	06(06)	**10(10)**
04	Residential Building Electrification	04(00)	10(04)	06(06)	**14(10)**
05	Protection of electrical installation	02(00)	08(04)	00(00)	**10(04)**
06	Illumination in residential installation	02(00)	00(04)	06(00)	**08(04)**
	Total	**18(12)**	**34(16)**	**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	2	R	2	5	R	2	6	R	2	1	R	2	**5/7**
	2	R	2																
02	1	R	4	1	U	4	2	U	4	1	R	4	2	U	4				**3/5**
03	2	U	4	3	U	4	4	U	4	3	R	4	4	U	4				**3/5**
04	4	R	4	5	U	4	5	U	4	5	U	4	6	U	4				**3/5**
05	3	A	6	6	A	6	3	A	6										**2/3**
06	4	A	6	4	U	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 wiring /circuit diagram, selection of material. writing procedure etc.	10
2	Performance	20
3	Skills	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	-	3	-	-	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	3	-
6	-	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.	Electrical Design Estimating and Costing	K.B. Raina and Dr. S. K. Bhattacharya, New Age International Ltd., First Edition:1991Reprint:2011	81-224-0363-8 978-81-224-0363-3
2.	Electrical Estimating & Costing	N. Allagappan, S. Ekambarram, Tata Mc Hill 1996 Edition.	10-0074624784, 13-9780074624784
3.	Electrical Estimating and Costing	Surjitsingh, Dhanpat Rai & Co., 2011 Edition.	13-1234567150995
4.	SP 30 National Electrical Code 2010.	Bureau of Indian Standard.	--
5.	IS: 732-1989, Code of practice for electrical wiring installation	Bureau of Indian Standard.	--

6.	SP 72 National Lighting Codes 2010.	Bureau of Indian Standard.	--
7	A Course in Electrical Installation Estimating & Costing	J B Gupta, S K Kataria & Sons First Edition: July,1968, Ninth Edition: July 2012	13-978-93-5014-279-0 10-81-88458-99-6
8	Electrical Wiring Estimating & Costing	S L Uppal, G C Garg, Khanna publications, Sixth Edition:2009,Second reprint: 2011	978-81-7409-240-3

❖ **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, assesed on 30 Jan 2016
- www.slideshare.net/bawaparam/made-by-param assesed on 30 Jan2016
- www.electricaltechnology.org/2013/09/electrical-wiring.html assesed on16 March 2016.
- www.mytrainingbc.ca/SkillsExploration/.../pdf/Elec_7_Crcuitdrawings
- www.electrical4u.com/questions-and-answers-on-electrical-fuse,assesed on 16 Mar2016.
- https://www.youtube.com/watch?v=BmwdSoGBIlg, assessed on16 mar 2016.
- www.electricaltechnology.org › EE Review, assessed on 16 mar 2016.

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

1. Toolbox (all wiring tools).
2. Megger 500V/1000V Hand driven
3. Earth tester 3 spike-measuring range 0-1 ohms to 10000 ohms.
4. Digital Multi-meter- 24V-250V AC/DC, Accuracy- 0.5% ± 1 digit
5. Tong tester ACA: 3/15/60A + 5% ACV: 300/600V + 5%, Size: 120x70x35mm.
6. Standard wire gauge, Stainless Steel Wire Gauge ,0-36 Gauge (0.19-8.23mm, Measurements: 3.5″ in diameter, .05″ thick
7. Outside Micrometer, 0-25 mm, least counts 0.01 mm accuracy.
8. Lux meter- Display: 3-1/2 digit 18mm LCD, Ranges: 0 - 50,000 Lux.3 ranges, Sampling rate: 0.4second, Operating Temperature: 0 ~ 50 °C (32 ~ 122 °F), Accuracy: ±5%

❖ **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. D. D. Lulekar	Head, Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	MR. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Shri. R. Y. Ghormade	Head, Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Shri. B. P. Bale	Dy. Ex .Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head, 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 ELECTRICAL ENGINEERING

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE405E

COURSE TITLE : COMPUTER AIDED ELECTRICAL DRAWING

PREREQUISITE : EE301E

TEACHING SCHEME : TH: 00; TU: 00; PR: 04(CLOCK HRs.)

TOTAL CREDITS : 02(1 TH/TU CREDIT = 0 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)

TH. TEE : NIL

PR. TEE : 02 HRs (External)

PT. : NIL

❖ RATIONALE:

The computer software's become the essential part of today's world to keep pace with growing technology and demand for the timely product design. Computer aided drawing software allow engineer to increase productivity, improves the quality of the drawing, saves time and easier for documentation.Objective of this course is to provide practice in freehand sketching of electrical drawing, use computer based software to draw working electrical drawing. This course also provides practice to read and interpret working electrical engineering drawings.

❖ COURSE OUTCOMES:

After completing this course students will –

1. Draw free hand sketches related to electrical drawings.
2. Use drawing software
3. Draw electrical circuit diagrams, wiring diagrams, single line diagrams, and block diagrams.
4. Develop, edit, save, and print electrical drawings.
5. Read electrical drawings.
6. Interpret electrical drawings.

❖ COURSE DETAILS:

A. THEORY :

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

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Explore the basic features, commands and general structure of the Electrical CAD software (open source) environment. • Start and exit the session • Electrical CAD Windows • On-line help • Input-output • File types	Introduction	**4**
2.	Use Electrical CAD software • Create, save and execute files • Perform basic operations. • Print drawing		**4**
3.	Draw different electrical and electronics symbols as per IS: 1032 or new equivalent IS. • Draw free hand symbols on sketch book • Draw using drawing software • Print File	Drawing	**4**
4.	Draw civil engineering plan of a 1BHK residential unit. Draw electrical Installation plan for the same. • Draw electrical Installation plan by free hand drawing on sketch book of existing any 1BHK residential unit with dimensions. • Draw the same using drawing software • Print File		**8**
5.	Draw single line diagram different layouts of commercial units. • Collect single line diagram of any existing commercial unit. • Read and interpret drawing. • Draw the same using drawing software • Print File		**8**
6.	Draw Panel wiring diagram like OCB panel in 11 KV substations. • Visit to 11 KV substation of the institute. • Observe Panel • Trace wiring of OCB panel and draw using free hand on sketch book • Draw the same using drawing software • Print File		**6**

7.	Draw Single line diagram for different substation layouts. • Collect single line diagram of any 132 KV or 400 KV substations. • Read and interpret drawing. • Draw the same using drawing software • Print File	Drawing	**8**
8.	Draw block diagram for different power plants layouts. • Draw block diagram of any one type of power plant by free hand drawing on sketch book. • Draw the same using drawing software • Print File		**8**
9.	Draw single line diagram for different electronics, microprocessor, control circuits • Draw single line diagram for different electronics, microprocessor, and control circuits by free hand drawing on sketch book. • Draw the same using drawing software • Print File		**8**
10.	Collect, read and interpret minimum four actual electrical working drawing.	Reading and Interpretation	**06**
		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
		Sketching		Continuous	05	--	Sketch Book & Printout	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 & Printout	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	Free hand sketch	10
2	Drawing work / skill	20
3	Printout layout aesthetic	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	-	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
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.	Electrical Engineering Drawing	S.K.Bhattacharya, New Age International Publishers, Reprint, 2005.	81-224-0885-9
2.	Engineering Drawing practice for Schools & Colleges-SP- 46:1988	Bureau Of Indian Standards, Reprint, 1998.	81-7061-091-2
3.	Computer Aided Electrical Drawing	M. Yogesh, B. S. Nagaraja, N. Nandan, PHI Learning;1st Edition, 2014	978-81-203-4953-7

❖ E-REFERENCES:

- https://www.youtube.com/watch?v=bowpbOReHMs, assessed on 30th September, 2016
- https://www.edrawsoft.com/wiringdiagram.php , assessed on 30th September, 2016
- https://www.edrawsoft.com/floorplan.php , assessed on 30th September, 2016

- http://www.mytrainingbc.ca/SkillsExploration/dwnld/pdf/Elec_7_Crcuitdrawings.pdf , assessed on 30th September, 2016

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1. Computers latest version
2. CAD Software
3. Laser jet Printer
4. DLP

❖ 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. D. D. Lulekar	Head of the Department, Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head of the Department, Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Executive Engineer,	MSTCL, Nagpur
15	Dr. S. S. Bharatkar	Head of the Department, 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 ELECTRICAL ENGG.

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE406E$

COURSE TITLE : ELECTRICAL MACHINE FUNDAMENTALS

PREREQUISITE : NIL

TEACHING SCHEME : TH: 03; TU: 00; PR: 04(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 the basic fundamentals of DC machines, AC machines and transformers. These machines are used in power system for generation, transmission & distribution and also in utilization systems. Knowledge gained by the students will be used in the study of technological subjects such as power system operation & control, utilization system, switchgear & protection and manufacturing processes. The knowledge and skill obtained by the student will be used by technicians in discharging technical functions such as supervisor, controller and R & D technician.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply laws governing the operation of electrical machines.
2. Evaluate different machine parameters under different conditions.
3. Recommend electrical machines for particular application.
4. Operate electrical motors and transformers.
5. Perform various tests on electrical machines.
6. Measure and find various electrical machine parameters.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1.DC Generator	1. State necessity of DC machine. 2. State various laws relate to AC and DC machines. 3. Compare AC and DC machines on various points. 4. State different parts of DC machine with their function 5. Describe construction of DC machine. 6. Compare armature and wave winding 7. Derive EMF equation of DC generator 8. Describe characteristics of DC generator 9. Describe various losses in generator.	1.1 Introduction to DC and AC. Machines., Laws related to DC and AC machines, Classification of AC machines, Differences between AC and DC machines. 1.2 Necessity of D.C. Machines, Construction, Different parts of D.C. Machines and their functions, Different materials used for parts. 1.3 Types of Armature winding- Lap and Wave windings 1.4 DC Generator Principle, EMF equation. 1.5 Types and Characteristics of DC generators and their applications. 1.6 Total losses in DC generator. **No Numerical on above topics**	**04**
2.DC Motor	1. State principle of DC Motor 2. State types of DC Motor 3. Draw connection diagrams of various types of DC motors 4. Draw different characteristics of DC motors 5. Describe characteristics of various types of DC motors 6. State necessity of DC motor starter 7. Draw constructional details of various DC motor starters 8. Describe working of various DC motor starters 9. Describe the speed control methods of DC motors 10. Calculate Losses and efficiency of DC motor 11. Describe circuit diagram of BLDC motor	2.1D.C. Motor Principle, back EMF and Torque equation. 2.2Types of DC motor, their Characteristics and applications. 2.3Necessity of Starter, Types of starters- Two point, three point, four point, their construction and working. 2.4Speed control of D.C. Motors, different methods of speed control of series, shunt and compound motors. No Numerical on Speed control 2.5 Losses and efficiency of DC motor. (Numerical on it) 2.6 Brushless DC Motor (BLDC) - Basic circuit diagram, Basic construction, Advantage and comparison of BLDC motor over DC motor, Application of BLDC. 2.7 Permanent Magnet Motor – working principle, construction, advantages, disadvantages, applications.	**08**

3. Single-phase Transformer	1. State working Principle of transformer and types of transformer. 2. Describe Constructional parts and their function, 3. Compare shell type and core type transformer 4. Derive EMF equation of Transformer 5. Draw phasor diagram of no-load and on load 6. Draw approximate equivalent circuits 7. Describe Open Circuit and Short Circuit Test of single-phase transformer 8. Calculate losses, efficiency and regulation 9. Calculate all day efficiency 10. Describe single-Phase autotransformer construction 11. Describe operation of auto transformer 12. Compare auto transformer with two winding transformer.	3.1 Working Principle of transformer 3.2Constructional parts and their function, Types of transformer. Comparison between shell type and core type transformer 3.3 Different material used in construction. 3.3 EMF equation 3.4 Voltage transformation ratio, KVA rating. 3.5 Concept of ideal transformer, practical transformer 3.6 Phasor diagram- no-load and on load 3.7 Approximate equivalent circuit diagram 3.8 Open Circuit and Short Circuit Test on single-phase transformer 3.9 Losses, efficiency and regulation of Single-phase transformer, different loading tests 3.10 All day efficiency 3.11 Applications Numerical on above topic.	**12**
4. Special Transformers	1. Describe construction of autotransformer, CT and PT. 2. Compare autotransformer with single wining transformer 3. State applications of special transformers.	4.1Single-Phase autotransformer, construction, operation and applications. Comparison with two winding transformer. 4.2Current transformer (CT), construction, operation and applications. 4.3Potential transformer (PT), construction, operation and applications. 4.4 Single phase Welding transformer, features, applications 4.5Isolation transformer, features, applications No Numerical on this topic.	**04**
5. Three-phase Induction motor	1. State advantages and limitations of three-phase Induction motor 2. Describe production of rotating magnetic field 3. Describe principle of three-phase Induction	5.1 Advantages and limitations of three-phase Induction motor 5.2 Production of rotating magnetic field 5.3 Principle of three-phase Induction motor 5.4 Synchronous speed, rotor speed,	**14**

	motor 4. Define Synchronous speed, rotor speed, Slip 5. Describe construction of three-phase induction motor and state their functions, 6. State types of Induction motors 7. Compare squirrel cage and slip ring induction motor 8. Calculate slip, rotor current magnitude and frequency 9. Describe effect of slip on rotor current frequency 10. Derive starting torque and torque under running conditions 11. State relation between torque and rotor p.f. 12. State Condition for maximum starting torque and torque under running conditions 13. Derive relationship between starting, full load and Maximum torque 14. Describe torque-speed curves and effect of rotor resistance 15. Draw Power stages of three-phase induction motor, 16. Calculate losses and efficiency 17. Describe double cage rotor construction 18. Describe torque-slip curve of double cage rotor 19. Compare slip ring motor with double cage rotor 20. Describe method of reversing the direction of rotation of three-phase induction motor, 21. Draw connection diagram reversible switch with induction motor 22. State industrial	Slip 5.5 Constructional parts and their functions, types of Induction motors, comparison of squirrel cage and slip ring induction motor 5.6 Equation for rotor current - magnitude and frequency. 5.7 Effect of slip on rotor current frequency 5.8 Starting torque and torque under running conditions, relation between torque and rotor p.f. 5.9 Condition for maximum starting torque and torque under running conditions 5.10 Relationship between starting, full load & Maximum torque 5.11 Torque-speed curves & effect of rotor resistance 5.12 Power stages of three-phase induction motor, losses and efficiency 5.13 Double cage motor, torque-slip curve, comparison with slip ring motor. 5.14 Reversing the direction of rotation of three-phase induction motor, Reversible switch and its connection diagram 5.15 Industrial Applications (Numerical on above topic)	

	Applications of induction motor		
6. Synchronous Machines	1. Describe generation of three-phase EMF 2. Compare different rotor constructions of alternator 3. Derive EMF equation of three-phase alternator 4. Calculate distribution factor pitch factor, useful flux, EMF and frequency 5. Describe effect of speed and excitation on induced EMF and frequency **,** State factors affecting size of alternator 6. Describe working principle & construction of synchronous motor	6.1 Alternators - Generation of three-phase EMF, principle, 6.2 Constructional parts and their function, Types of rotor construction, their comparison 6.3 Advantage of rotating field and stationary armature system. 6.4 Distribution factor, pitch factor and EMF equation (Numerical on it) 6.5 Effect of speed and excitation on induced EMF and frequency ,factors affecting size of alternator 6.6 Synchronous Motors – principle of operation, construction, starting methods 6.7Comparison with Induction motor, applications	**06**
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify different parts and windings of DC compound machine.	DC Generator	**2**
2	Find the value of critical resistance of DC shunt generator by plotting OCC		**2**
3	Perform load test on DC shunt generator		**2**
4	Perform load test on DC cumulatively compounded generator		**2**
5	Start DC shunt motor without and with starter and to reverse the direction of rotation of motor.	DC Motor	**4**
6	Start DC series motor by using 2 point starter and to reverse the direction of rotation of motor.		**4**
7	Control the Speed of D.C. shunt motor using (i) field control and (ii) armature control methods.		**4**
8	Perform load test on D. C. shunt. And plot Speed torque characteristics.		**2**
8	Perform load test on D. C. series motor. And plot Speed torque characteristics.		**2**
9	Perform polarity test on single-phase transformer.	Single-phase Transformer	**2**
10	Find transformation ratio of single-phase transformer.		**2**
11	Find the regulation and efficiency of single-phase transformer by direct loading.		**4**
12	Perform O.C. and S.C. test on single-phase transformer and determination of equivalent circuit, regulation and efficiency.		**4**
13	Use CT and PT to measure high value of current and high value of voltage respectively.	Special Transformers	**4**
14	Identify different parts and windings of single phase autotransformer.		**2**
15	Start three-phase squirrel cage induction motor and reverse the direction of rotation using reversible switch.	Three-phase Induction Motor	**2**
16	Measure the slip of three-phase squirrel cage induction motor by different methods.		**4**
17	Perform load test on three-phase squirrel cage induction motor and plot performance curves.		**4**
18	Perform load test on three-phase slip ring induction motor and plot performance curves.		**4**
19	Perform the test on three-phase alternator to find the effect of speed and field current on induced EMF.	Synchronous Machines	**2**
20	Start synchronous motor		**2**
		Skill Test	**4**
		Total Hrs	**64**

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	DC Generator	02(00)	04(04)	00(00)	**06(04)**
02	DC Motor	02(00)	04(08)	06(00)	**12(08)**
03	Single-phase Transformer	06(02)	08(04)	06(06)	**20(12)**
04	Special Transformers	00(02)	04(00)	00(00)	**04(02)**
05	Three-phase Induction motor	02(04)	14(00)	06(06)	**22(10)**
06	Alternator	02(00)	00(04)	04(00)	**06(04)**
	Total	**14(08)**	**34(20)**	**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	2	R	2	3	R	2	5	R	2	6	R	2	3	R	2	**5/7**
	4	R	2																
02	1	U	4	2	U	4	3	U	4	1	U	4	2	U	4				**3/5**
03	3	U	4	4	U	4	6	A	4	6	U	4	3	U	4				**3/5**
04	3	R	4	5	U	4	5	U	4	5	R	4	2	U	4				**3/5**
05	2	A	6	3	A	6	3	A	6										**2/3**
06	5	U	6	5	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 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	-	-	-	-	-	-	-	-	3	3
2	-	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
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.	Basic Electrical Engineering	V.N.Mittle, Arvind Mittal, The McGraw Hill Education Pvt. Ltd, Reprint, 2011	13: 978-0-07-059357-2
2.	Electrical Machines	S.K. Bhattacharya, The McGraw Hill companies, Seventh Reprint, 2011	13:978-0-07-066921-5 10:0-07-066921-X
3.	Principle of Electrical Machines	V K Mehta, Rohit Mehta, S. Chand Publishing, 2nd Edition, 2002	9788121921916
4.	Electrical Technology Vol. II AC & DC Machines	B.L.Theraja, S. Chand & Company Ltd., Third, 1990	10: 8121924375 13: 978-8121924375
5.	Experiments in Basic Electrical Engineering	S.K. Bhattacharya, K.M. Rastogi, New Age International Publisher, Reprint, 2009.	978-81-224-1042-6
6.	A Text Book on laboratory courses in Electrical Engineering	S.G. Tarnekar, P.K. Kharbanda, S. Chand & Company Ltd., Third, 1990	13: 978-8121901048

❖ **E-REFERENCES:**

- https://www.youtube.com/watch?v=-xebh8wU8gY, assessed on 16thSeptember, 2016
- https://www.youtube.com/watch?v=fWyzPdyCAzU, assessed on 16thSeptember, 2016
- https://www.youtube.com/watch?v=bCEiOnuODac, assessed on 16th September, 2016
- http://www.electrical4u.com/electrical-power-transformer-definition-and-types-of-transformer, assessed on 16th September, 2016
- http://nptel.ac.in/courses/108108076/16, assessed on 16th September, 2016

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

1. Auto transformer (Dimmerstat), single-phase, Input-240 V, Output 0-270 V, Current rating - 4A, portable table model.
2. Auto transformer (Dimmerstat), three-phase Input-440 V, Output 0-470 V, Current rating - 12A,table model.
3. D.C. compound Motor, Voltage rating 220 Volts, Power rating1 KW
4. Single phase transformer, 2 KVA, 230/115 V
5. Three-phase squirrel cage induction motor,440 volts, 2.7 KW, 1440 rpm, (Six terminals brought out in terminal box), With star/ delta starter.
6. Synchronous Motor, three-phase AC, 2.7 KW
7. Alternator three-phase 7.5 KW Resistive load, Three-phase, 50 Hz.440 V, Rating- 3 KW,10 A per phase at unity power factor.

❖ **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. D. D. Lulekar	Head of the Department, Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head of the Department, Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Executive Engineer,	MSTCL, Nagpur
15	Dr. S. S. Bharatkar	Head of the Department, 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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**PROFESSIONAL COURSES**
COURSE CODE	**:**	**EE407E**
COURSE TITLE	**:**	**GENERATION ENGINEERING**
PREREQUISITE	**:**	**EE301E**
TEACHING SCHEME	**:**	**TH: 04; TU: 00; 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:

This course is classified under applied technology courses. Knowledge of various energy sources is essential for the diploma holder for generation of the electrical energy. Also knowledge of constructional features, operations of different machineries and equipments of power generating station is necessary for the electrical engineers so as to enable him to satisfy the increasing demand of electrical energy in industrial complexes.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify the types of power generation.
2. Select site for various types of power plants.
3. Apply the knowledge of functioning of generating equipment for supervision and maintenance.
4. Select and Recommendvarious pollution control and waste disposal method
5. Analyze the environmental impact of power plants
6. Calculate performance parameters of power plants.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Thermal Power Station	1. State the types of fuels and types of coal 2. State the energy sources 3. State advantages and disadvantages 4. Describe the line & Block diagram 5. Describe the functions of each equipment's 6. Describe the Flow diagram of Water, Hydrogen ,coal-ash path, & flue –gas path 7. State the causes of pollution control 8. State the methods of pollution control	1.1 Importance of electric energy, Generation of electric energy 1.2 Types of fuel – liquid, gaseous, solid- their calorific value, relation between high calorific value and low calorific value. 1.3 Coal – types of coal and their calorific values. 1.4 Electric energy Sources- conventional, renewable 1.5Advantages&disadvatages of thermal power station Site selection for thermal power plant 1.6 Explanation through line &Block diagram of the system(No constructional detail) showing the process of energy conversion Functions of equipment used in the systems such as, • Coal handling plant • Boiler plant-classification of boiler based on method of firing • Economizer • Air pre –heater • Super-heater • ID /FD fans • Condensers • Cooling towers & Cooling systems 1.7Steam turbine- working principle ,type, specification ,speed control and temperature/ pressure ranges of turbines 1.8Alternator- special features of turbo alternator ,specification, hydrogen cooling of alternator 11.Ash handling plant ,Ash precipitators-	14

		Electrostatic precipitator 1.9Flow diagrams- water-steam path, hydrogen path, coal-ash path, and Flue-gas path. 1.10Causes of pollution in thermal power plant. 1.11 Environmental impactof thermal power plant 1.12Methods of pollution control in steam power plant.	
2. Hydro-Electric Power Station	1. State the advantage & disadvantage of Hydro plant 2. Describe the line & block diagram of hydro plant 3. State the types of Hydroelectric plant on the basis of head & loads 4. Describe the special features of alternators for Hydro plant 5. Describe the function of each components of Hydro plant 6. State the types of turbine used in hydro plant 7. Justify the use of surge tank inHydropower station	2.1 Introduction, Advantages and disadvantages of hydroelectric plants. Hydrology, site selection for hydroelectric plant. 2.2 Explanation through line and block diagram of the system (No constructional details) showing the process of energy conversion. 2.3 Classification of hydroelectric power stations. 2.4 Special features of alternator used in hydroelectric power plant. 2.5 Functions of catchment area, dam, spillways, surge tank, reservoir, penstocks and tailrace. 2.6 Classification of turbine based on head of water. Working principle & constructional feature of each type of turbines. 2.7 Pumped storage plants for supplying peak load- description, advantages and types. 2.8 Environmental impact of hydro power plant	12
3. Nuclear Power Station	1. State the advantages & disadvantages of nuclear plant. 2. Describe the line & block diagram of Nuclear power station. 3. Describe Nuclear chain reaction for Nuclear power station. 4. State the types of Reactor	3.1 Introduction, Advantages and disadvantages of nuclear power plant, site selection for nuclear plant , Economics of nuclear power generation , Nuclear power plants in India and their capacities . 3.2 Explanation through line and block diagram of the system (no constructional details), showing	12

	for Nuclear power station. 5. State the types of nuclear wastes & their disposal methods.	the process of energy conversion. 3.3 Nuclear physics, Nuclear fission chain reaction, moderator and coolant, fissile and fertile materials and their properties , Nuclear reactors , classification, Boiling water reactor , Pressurized water reactor, liquid metal fuel reactor, CANDU reactor, Fast breeder reactor, control of nuclear reactors . 3.4 Types of radiations, effects of radiation on humans, Units of contamination and radiation, shielding. 3.5 Types of nuclear wastes and their disposal. 3.6 Environmental impactof nuclear power plant	
4. Diesel Power Plant	1. State the advantages & disadvantages of Diesel power plant. 2. Describe the line & block diagram of Diesel power station. 3. Describe the working principles of Diesel engine. 4. Performance of Diesel Engine. 5. State the causes of pollution & method of pollution control.	4.1 Introduction, Advantages and disadvantages of diesel plant, application of diesel plant. 4.2 Explanation through line and block diagram of the system (no constructional details), showing the process of energy conversion. 4.3 Diesel engine - working principles, components of diesel engine. 4.4 Lubrication and starting method. Performance, fuel requirement. 4.5 Causes of pollution and methods of pollution control. 4.6 Environmental impact of diesel power plant	08
5. Gas Power Plant	1. Describe the line & block diagram of Gas power station. 2. State the important properties of fuel for Gas Turbine. 3. State the advantages and disadvantages. 4. Sate the causes of pollution and	5.1 Introduction, Block diagram of gas power plant. 5.2. Fuels, important properties while selecting the fuel for gas turbine, Energy conversion Cycle. 5.3 Advantages and disadvantages of gas power plant, comparison of gas turbine and steam power plant. 5.4 Causes of pollution and methods of pollution control	08

	5. Describe methods of pollution control	5.5 Environmental impact of gas power plant	
6. Performance Of Power Station	1. State the different parameters concern with the performance of power station. 2. State the various factor. 3. Describe load curve and load duration curve of power station. 4. Calculate the parameters from load duration curve.	6.1 Comparison between different power stations with respect to sources of energy, site, initial cost, and running cost, pollution, efficiency, maintenance, gestation period and stand by losses. 6.2 Definitions - connected load, maximum demand, average load, installed capacity, de-rated capacity, load factor, diversity factor, demand factor, plant capacity factor, plant utilization factor, (Numerical based on it.) 6.3 Load curve and load duration curve, their importance. Concept of generating units. Choice of number and rating of units for a given load curve and operational schedule, spinning reserve. (Numerical based on it.) 6.4 Concept of base load & peak load stations and working criteria. Concept of economical load division between power stations for a given load duration curve.	10
		Total Hrs.	64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	**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	Thermal Power Plant	06(04)	04(04)	06(00)	**16(08)**
02	Hydro Power Plant	00(02)	04(04)	06(00)	**10(06)**
03	Nuclear Power Plant	06(00)	04(00)	00(06)	**10(06)**
04	Diesel Power Plant	00(00)	10(04)	00(00)	**10(04)**
05	Gas Power Plant	06(02)	04(04)	00(00)	**10(06)**
06	Performance of Power Station	00(04)	08(00)	06(06)	**14(10)**
	Total	**18(12)**	**34(16)**	**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	1	R	2	3	R	2	5	R	2	2	R	2	**5/7**
	5	R	2																
02	1	U	4	2	U	4	3	U	4	1	R	4	1	U	4				**3/5**
03	1	R	4	4	U	4	5	U	4	2	U	4	4	U	4				**3/5**
04	5	R	4	6	U	4	6	U	4	6	R	4	5	U	4				**3/5**
05	1	A	6	2	A	6	3	A	6										**2/3**
06	4	U	6	6	A	6	6	A	6										**2/3**

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	-	3	-	-	-	-	-	-	-	-	-	3
3	-	3	-	-	-	3	-	-	-	-	-	3
4	-	3	-	-	-	3	-	-	-	-	-	3
5	-	3	-	-	-	3	-	-	-	-	-	3
6	-	3	-	-	-	-	1	-	-	1	-	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 Of Electrical Energy	B.R.Gupta, Eurasia Publishing House (Pvt.) Ltd, Third Edition, 1996.	81-219-0102-2
2.	Principles Of Power System	V.K. Mehta, S.Chand&Co.Ltd, Reprint, 1996.	81-219-0594-X
3.	A Text Book on Power System Engineering	A. Chakrabarti, P. V. Gupta, M. I. Soni, U.S. Bhatnagar, DhanpatRai Publishing Company (P) Ltd., 2008	10: 8177000209 13: 978-8177000207
4.	Power Plant Engineering	K.K.Ramalingam, Sciech Publications (India) Pvt. Ltd, Reprint, 2010	81-8732-877-0
5.	Elements of Electrical Power Station Design	M.V. Deshpande, Prentice Hall India Learning Private Limited, 2009	10: 812033647X 13: 978-8120336476
6.	Power Plant Engineering	G.R. Nagpal, S.C. Sharma, Khanna Publishers-Delhi, 2012	10: 8174093095 13: 978-8174093097

❖ **E-REFERENCES:**

- https://www.youtube.com/watch?v=-xebh8wU8gY, assessed on 16th September, 2016
- https://www.youtube.com/watch?v=fWyzPdyCAzU, assessed on 16th September, 2016
- https://www.youtube.com/watch?v=bCEiOnuODac, assessed on 16th September, 2016
- http://www.electrical4u.com/electrical-power-transformer-definition-and-types-of-transformer, assessed on 16th September, 2016
- http://nptel.ac.in/courses/108108076/16, assessed on 16th 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	Dr. C.S.Thorat	Principal	Government Polytechnic, Nagpur.
2	Dr. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K.M.Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R.I.Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S.P.Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R.S.Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G.V.Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H,N.Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N.H.Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A.P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Ex Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE408E$

COURSE TITLE : ELECTRICAL INSTALLATION SYSTEMS

PREREQUISITE : EE404E

TEACHING SCHEME : TH: 03; TU: 00; PR: 04 (CLOCK HRs.)

TOTAL CREDITS : 05 (1 TH CREDIT =1 CLOCK HR.1 PR CREDIT= 2CLOCK HRS.)

TH. TEE : 04 HRs

PR. TEE : 03 HRs (External)

PT. EXAM : 1 ½ HRs

❖ RATIONALE:

As per the need of industries, essential efforts are made in framing the curriculum of this course. The student should be able to collect the required information for estimating and costing of product of any given project. The student will be compatible to plan, draw layout and make survey to know current market rate of each component and material required. Knowledge of this subject will be helpful to work as a Contractor, an entrepreneur and execute different electrical installations. The knowledge of this course is also useful to do testing of any new installation. The IE rules related to an electrical installation are helpful while making an electrical installation and testing of an electrical installation.

❖ COURSE OUTCOMES:

1. Follow National Electrical Code 2011.
2. Design non-industrial and industrial electrical installations.
3. Design outdoor electrical installations.
4. Prepare abstract, tender, quotation and other documents.
5. Draw electrical installation plans and electrical diagrams.
6. Estimate various electrical installation schemes.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1 Introduction	1. State scope and features NRC 2011. 2. Define various terms related to estimation and contracts. 3. Choose type of estimate as per requirement of work. 4. Describe purposes of various types of estimates and contracts. 5. Describe tendering and calling quotation procedure. 6. Prepare tender and quotations, bills etc. 7. Compare tender & quotation	1.1 Introduction • Scope and features of National Electrical Code 2011 (NEC 2011), • Types of electrical installation- Non industrial and industrial, • Standard value of voltages and their limits, • Fundamental principles for electrical installations • Safety in electrical work, permit to electrical work, safety instruction and safety practices 1.2 Estimating and costing. • Purpose of estimating and costing, Qualities of good estimator, essential elements of estimating and costing • Meaning and purpose of- Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate • Factors to be considered while preparation of detailed estimate and economical execution of work. 1.3 Contracts • Concepts of contracts, types of contracts, contractor, role of contractor, qualities of good contractor 1.4 Tenders and Quotations • Type of tender, tender notice, preparation of tender document, and method of opening of tender • Quotation, quotation format, comparison between tender and quotation. • Comparative statement, format of comparative statement. Order format, placing of purchasing order • Principles of execution of works, planning, organizing and completion of work, Billing of work.	**04**

2 Non-Industrial Installations	1 State and Compare various installations. 2 State illumination levels for various locations 3 State ratings of various accessories 4 Draw installation plans, wiring diagrams and single line diagrams 5 Calculate no of luminaries required 6 Select proper modern switches and luminaries as per requirement. 7 Calculate total load for selecting main switches and wires 8 Decide sub circuits 9 Calculate conduit, wires, and other accessories required 10 Select proper earth conductor and type of earting 11 Design and Estimate non- industrial installations 12 Describe erection, inspection and testing procedure.	2.1 Types of Non-industrial installations- Office buildings, shopping and commercial centres etc. Comparison of office buildings, shopping and commercial centreswith residential installation, Electric service & supply- different types of distribution arrangement for medium and large installation. 2.2 Design consideration of electrical installation in commercial buildings. 2.3 Design procedure of installation- • Calculate number of luminaries according to recommended values of illumination. • Calculate total load • Deciding number of sub-circuit • Deciding size and rating of switch board and distribution boards. • Deciding size of cables. • Deciding size of conduits • Bus bar and bus bar chamber • Mounting arrangement of switch board & distribution board • Calculation of length of wire and other materials. • Preparation of material schedule • Calculation of labour cost • Estimation and costing of unit. 2.4 Earthing of commercial installation. Selection of earth electrode & earth conductor. 2.5 Design electrical installation scheme of commercial complex such as cinema theatre, auditorium, three star hotel and public hospital. Drawing single line diagram and preparation of material schedule and detailed estimation (Problems based on it) 2.5 Erection, Inspection and testing of installation as per part 1 section 13 of NEC 2011.	**12**
3. Industrial Installation	1. Compare various installations 2. Select starters for machines. 3. Choose proper	3.1 Classification of industrial buildings, Classification based on power consumption, Difference between non-industrial and industrial load. 3.2 General characteristics of industrial	**12**

	wire/cable, main switch for motors. 4. Draw an installation plan, wiring diagrams and single line diagrams. 5. Calculate various materials required for installation. 6. Design and estimate industrial installations. 13 Prepare list of material required with costing. 14 Design and Estimate industrial installations 15 Describe erection, inspection and testing procedure.	building, selection of wiring system 3.4 Drawing of wiring diagram and single line diagram for single phase and three phase motors. 3.5 Design consideration in industrial installations. 3.6 Design procedure of installation- • Drawing of installation plan, • Calculation of total load • Selection and rating of wire & cable size, main switch, fuses, distribution board, bus-bar cable roots, motor starter, earthing wire & earthing. • Calculation of length of wire and other materials. • Preparation of material schedule • Calculation of labour cost • Estimation and costing of unit. 3.7 Design electrical installation scheme of factory/ small industrial unit example: Factory having total aggregate three - phase load approximately 30KW. 3.8 Preparation of material schedule and detailed estimation (Problems based on it) 3.9 Installation & estimation of agricultural pump & flourmill 3.10 Erection, Inspection and testing of installation as per part 1 section 13 of NEC 2011.	
4. Public Lighting Installation	1. Define various terms related to public lighting installations 2. Classify roads and their standard layouts. . 3. Draw installation plan, single line diagrams and other related drawings. 4. Select proper cable, sources and type of street lighting 5. List and Calculate various materials required. 6. Design and estimate public lighting installations.	4.1 Classification of outdoor installations, streetlight/ public lighting installation 4.2 Terminology used according to NEC2011 – Terms related to highway, lighting installation, photometric terms, luminaries etc. Aims of public lighting installation, Classification of roads, standard layout of roads. 4.3 Street light pole structures. Selection of equipments, sources used in street light installations. 4.4 Cables, recommended types and sizes of cable. Control of street light installation. 4.5 Design, estimation and costing of streetlight.	**06**

5. Distribution Lines	1. Define various terms 2. List accessories required for erecting LT lines 3. Draw the diagram for three phase three wire system and three phase four wire system by using different types of insulators. 4. Draw various pole structures. 5. State factors to be considered for selection of cable. 6. Describe cable laying method 7. Design and Estimate distribution lines.	5.1 Introduction to overhead and underground distribution line. 5.2 Materials used for distribution line HT (11KV) and LT (415 V) • Poles and their fittings, • Conductors and their accessories, • Earth wire and its accessories, • Insulators stays and their accessories, • Anti- climbing devices, danger sign boards, guarding wire & their types and other materials, requirement and specifications according to IS. 5.3 Cables used for distribution line, factors determining selection of LT/ HT power cables, cable laying and cable termination method according to IS. 5.4 Design, estimation and costing of HT, LT overhead line and underground cabling. (Problems)	**08**
6. 11 KV sub-station	1. Draw single line diagram of power system and state voltage levels 2. State various equipment's and their functions 3. Draw single line and layout diagrams of various substations 4. Determine size of distribution transformer 5. Design and Estimate various 11 kV sub-stations.	6.1 Introduction to different sub-stations in power system, their representation using single line diagram and various voltage levels, reason for establishing substations 6.2 Types of 11 KV Distribution substations their line diagram, typical layout and specifications according to IS, functions of various equipment's in substations. • Outdoor- H- pole mounted, Platform mounted, floor mounted. • Indoor floor mounted. 6.3 Estimation of load, load factor, diversity factor & determination of rating of distribution transformer. 6.4 Design, estimation and costing of outdoor and indoor 11 KV sub-station. (Problems)	**06**
		Total Hrs.	**48**

❖ B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Read National Electrical Code 2011 and prepare abstract of any one section.	Introduction	**4**
2.	Procure tender notice of different work from newspapers.		**2**
3.	Prepare a tender notice for purchasing a transformer of 200 KVA for commercial installation.		**2**
4.	Prepare a quotation for purchasing different electrical material required.		**2**
5.	Prepare a comparative statement for above material. Prepare purchase order for the same.		**2**
6.	Design drawing, estimating and costing of hall / cinema theater / commercial installation Prepare report & draw sheet.	Non- Industrial Installations	**14**
7.	Design electrical installation scheme for any one factory / small industrial unit. Draw detailed wiring diagram. Prepare material schedule & detailed estimate. Prepare report & draw sheet.	Industrial Installation	**14**
8.	Design & estimate Installation of streetlight scheme for small premises. Prepare report & draw sheet.	Public Lighting Installation	**08**
9.	Design & estimate L.T. line installation. Prepare report & draw sheet.	Distribution Lines	**08**
10.	Design & estimate 500 KVA, 11/0.433 KV outdoor sub-station. Prepare report & draw sheet.	11 KV sub-station	**08**
Note: A2 size drawing sheet should be used for drawing.			
		Total Hrs.	**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)	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 & Drawing Sheets	4,5,6
		Journal & Drawing Portfolio		Continuous	05	--	Journal & Drawing Portfolio	4,5,6
				TOTAL	**25**	**10**		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	**50**	**20**	Rubrics & Practical Drawing 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			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

SN	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Introduction	02(02)	04(00)	00(00)	**06(02)**
02	Non- Industrial Installations	02(00)	04(00)	12(12)	**18(12)**
03	Industrial Installation	02(00)	04(00)	12(12)	**18(12)**
04	Public Lighting Installation	02(00)	06(06)	00(00)	**08(06)**
05	Distribution Lines	00(02)	06(06)	06(00)	**12(08)**
06	11 KV sub-station	02(00)	06(06)	00(00)	**08(06)**
	Total	**10(04)**	**30(18)**	**30(24)**	**70(46)**

❖ 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	1	R	2	**5/7**
	5	R	2																
02	1	U	4	2	U	4	3	U	4	6	U	4							**3/4**
03	4	U	6	5	U	6	4	U	6										**2/3**
04	5	A	6	6	U	6	6	U	6										**2/3**
05	2	A	12	2	A	12													**1/2**
06	3	A	12	3	A	12													**1/2**

R – Remember U – Understand A – Analyze / Apply

T=Unit/Topic Number L= Level of Question M= Marks

❖ SCHEME OF PRACTICAL EVALUATION:

S.N.	Description	Max. Marks
1	Design of any scheme-Drawing, load calculation, selection	10
2	Drawing installation plan and diagrams	20
3	Skills and Results	10
4	Viva voice	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	-	-	-	-	3	-	3
2	-	3	3	-	-	-	3	-	-	3	-	3
3	-	3	3	-	-	-	3	-	-	3	-	3
4	-	3	-	-	-	-	3	3	3	3	-	3
5	-	3	3	2	-	-	-	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.	Electrical Design Estimating and Costing	K.B. Raina, Dr. S. K. Bhattacharya, New Age International Publisher, First, Reprint 2010	10:81-224-0363-8 13:978-81-224-0363-3
2.	Electrical Estimating & Costing	N. Allagappan, S. Ekambarram, Tata Mc-Graw Hill Publishing Co. Ltd, First Edition, 2000	13: 9780074624784
3.	Electrical Estimating and Costing	Surjit Singh, Ravi Deep Singh, Dhanpat Rai & Sons, 2014	13:1234567150995
4.	A Course in Electrical Installation Estimating and Costing	J.B. Gupta, S.K. Kataria & Sons; Reprint Edition, 2013	10: 9350142791 13: 978-9350142790
4.	SP-30:2011, National Electrical Code 2011	Bureau of Indian Standard.	-
5.	IS: 732-1989, Code of Practice for Electrical Wiring Installation	Bureau of Indian Standard.	-

6.	IS: 694-2010, Polyvinyl Chloride Insulated Unsheathed And Sheathed Cables/Cords With Rigid And Flexible Conductor For Rated Voltages Up To And Including 450/750 V	Bureau of Indian standard.	-

❖ **E-REFERENCES:**

- https://beeindia.gov.in/sites/default/files/ctools/Energy%20Efficient%20Street%20Lighting%20Guidelines.pdf, accessed on 7th November, 2016
- https://www.youtube.com/watch?v=npSbEs8gJOs, accessed on 7th November, 2016
- https://law.resource.org/pub/in/bis/S05/is.694.2010.pdf , accessed on 7th November, 2016
- https://law.resource.org/pub/in/bis/S05/is.732.1989.pdf , accessed on 7th November, 2016
- https://law.resource.org/pub/in/bis/S05/is.sp.30.2011.pdf , accessed on 7th November, 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. C.S.Thorat	Principal	Government Polytechnic, Nagpur.
2	Dr. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE409E$

COURSE TITLE : TRANSMISSION AND DISTRIBUTION

PREREQUISITE : EE301E

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:

The electricity is generated in bulk at remote places and transmitted to long distances and then distributed in cities, villages and to industry. The transmission and distribution of electric power is a complex issue which requires knowledge of different types of transmission lines and power equipments. Technicians are required to operate and maintain the power transmission and distribution system so that electrical energy is continuously available to the consumers economically. After completion of this course student will able to supervise installation, operate and maintain equipments in substation, supervise the installation and laying of overhead lines and underground cables as well as assist in-charge in planning and designing distribution system.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Select suitable conductors, insulators and support for use in transmission & distribution system.
2. Calculate sag, efficiency & voltage regulation of transmission line from the given data.
3. Select the size of conductor and its type for overhead lines and underground cables required for various distribution systems.
4. Draw the layout and state functions of the equipment in substation.
5. Identify various components and functioning of load dispatch center.
6. Interpret layout drawing of various substations and load dispatch centre.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Transmission line components and line Constant	1. State desirable characteristics of line support. 2. Compare wooden poles, steel tubular and rail poles, RCC poles, Steel towers. 3. State the advantage of double circuit over single circuit. 4. Describe ACSR and bundled conductor. 5. Calculate sag for the given support system. 6. State the desirable properties of line insulator. 7. Calculate voltage distribution and string efficiency for given system. 8. State the purpose of ground wire. 9. Describe skin effect and proximity effect. 10. Calculate inductance for the given system. 11. Calculate capacitance for the given system.	1.1 Introduction to main components of overhead lines 1.2 Line supports, desirable characteristics, types- wooden poles, steel tubular and rail poles, RCC poles, Steel towers for single circuit and double circuit. 1.3 Conductors- desirable properties, types-copper, all-aluminum (AAC), all-aluminum alloy (AAA), aluminum conductors steel reinforced (ACSR), cadmium copper, galvanized steel, composite conductors, bundled conductors. 1.4 Conductor accessories- binding tape, binding wire, parallel groove clamp, jointing sleeve, repair sleeve, tension clamp and suspension clamp. 1.5 Spacing between conductors, span length and sag calculation, vibration dampers. (Numerical based on it). 1.6 Line insulators, desirable properties, insulator materials, types of insulators (For transmission and distribution lines), comparison, applications, failure of insulators, potential distribution over a string of suspension insulators, string efficiency, methods of improving string efficiency.(Numerical based on it) 1.7 Guys, guy insulator, ground wires. 1.8 Resistance, leakage conductance, skin effect, proximity effect 1.9 Inductance, inductance of 1-ϕ, 2-wire line, inductance of 3-ϕ,(symmetrical & asymmetrically spaced) lines, inductance of double circuit 3-ϕ line. (No derivation), transposition of	**12**

		power conductors, inductive inference with communication lines (numerical based on it) 1.10 Capacitance, capacitance of 1-ϕ 2-wire line, capacitance of 3-ϕ (symmetrical & asymmetrically spaced) lines, capacitance of double circuit 3-ϕ lines, (No derivation), effect of earth on capacitance of conductors. (numerical based on it)	
2. Performance of Transmission Lines	1. Classify transmission line on the basis of length and voltage. 2. State the effect of load power factor on regulation and efficiency of short lines. 3. Calculate regulation and efficiency of given short transmission line. 4. Describe phenomenon of Corona. 5. State the methods of reducing Corona	2.1 Classification of transmission lines, regulation and efficiency of transmission line. 2.2 Short transmission line, equivalent circuit representation and phasor diagram, derivation for regulation and efficiency, effect of load power factor on regulation and efficiency of short lines. (Numerical based on it) 2.3 Medium transmission line, nominal- π& nominal-T circuit representation and analysis, phasor diagram. (No numerical) 2.4 Long transmission line, equivalent circuit representation phasor diagram, Ferranti effect. (No numerical) 2.5 Corona, physical concept, circuit disruptive voltage, critical visual corona voltage, effects of corona, corona loss, factors affecting corona, advantages and disadvantages, methods of reducing corona loss.	**08**
3. EHVAC and HVDC Transmission	1. State advantages of EHVAC system. 2. Compare different types of HVDC system. 3. Compare EHVAC transmission system with HVDC transmission system. 4. State the limitations of HVDC system.	3.1EHV-AC transmission system, applications, configuration of EHV-AC transmission link. 3.2HVDC transmission system, applications, types of HVDC system, configuration & parts of HVDC system, standard rated voltage, present status and growth prospects of HVDC transmission system 3.3EHV-AC versus HVDC transmission system, comparative technical and	**06**

		economical advantages and limitations.	
4. Distribution Systems, voltage control & power quality	1. Compare feeders, distributor and service lines. 2. Distinguish between radial, loop and ring mains system. 3. Calculate voltage drop in 1-phase & 3-phase distributors. 4. Design feeder and distributor for given system. 5. State importance of voltage control in power system & methods of voltage control 6. State power quality attributes , effect of harmonics on power quality and methods of improving power quality .	4.1 Introduction, feeders, distributor and service lines. 4.2 Construction of overhead distribution lines, earth wire, guarding. 4.3 Primary distribution systems, method of feeding-radial, loop and ring mains, comparative advantages & limitations. 4.4 Secondary distribution systems, type of connection-radial, loop & network system 4.5 Voltage drop in 1-phase & 3-phase distributors, distributor fed at one end and fed at both ends, design Consideration for feeder and distributor (numerical based on it), Need of underground distribution , comparison with overhead lines . 4.6 Voltage control – Importance , permissible voltage variation 4.7 Methods of voltage control- excitation control and automatic voltage regulation of alternators, tap changing transformer, shunt compensation, flexible AC transmission . 4.8 Power quality – definition, importance, attributes, sources of power quality disturbance, effects of harmonics, power quality improvement methods.	**10**
5. Inter-connected Power System and Load Dispatch	1. State merits and limitations of interconnected power system. 2. Describe load frequency or real power control and automatic voltage or reactive power control. 3. Describe the concept of economic load dispatch and load shedding.	5.1 Interconnected power system, introduction, merits and limitations, concept of national grid, concept of smart grid, features & applications , scope in India 5.2 Real and reactive power control, load frequency or real power control, Automatic voltage or reactive power control, SCADA system. 5.3 Concepts of load dispatch, economic load dispatch, load shedding.	**06**

6. Substations	1. Classify substations according to service & location. 2. Draw single line diagram of typical11 KV/0.415KV pole mounted distribution substation, 3KV/11KV substation, 132 KV or 220 KV substations. 3. List substation equipments and auxiliary systems. State their functions, types and standard ratings, 4. Draw block diagram of PLCC system and state its applications.	6.1 Introduction, classification of substations according to service & location. 6.2 Typical single line connection diagrams of substation layouts, 11 KV/0.415KV pole mounted distribution substation, 33KV/11KV substation, 132 KV or 220 KV substations. 6.3 Substation equipments and auxiliary systems, their functions, types and standard ratings, control room, substation earthing. 6.4 Power line carrier communication (PLCC) system-Block diagram and applications. 6.5 Applications of fibre optics in electrical power systems.	**06**
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify different types of transmission and distribution line supports. Prepare report and draw sheet.	Transmission line components and line Constant	**4**
2	Identify different types of overhead line insulators. Prepare report and draw sheet.		**4**
3	Identify different types of transmission line conductors. Prepare report and draw sheet.		**4**
4	Identify different types of underground cables. Prepare report and draw sheet.	Substations and Cables	**2**
5	Identify different components of HVDC terminal substation. Prepare report and draw sheet.	EHVAC and HVDC Transmission	**2**
6	Identify different components of 132 or 220 or 400 KV outdoor substation. Prepare report and draw sheet.	Substations and Cables and Performance of Transmission Lines	**4**
7	Identify different components of 11KV/0.415KVsubstation. Prepare report and draw sheet.	Distribution System	**4**
8	Prepare visit report of load dispatch centre. Observe all activities.	Inter- connected Power System and Load Dispatch	**2**
9	Interpret the given layout drawing of HVDC terminal substation and identify the type of its configuration.	EHVAC and HVDC Transmission	**2**
10	Interpret the meaning of various symbols and indicators on penal drawing of interconnected power system collected from load dispatch centre.	Inter- connected Power System and Load Dispatch	**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	Transmission line components and line Constant	00(02)	10(04)	10(06)	**20(12)**
02	Performance of Transmission Lines	02(00)	06(08)	06(00)	**14(08)**
03	EHVAC and HVDC Transmission	04(00)	04(04)	00(00)	**08(04)**
04	Distribution Systems, voltage control & power quality	04(02)	04(00)	04(06)	**12(08)**
05	Inter- connected Power System and Load Dispatch	04(04)	04(00)	00(00)	**08(04)**
06	Substations	04(00)	04(04)	00(00)	**08(04)**
	Total	**18(08)**	**32(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	2	R	2	3	R	2	3	R	2	6	R	2	6	R	2	1	R	2	**5/7**
	4	R	2																
02	4	R	4	1	U	4	3	U	4	1	U	4	2	U	4				**3/5**
03	5	R	4	4	U	4	5	U	4	3	U	4	5	R	4				**3/5**
04	6	U	4	1	A	4	4	A	4	2	U	4	6	U	4				**3/5**
05	1	U	6	1	A	6	1	A	6										**2/3**
06	2	U	6	2	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 & Drawing Sheets	4,5,6
		Journal & Drawing Portfolio		Continuous	05	--	Journal & Drawing Portfolio	4,5,6
				TOTAL	**25**	**10**		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	**50**	**20**	Rubrics & Practical Drawing 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 sheets	20
2	Report writing (if any)	10
3	Viva voce	20
	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
2	-	3	-	-	-	-	-	-	-	-	-	3
3	-	3	-	-	-	-	-	-	-	-	-	3
4	-	3	2	-	-	-	-	2	2	2	-	3
5	-	3	2	2	-	-	-	2	2	2	-	3
6	-	3	2	2	-	-	-	2	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.	A Course In Electrical Power	J.B.Gupta, S.K.Kataria & Sons, Pvt. Ltd.,1990.	978-9350143742
2.	Transmission and Distribution of Electrical power	K. B. Raina, K.C. Singal and Y.K. Anand, Tata McGraw- Hill Publication Ltd., 1985.	8122403638
3.	Principles Of Power System	V. K. Mehta, S.Chand & Co Pvt. Ltd., 2000.	81-219-0594-X
4.	Electrical Power System	C. L. Wadhawa, New Age International, 01-Jan-2005.	978-81-224-2839-1
5.	A Text book on Power System Engineering	A. Chakrabarti , M.L.Soni, P. V. Gupta, Dhanpat Rai & Co. (P) Ltd., 2000.	81-7700-020-9

❖ **E-REFERENCES:**

- http://nptel.ac.in/syllabus/syllabus.php?subjectId=108108033, assessed on 16th Sept. 2016
- http://www.electrical4u.com/electrical-power-transmission-system-and-network/, assessed on 16thSeptember, 2016
- https://www.youtube.com/watch?v=lr1jgbR5ca8&list=PLD4ED2FAF3C155625&index=10, assessed on 16thSeptember, 2016

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

1. Types of Cables display board
2. Various Line Insulators

❖ **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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Ex .Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**PROFESSIONAL COURSES**
COURSE CODE	**:**	**EE410E$**
COURSE TITLE	**:**	**ELECTRICAL MACHINE OPERATION**
PREREQUISITE	**:**	**EE406E**
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:**

This subject is classified under core technology group intended to teach the student facts, concepts, principles and procedures for the starting & operations of electric machines such as electric motors, generators and transformers. They will also be able to analyze characteristics of electric machines and qualitative parameters.

These machines are used in power system for generation, transmission & distribution and also in utilization systems. Knowledge gained by the students will be used in the study of technological subjects such as power system operation & control, utilization system, switchgear & protection and manufacturing processes.

Technicians in discharging technical functions such as supervisor, controller and R&D technician will use this knowledge and skill.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to –

1. Apply methods of operation and control of electrical machines.
2. Determine regulation and efficiency of alternator, three phase induction motor.
3. Draw and Analyze circle diagram.
4. Operate & control induction motor.
5. Operate and control single phase and three phase transformer.
6. Operate 1-phase induction motor, 1-phase commutator motor & special motors.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Operation and Control of Alternator	1. Define Voltage regulation 2. Determine voltage regulation and efficiency of alternator 3. Describe methods of cooling in alternator 4. Describe frequency control and voltage control methods for alternator. 5. State necessity and Conditions of parallel operation of alternator. 6. Calculate load sharing between two alternators	1.1 Voltage regulation, determination of voltage regulation by synchronous impedance method, M.M.F. method and direct loading method, Numerical based on it. 1.2 Losses in alternator, heating and temperature rise, cooling of turbo alternator. Hydrogen & D.M. water-cooling. 1.3 Concept of excitation systems in modern alternator. 1.4 Concept of frequency control. 1.5 Concept of voltage control, working of any one type of automatic voltage regulator. 1.6 Necessity of parallel operation. Conditions of parallel operation. 1.7 Methods of synchronizing used in power station. Effect of excitation and steam power input on load sharing. Effect of failure of field & prime mover. Control of active, reactive power & power factor. Load sharing between two alternators, Numerical based on it.	**09**
2.Operation and Control of Three Phase Induction Motor	1. Draw Equivalent circuit and phasor diagram for three-phase induction motor. 2. Draw Phasor diagram on no-load and on-load condition 3. Describe the effect of load on power factor, input current, slip, speed & efficiency. 4. Draw circle diagram and calculate equivalent circuit parameters. 5. State the necessity of starters and its types. 6. Compare different types of starters on different basis. 7. State the necessity of speed	2.1Equivalent circuit of three-phase induction motor. 2.2Phasor diagram on no-load and on-load condition. 2.3Effect of load on power factor, input current, slip, speed & efficiency. Direct loading test. Performance characteristics. 2.4Concept of circle diagram. No-load test & block rotor test. Obtaining circle diagram & equivalent circuit from test results. Predicting performance of induction motor from circle diagram. Numerical based on it. 2.5Necessity of starter. Principle of reducing starting current. Types of starter, starting torque & starting current with different starters.	**10**

	control. 8. Describe the methods of speed control of three-phase induction motor. 9.Calculate losses ,slip, power factor and efficiency 10. Describe performance of three phase induction motor under abnormal conditions. 11. Describe crawling and cogging.	2.6 Generalized construction of starter, wiring diagram and working of a. Direct on line starter. b. Star delta starter-Manual and automatic starter c. Autotransformer starter. d. Rotor resistance starter. Comparison between different starters, points to be considered in selecting starter. Concept, operation & advantages of soft starters. (No numerical based on above topic) 2.7 Necessity of speed control. Methods of speed control. Stator side- pole changing, stator voltage control, Variable voltage – variable frequency control (VFD), Rotor side- rotor resistance variation, EMF injection. 2.8 Comparison between different methods.(No numerical based on above topic) 2.9 Operation under abnormal voltage. 2.10Operation under abnormal frequency. 2.11 Operation under single phasing. 2.12 Crawling and cogging or magnetic locking.	
3. Operation and control of Transformers	1. Demonstrate the parts of three-phase transformer and their functions. 2. Calculate transformation ratio. 3.Draw vector groups 4. Compare three-phase transformer unit and three-phase bank of single-phase transformer unit. 5. Describe working principle and operation of furnace, welding and auto transformer. 6. Calculate load sharing of transformers. 7. State the necessity of	3.1 Different parts of three-phase transformer and their functions. Transformation ratio, Numerical based on transformation ratio, polarity marking. 3.2 Vector groups, its advantages & applications. Connections, 3-phase to two-phase conversion Comparison between three-phase transformer unit and three-phase bank of single-phase transformer unit. 3.3 Introduction to furnace and welding transformer (single and three-phase) 3.4 Three-phase autotransformer, construction, operation and	**10**

	parallel operation	applications 3.5 Necessity of parallel operation. Condition to be fulfilled. Load sharing between two transformers. Factors affecting parallel operation. Numerical based load sharing.	
4. Single Phase Induction Motor	1.State principle of self-starting 2.State the types of single-phase induction motors 3. Compare resistance start, capacitor start and capacitor start and run motor. 4. Describe Construction, principle & application of shaded pole motor.	4.1 Introduction to single-phase induction motors. Principle of self-starting. Phasor diagram of split phase motor. Types of single-phase induction motors, Their construction, principle & application. Comparison between single-phase and three-phase induction motor. 4.2 Construction, principle and application of resistance start, capacitor start, capacitor start and run motor, shaded pole motor. Applications of above motors. 4.3 Comparison between resistance start, capacitor start and capacitor start and run motor.	**09**
5.Single-Phase Commutator Motor	1. Describe Construction, Principle of operation, characteristics & Application of A.C. Series motor. 2. Describe Starting and controlling methods of speed control of A.C. Series motor. 3. Compare D.C. Series motor & A.C. Series motor. 4. Describe Construction, Principle of operation of universal motor. 4. Describe Construction, Principle of operation & 5. State the applications ac series motor, universal motor and repulsion motor.	5.1 Construction, Principle of operation, characteristics and Application of A.C. Series motor. Starting and speed control of A.C. Series motor. 5.2 Comparison between D.C. Series motor & A.C. Series motor. 5.3 Construction, Principle of operation and Application of universal motor. 5.4 Construction, Principle of operation & Application of repulsion motor.	**05**
6.Special Motors	1. Describe Construction, Principle of operation of Reluctance motor ,Hysteresis motor, Stepper motor Servo motor (AC & DC). 2. State the applications of	6.1 Construction, Principle of operation and Application of Reluctance motor 6.2 Construction, Principle of operation and Application of Hysteresis motor 6.3 Construction, Principle of	**05**

	different motors.	operation and Application of Stepper motor 6.4 Construction, Principle of operation and Application of AC & DC Servo motor	
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Perform direct loading test on three-phase alternator at different power factor and find regulation.	1. Operation and Control of Alternator	**6**
2	Perform no-load test and block rotor test on three-phase induction motor. Determine equivalent circuit. Draw circle diagram and Predict performance at full load.	2.Operation and Control of Three Phase Induction Motor	**6**
3	Perform direct loading test on three-phase induction motor and Plot performance characteristic.		**6**
4	Open any one of three phase induction motor starter and identify components. Connect the starter to three-phase induction motor		**4**
5	Connect different types of three phase induction motor starters for starting motor.		**4**
6	Control the speed of squirrel cage and slip ring type three-phase induction motor using any two methods.		**6**
7	Record line voltage, line current and speed during single phasing.		**4**
8	Perform open circuit (O.C) and short Circuit (S.C.) test on three-phase transformer & determine regulation & efficiency.	3.Operation and control of Transformers	**6**
9	Perform Parallel operation of single-phase transformer and record their load sharing.		**6**
10	Start and control the speed of D.C. series motor.	4. Single Phase Induction Motor	**4**
11	Perform load test on single-phase induction motor and Plot characteristic.		**4**
12	Perform no-load & block rotor test on single phase induction motor and determine approximate equivalent circuit parameters		**6**
		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	Operation And Control Of Alternator	00(00)	04(04)	06(00)	**10(04)**
02	Operation And Control Of Three Phase Induction Motor	06(00)	08(06)	06(04)	**20(10)**
03	Three-Phase Transformer, Parallel Operation Of Single-Phase & Three-Phase Transformer	02(00)	04(04)	06(06)	**12(10)**
04	Single Phase Induction Motor	02(04)	06(00)	00(00)	**08(04)**
05	Single Phase Commutator Motor	02(02)	08(04)	00(00)	**10(06)**
06	Special Motors	02(02)	08(04)	00(00)	**10(06)**
	Total	**14(08)**	**38(22)**	**18 (10)**	**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	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	5	R	2	**5/7**
	6	R	2																
02	2	R	4	1	U	4	2	U	4	1	U	4	3	U	4				**3/5**
03	2	U	4	3	U	4	5	U	4	4	R	4	5	U	4				**3/5**
04	5	U	4	6	U	4	6	U	4	6	U	4	2	A	4				**3/5**
05	1	A	6	2	A	6	2	U	6										**2/3**
06	4	U	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 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	-	-	-	-	-	-	-	-	3	3
2	-	3	-	-	-	-	-	-	-	-	3	3
3	-	3	-	-	-	-	-	-	-	-	3	3
4	-	3	2	2	-	-	-	2	-	2	3	3
5	-	3	2	2	-	-	-	2	-	2	3	3
6	-	3	2	2	-	-	-	2	-	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.	Electrical Machinery.	S. K. Sen, Khanna Publishers, 3rd Edition, 1984.	8174091521, 9788174091529
2.	Experiments In Electrical Engineering	S.K. Bhattacharya ,New Age International, Edition 2007	8122410421, 9788122410426.
3	Electrical Machinery	D. P. *Kothari*, I. J. *Nagrath*. Tata McGraw-Hill Education, 2004	0070583773, 9780070583771.
4	Alternating Current Machines	M.G. Say, Pitman PublishingLtd. 4th Edition 2013	0 273 36197
5	A Text Book Of Electrical Technology Vol-II	B.L.Theraja & A.K.Theraja. S.Chand and Co.Ltd. 2012	10: 8121924375
6	Principles of Electrical Machines	V.K.Mehta & Rohit Mehta, S.Chand and Co.Ltd, First, 2002.	81-219-0632-6
7	Electrical Machinery	P.S.Bhimbra. Publisher: Khanna Publishers Edition: 7th Edition, 2011	9788174091734, 8174091734
8	Laboratory Courses in Electrical Engineering	S. G.Tarnekar, P.K.Kharabanda, S.B. Bodhakhe, S.D. Naik, S. Chand & Company Ltd., Reprint 2010	81-219-0104-9

❖ **E-REFERENCES:**

- www.**youtube**.com/watch?v=JXMyrZ3o2G8,assessed on 17th September, 2016
- https://www.**youtube**.com/watch?v=-j9mjXW-r8o,assessed on 17th September, 2016
- https://www.**youtube**.com/watch?v=kuuMR0x2dZ8,assessed on 17th September, 2016
- https://www.**youtube**.com/watch?v=5t1S8qy9oVk,assessed on 17th September, 2016

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

1. Digital Multi-meter 0-5,10A,250V,500V
2. Rheostat 1100 ohm,1200ohm
3. Three phase induction motor 1 HP,440V,50HZ
4. Single Phase Transformer 230/115V,2KVA,50HZ
5. Three phase transformer 440/220V,2KVA
6. Alternator 440V,50hz,5KVA
7. Single phase induction motor 230V,50HZ,1HP

❖ **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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs.K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Ex. Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE411E$

COURSE TITLE : UTILIZATION AND TRACTION SYSTEMS

PREREQUISITE : EE301E

TEACHING SCHEME : TH: 03; TU: 00; PR: 02(CLOCK HRs.)

TOTAL CREDITS : 04(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:

Electricity used in different industries for different processes such as heating, welding, electroplating, refrigeration and for motive power. Also country is leading towards the railway electrification, metro and monorail system. Every diploma electrical engineer therefore should know to operate and maintain main electrical utilities and traction systems for their efficient operations. This course will enable the students to develop knowledge and skills to maintain /troubleshoot various electrical equipments in electrical utilities and traction systems. The students will be able to make proper selection of equipments according to requirements to ensure economical and efficient use of electricity.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply principle of heating, welding, refrigeration and air-conditioning processes .
2. Recommend track electrification system, select suitable traction motor & train lighting system.
3. Recommend energy conservation tips for domestic & industrial consumers.
4. Operate heating & welding process equipments, Identify components of refrigeration and air-conditioning systems.
5. Start three-phase Induction motor by soft starter & control by VFD drive.
6. Prepare technical reports of visit to traction substation, train lighting system installation & electric loco shed.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Electrical Heating and Welding	1. Describe the requirements of heating element materials. 2. Describe the principle of Resistance Heating. 3. Describe the principle of arc heating. 4. Describe the working of salt bath furnace. 5. Describe the working of resistance oven. 6. Describe the working of arc furnaces. 7. Calculate length of heating element for a given resistance heating furnace. 8. Describe the principle of induction heating and their applications 9. Describe the working of various types of induction furnaces 10. Calculate efficiency of induction heating furnace for given data. 11. Describe the principle of dielectric heating and their applications. 12. Determine voltage necessary for a given data of dielectric heating. 13. State the significance of good welds. 14. Describe the principle Resistance Welding and list its types. 15. Describe the principle of electric arc welding and its types.	**1.1 Electric heating**- Introduction, advantages, modes of transfer of heat, classification of electric heating methods. **1.2 Resistance heating**- Principle, direct & indirect resistance heating, resistance furnace, heating materials, desirable properties, design of heating element, Numerical based on it, temperature control of resistance furnace, infra-red or radiant heating. **1.3 Arc furnace**- Principle, types, construction, main components, advantages. **1.4 Induction heating**- Principle, core type and coreless induction furnace, advantages, choice of frequency, source of high frequency efficiency and losses. **1.5 Dielectric heating**- Principle advantages, choice of voltage and frequency for dielectric heating, Numerical based on it, applications. **1.6 Electric resistance welding**- Principle, types- spot, seam, butt, projection and percussion welding. **1.7 Electric arc welding**- Principle, types- carbon arc, shielded metal arc, atomic hydrogen arc, inert gas metal arc, submerged arc welding, power supply for arc welding, Electric welding equipment, electrodes, comparison between resistance and arc welding. **1.8 Modern welding techniques**- Electron beam welding, ultra sonic welding, laser beam welding.	**12**

2. Electrical Drives	1. Describe function of major parts of an electric drive with block diagrams. 2. State the factors governing selection of electric motors in a electric drive. 3. Differentiate between: i. AC and DC Drive ii. Individual & group drive. 4. Describe steady state and transient characteristics of various motors.	2.1 Factors governing selection of motor, Electrical characteristics of motors. Review:- Starting, running, reversing, speed control 2.2 Electrical braking, - types, comparative advantages and disadvantages, electric braking applied to DC shunt, DC series and three-phase induction motor. 2.3 Mechanical characteristics- Enclosures, bearings, power transmission and noise level. 2.4 Size and rating of motor, numerical based on it, load equalization. 2.5 Selection of electric motors for industrial applications and particular service based on load characteristics & requirements.	**10**
3. Refrigeration and Air Condition	1. Describe vapour compression refrigeration cycle. 2. Draw electric circuit of window type AC. 3. List the refrigerants used for domestic and industrial refrigeration. 4. Draw electric circuit of domestic refrigerator. 5. Describe Construction and working of window type room air conditioner	3.1 Introduction- vapour compression refrigeration system, refrigerants- desirable properties, banned & new refrigerants. 3.2 Domestic refrigerator- Constructional features, working principle, refrigerants used, Electric circuit of refrigerator, power rating of refrigerator. 3.3 Air conditioning - Functions involved, types of air conditioning, window type room air-conditioner, Constructional features, working principle, and Electric circuit, split air conditioner, rating of air-conditioner.	**04**
4. Economic aspects	1. State salient features of Indian electricity act. 2003 2. State causes of low lagging power factor & disadvantages of low power factor. 3. State need & benefits of energy conservation. 4. Describe power factor improvement methods. 5. Describe types of energy audit. 6. State types of energy theft.	4.1Salient features of Indian electricity act. 2003 4.2 Tariff – objectives, types. 4.3 Power factor improvement – causes of low lagging power factor, disadvantages of low power factor, methods of improving power factor & their location 4.4 Energy conservation – need, benefits, energy conservation opportunities in residential & industrial installations. 4.5 Energy audit –definition, need, types 4.6 Energy theft –theft in distribution & service connection, prevention of energy theft.	**05**

5. Electrical Traction Systems & power supply arrangements	1. State the need of single phase 25 kV AC for traction. Classify traction substations 2. Describe different methods of feeding the traction sub- station 3. Draw the power circuit diagram for AC locomotive with 3 ph induction motor. 4. State different methods of obtaining supply for train lighting. 5. Describe 'End on Generation' train lighting system. 6. State advantages of Metro rail system.	5.1 Introduction, traction systems, electric traction system, advantages & disadvantages. 5.2 Power supply systems for track electrification, advantages of 25 KV AC system over DC system, problems of single phase traction systems, 2x25 KV system 5.3 Metro rail- supply systems, advantages, schemes in india . 5.4 Components of traction supply system, substation, feeding post, major equipments at AC substation, Overhead equipment (OHE), neutral section, polygonal OHE, types, current collection gear for OHE. Power circuit AC locomotive (with DC series motor and three-phase induction motor), main equipments and their functions. 5.5 Train lighting-requirements, methods of obtaining supply for train lighting – SG,EOG and HOG system	**12**
6.Traction motor control & traction mechanics	1. State the desirable features of traction motors. 2. Describe suitability of D.C. series motor & 3-ph induction motor for traction work . 3. Draw the speed time curve related to different traction system. 4. Calculate the distance between the station for a given speed time curve. 5. Calculate specific energy consumption from given data.	6.1 Traction motors – desirable characteristics 6.2 Suitability of D.C. series motor for traction duty, field control, multiple unit control, rheostatic braking 6.3 A. C. Traction motors-single phase, Three phase, Linear Induction Motor 6.4 3-ph Induction motor – suitability for traction duty, advantages over dc series motor , vvvf control, regenerative braking 6.5 Speed- time curve of mainline, urban & sub-urban services, average and schedule speed, accelerating and adhesive weight, coefficient of adhesion, simplified speed-time curves, tractive effort, propulsion of train vehicle, power of traction motors, specific energy consumption, (numerical based on it), factors affecting specific energy consumption.	**05**
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Operate electrical heating furnace available in metallurgical/electrical department and prepare a technical report.	Electrical Heating and Welding	**2**
2.	Operate electrical welding machines available in college workshop & prepare report .	Electrical Heating and Welding	**4**
3.	Demonstrate application of soft starter for starting & variable voltage variable frequency control of 3-ph induction motor .	Electrical Drives	**2**
4.	Identify different parts of refrigerator & draw its electrical circuit diagram.	Refrigeration and Air Condition	**4**
5.	Identify different parts of air conditioner & draw its electrical circuit diagram.	Refrigeration and Air Condition	**4**
6.	Visit electric-traction substation, draw single line diagram & prepare report.	Electrical Traction Systems & power supply arrangements	**4**
7.	Visit electric-traction train lighting system installation, identify components of system & prepare report.	Electrical Traction Systems & power supply arrangements	**4**
8.	Visit electric-traction locoshed, investigate working of each section & prepare report.	Traction motor control & traction mechanics	**4**
9.	Collect recent electricity tariff structure of MSEDCL and validate one LT & one HT electricity bill from tariff structure.	Economic aspects	**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 Heating and Welding	02 (02)	08 (00)	06 (06)	**16 (08)**
02	Electrical Drives	02 (04)	08 (04)	06 (00)	**16 (08)**
03	Refrigeration and Air Condition	02 (00)	04 (04)	00 (00)	**06 (04)**
04	Economic aspects	04 (00)	04 (04)	00 (00)	**08 (04)**
05	Electrical Traction Systems & Power supply arrangements	04 (02)	08 (08)	00 (00)	**12 (10)**
06	Traction motor control & Traction mechanics	00 (00)	06 (06)	06 (00)	**12 (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	2	R	2	3	R	2	4	R	2	4	R	2	1	R	2	**5/7**
	5	R	2																
02	1	U	4	1	U	4	2	U	4	2	R	4	2	U	4				**3/5**
03	2	U	4	3	U	4	4	U	4	3	U	4	4	U	4				**3/5**
04	5	R	4	5	U	4	5	U	4	5	U	4	5	U	4				**3/5**
05	1	A	6	2	A	6	1	A	6										**2/3**
06	6	U	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/investigation	20
2	Observation/Presentation	10
3	Report writing	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	-
2	-	3	-	-	-	-	-	-	-	-	-	2
3	-	3	-	-	1	2	2	-	-	-	-	2
4	-	3	2	2	-	2	-	2	2	2	2	-
5	-	3	2	2	-	-	-	2	2	2	2	-
6	-	3	2	2	-	-	-	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.	Utilization of Electric Power & Electric Traction	Gupta J.B.,S.K.Kataria and Sons, Reprint,2001.	978-9350142585
2.	Utilization of Electric Power & Electric Traction	Garg G.C., Khanna Publishers	978-8174091642
3.	Art & Science of Utilization of Electrical Energy	Partab H., Dhanpat Rai & Co. (Pvt.) Ltd,	9788177001440
4.	Modern Electric Traction	Partab H., Dhanpat Rai & Co. (Pvt.) Ltd,1998	1234567147206
5.	Utilisation Of Electric Power	Suryanarayana N.V., New Age International Publishers, Reprint 2010.	9788122405460

❖ **E-REFERENCES:**

- http://nptel.ac.in/courses/108104011/, **assessed on 30thSept 2016**
- http://www.electrical4u.com/electrical-drives/, **assessed on 30thSept 2016**
- https://www.youtube.com/watch?v=fakGLu03jYg**, assessed on 30thSept 2016**

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

1. Induction motor 3- phase, 3 HP/ 2.2 KW, 440V, 50 Hz,
2. DC Series motor 3 KW, 1500 rpm, 230V, 19.6A,
3. Arc welding machine
4. Induction heating furnace
5. Resistance heating furnace

❖ **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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	MR. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Shri. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Shri. B. P. Bale	Dy. Ex. Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**PROFESSIONAL COURSES**
COURSE CODE	**:**	**EE412E$**
COURSE TITLE	**:**	**SWITCHGEAR AND PROTECTION**
PREREQUISITE	**:**	**EE301E**
TEACHING SCHEME	**:**	**TH: 04; TU: 00; PR: 02(CLOCK HRs.)**
TOTAL CREDITS	**:**	**05 (1 THCREDIT=1 CLOCK HR., 1 PR CREDIT=2 CLOCK HRs.)**
TH. TEE	**:**	**03 HRs**
PR. TEE	**:**	**02 HRs (External)**
PT. EXAM	**:**	**01 HR**

❖ RATIONALE:

Safety is the major criteria of every power station and sub- station for machines/ equipment and human beings. So various protective schemes applied to various electrical equipment/ machines/ bus bars, feeders, transmission lines/ distribution lines etc. are essential to minimize normal and abnormal faults and for safety of human being. Operating skill of switchgear and protective systems are much essential for the technician working in the particular work area such as substation, grid station, switching station. Essential efforts are being made in this course to ensure that students develop skills in operating various controls and switchgear in power system.

❖ COURSE OUTCOMES:

1. Apply basic principles of switchgears used in power system.
2. Apply principles of protective relays and circuit breakers used in power system.
3. Develop procedure for protection of transformer, motor, transmission line and over voltages.
4. Record performance of different relays.
5. Operate power system simulation model and observe operation of relays.
6. Collect specification and prepare reports on substation switchgears.

❖ **COURSE DETAILS:**

A. THEORY :

Units	**Specific Learning Outcomes (Cognitive Domain)**	**Topics and subtopics**	**Hrs.**
1 Basic concepts of Faults and Protection	1State different types of switchgears. 2 Draw line diagram of power system with position of switchgear. 3 Compare normal and abnormal condition of power system. 4 State the causes of faults. 5 List out types of faults. 6 Elaborate the effects of faults 7 Derive the formula for fault KVA 8 Convert percentage value in to per unit value. 9 Calculate fault KVA, Fault current. 10 Define main and back up protection.	1.1 Need of protection of power system. 1.2 Meaning and role of switchgear in power system. 1.3 Types of switchgear and their function in power system, Sequence of operation of switchgear under normal and abnormal condition. 1.4 Line diagram of power system. With position of switchgear. 1.5 Normal and abnormal conditions in power system. 1.6 Types of faults, Causes of faults. Effects of faults. 1.7 Fault KVA calculation-Need of fault KVA calculation, Derivation for base impedance ,Fault KVA, Per unit system ,Procedure of fault KVA calculation ,Use of current limiting reactors & their arrangements.(Numerical Based on it) 1.8 Zone of protection, necessity to form protective zone in power system, overlapping protective zone, necessity of overlapping of zone, line diagram of power system with protective zone. 1.9 Types of protection –Main and back up protection, need of primary and back up protection .Different types of back up protections	**10**
2 Protective Relays	1 State function of relay. 2 Show connection of relay with other switchgear. 3 Define basic terms related to relay 4 List out important qualities of relay. 5 Classify relay on the basis of principle of operation and time of operation.	2.1 Concept of protective relay and its selection , operation of relay in general protective circuit containing circuit breaker, relay and trip circuit, Interlocking of relay with circuit breaker, Sequence of operation of relay. 2.2 Basic terms related to relay like pick up value, reset value and	**12**

	6 Draw the diagram of watt-hour meter type induction relay. 7 Compare directional And non-directional relay. 8 State the different types of Thermal relay. 9 Show the position of Buchholz relay in transformer. 10 State the limitation of Buchholz relay. 11 Compare impedance, reactance and mho relay. 12 List out the drawback of differential relay. 13 Draw block diagram of static relay 14 State advantages and disadvantages of static and microprocessor relay. 15 Estimate PSM, TSM and operating time of relay. 16 Describe the working of Buchholz relay.	operating current, relay operating time etc. 2.3 Important required qualities of relay like selectivity , discrimination sensitivity, stability, speed, cost etc. 2.4 Classification of relay on the basis of Principle of operation, time of operation and application. 2.5 Electromagnetic Induction type relay • Different induction type relays with their diagram .Construction ,diagram, working principle, torque equation and application of Watt-hour meter type induction relay • Plug setting multiplier, Time setting multiplier, characteristic of relay for different Plug setting multiplier & calculation of actual operating time Of relay. Numerical on relay setting. • Meaning of directional & non directional relay, Construction, diagram, working principle, of induction type directional over current relay. • Construction, diagram, working of principle of induction type directional Power relay. • Operation and Characteristic of Instantaneous relay, Definite minimum time relay, Inverse Definite minimum time relay. 2.6 Thermal relay-Construction, diagram, working principle and application. 2.7 Buchholz relay- Construction, diagram, working principle and application and limitation. 2.8 Differential relay-Principle of operation of differential relay, working by using balanced beam relay. • Differential relay and characteristic , • Biased differential relay Operation ,characteristic,	

		connection of relay for various maximum torque angle 2.9 Distance relay--Principle of operation of differential relay, working by using balanced beam relay .Characteristic of Impedance relay, reactance relay, mho relay and their use for various transmission line. 2.10 Static relay-General Block diagram, operation, advantages and disadvantages. 2.11 Microprocessor based relay- Block diagram, operation, advantages and disadvantages. Block diagram and operation of microprocessor based over current Relay, microprocessor based differential relay, microprocessor based distance relay. 2.12 Numeric relay- Block diagram, operation, advantages , disadvantages Applications	
3 Isolator And Circuit Breaker	1 State the position of isolator in protection system. 2 List different circuit breakers. 3 Elaborate arc extinction process. 4 Specify effect of arc 5 Identify different circuit breakers. 6 List the ways of increasing resistance of arc 7 State current chopping phenomenon. 8 Draw diagram of circuit breakers 9 Compare different arc extinguishing medium 10 State specification of circuit breaker. 11 Differentiate various circuit breakers. 12 State necessity of resistance switching. 13 Classify different circuit	3.1 Isolator- Function of Isolator, Types -Horizontal break, Vertical break, pantograph and their use. 3.2 Circuit Breaker-Function of circuit breaker, Classification of circuit breaker. 3.3 Arc formation - Meaning of arc, theory of arc formation, Arc voltage, effect of arc on system voltage and current and their waveforms. 3.4 Arc Extinction-Different methods of arc extinction of ac and dc circuit breaker. high resistance method Increase in resistance of arc by • Lengthening of arc • Splitting of arc • Cooling of arc • Arc runner, arc splitter Low resistance or current zero arc interruption method 3.5 Terms like recovery voltage, prestriking voltage, Making capacity, Breaking capacity, arc	**16**

	breaker. 14 Compare minimum and bulk oil circuit breaker. 15 State advantages of explosion pot in Minimum oil circuit breaker. 16 List out dielectric properties of Sulphur Hexafluoride Circuit breaker. 17 Mention use of alumina in dead tank design. 18 Elaborate arc extinction due to vacuum. 19 Draw an installation position of different circuit breaker.	extinction time and Circuit breaker time. 3.6 Arc extinction for inductive and capacitive circuit. 3.7 Specification of Circuit Breaker. 3.8 Air blast Circuit breaker – Properties of air as arc quenching medium, Arc quenching methods, working, Advantages and disadvantages. 3.9Resistance switching in Air blast Circuit breaker.-Necessity and resistance switching operation. 3.10 Oil Circuit breaker – Properties of oil as a arc quenching medium, Types, - Minimum oil Circuit breaker Diagram, working, Advantages and disadvantages. 3.11 Sulphur Hexafluoride Circuit breaker.- Properties of Sulphur Hexafluoride as arc quenching medium. Advantages of SF6 gas circuit breaker • Classification of Sulphur Hexafluoride Circuit breaker. constructional diagram, • Working of Puffer type Sulphur Hexafluoride Circuit breaker. • Dead tank Sulphur Hexafluoride Circuit breaker. Diagram, Working principle 3.12Vacuum circuit breaker-Arc extinction due to vacuum, Diagram, working, Advantages and disadvantages.	
4 Protection of Alternator And Bus bar	1 State the different abnormalities Of alternator. 2 List stator and rotor faults. 3 List the protections for different stator and rotor faults 4Draw the connection diagram of alternator differential protections. 5Calculate the percentage of winding to be protected. 6 Describe the differential protection of alternator.	4.1 Different abnormal conditions of alternator, Types of stator and rotor faults in an alternator, reason of faults, protection for particular fault as per rating and service condition. 4.2 Protections to stator of alternator • Overload or Over current protection • Biased differential protection for delta and star connection. Numerical on it.	**10**

		• Earth fault protection Restricted earth fault protection Stator Inter turn fault protection • Overvoltage , Over speed protection, protection against Motoring 4.3Rotor protection. • Rotor earth fault protection by resistance and sensitive earth fault relay • Loss of excitation protection • Rotor overheating protection. • Protection by Negative sequence relay • External fault back up Protection. • Diagram of direct connected alternator protection. 4.4Busbar protection • Current differential protection of bus bar, • Earth fault and over current protection of bus bar. - Frame leakage protection.	
5 Protection of Transformer and Motor	1 State different faults in Transformer. 2 List out different protection scheme 3 Draw a connection diagram of different protection. 2 Select the proper protection as per ratings 3 Set relay for earth fault and over current Protection. 4 Mention the drawback of differential protection. 5 Draw Connection diagram of CT with relay. 6 Elaborate the working of different protections. 7 List out the protections of high HP motor. 8 Describe the protection of low HP motor. 9 Calculate CT ratio.	5.1 Types of faults in transformer 5.2 Protection by Buchholz relay 5.3 Differential protection of transformer principle of differential protection requirement for protection, selection of CT, CT connections determination of CT ratio. Drawback of differential protection and Remedies. 5.4Biased or percentage differential Protection different connection of biased differential protection, numerical on it. 5.5Earth fault protection, Restricted earth fault protection. 5.6Combined over current and Earth Fault Protection. 5.7 Protection of motors • Different faults in motor • Protections of low HP motor • Protections of high HP motor	**08**
6 Transmission Line and a	1List the types of transmission line protections.	6.1 Time graded protection-Radial feeder, Parallel feeder protection and ring mains protection. Current	**08**

Over voltage protection	2 State the effects of lightening 3 Identify different lightening arrestors. 4 State advantages and disadvantages of Lightening Arrestors 5 Define surge absorber. 6 Describe the working of Lightening Arrestors.	graded protection to radial feeder. 6.2 Overloading protection, over current and Earth Fault Protection, current balance differential pilot wire protection. Carrier current protection. 6.3Distance protection, Three step distance protection,. 6.4 Internal causes of over voltages, Lightening phenomenon, types of lightning strokes. Protection of Substation, power station and overhead transmission line from direct lightning strokes. 6.5 Different types of Lightening Arrestors such as rod gap, horn gap .valve type, Expulsion, Thyrite type with working, diagram, advantages and disadvantages. 6.6Surge absorber-Surge capacitor, surge reactor, Ferranti surge absorber.	
		Total Hrs.	**64**

❖ B LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Prepare report on specifications of LT switchgear eg. MCB, MCCB, ELCB, RCCB used in Electrical power system through market survey.	Protective Relays	**4**
2	Plot time current characteristics of re-wirable / HRC fuse.		**2**
3	Simulate the fault condition on power simulation model and record the performance of different relays.		**2**
4	Measure the current and time of operation of IDMT relay and plot its characteristic.		**2**
5	Measure the current and time of operation of thermal relay and plot its characteristic.		**2**
6	Demonstrate the operation of MCB/MCCB under the normal and abnormal condition.		**2**
7	Identify the components of different types of circuit breakers with their specifications (through visits / video / model).	Isolator And Circuit Breaker	**2**
8	Prepare visit report on protection schemes of Transformer.	Protection of Transformer and Motor	**4**
9	Demonstrate the operation of single phasing preventer for protection of three phase induction motor		**2**
10	Prepare report of protection schemes of alternator through visit	Protection of Alternator and Bus bar	**4**
11	Prepare visit report of substation and trace protection scheme of transmission line and feeder.	Transmission Line and over voltage protection	**2**
12	Collect information about Lightening arrestors and prepare report.		**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	Basic concepts of Faults and Protection	02(00)	04(00)	06(06)	**12(06)**
02	Protective Relays	02(02)	04(04)	06(00)	**12(06)**
03	Isolator And Circuit Breaker	02(04)	12(04)	00(00)	**14(08)**
04	Protection of Alternator And Bus bar	02(00)	04(08)	06(00)	**12(08)**
05	Protection of Transformer and Motor	04(02)	00(04)	06(00)	**10(06)**
06	Transmission Line and a Over voltage protection	02(00)	08(00)	00(06)	**10(06)**
		12(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	2	R	2	3	R	2	4	R	2	6	R	2	2	R	2	**5/7**
	5	R	2																
02	5	R	4	1	U	4	2	U	4	5	U	4	2	U	4				**3/5**
03	3	U	4	3	U	4	3	U	4	3	R	4	3	U	4				**3/5**
04	4	U	4	6	U	4	6	U	4	4	U	4	4	U	4				**3/5**
05	1	A	6	2	A	6	1	A	6										**2/3**
06	4	A	6	5	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, 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	-	-	-	-	-	-	-	-	3	3
2	-	3	-	-	-	-	-	-	-	-	3	3
3	-	3	-	-	-	-	-	-	-	-	3	3
4	-	3	2	2	-	-	-	2	2	2	3	3
5	-	3	2	2	-	-	-	2	2	2	3	3
6	-	3	2	2	-	-	-	2	2	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.	Power System Protection and Switch Gear	Badriram & D. N. Viswakarma Tata McGraw Hill pub.	0-07-462350-8
2.	Switchgear and protection	U. A. Bakshi & Mayuresh V Bakshi Technical Publication Pune	9788184316391
3.	Power System Protection and Switchgear	B Ravindranath, M Chandar Wiley Eastern Ltd	8181-219-0632-6
4.	Fundamentals of Power System Protection	Y.G. Paithankar, S. R .Bhide	978-81-86308-18-0
5.	Switchgear Protection & Power System	Sunil S Rao, Khann Publisher Ltd	81-7409-029-0
6	Principles of Power System	VK Mehata, S Chand and Co. Ltd	81-219-0594-x

❖ **E-REFERENCES:**

- http://electrical-engineering-portal.com/flexibility-and-reliability-of-numerical-protection-relay,assessed on 19th Aug2016
- http://myelectrical.com/notes/entryid/150/restricted-earth-fault-protectionassessed on 2nd Sept2016

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

1. Rheostat assorted sizes
2. Dimmerstat 15A,300V
3. Variable rectifier100 A,300V DC
4. DC power pack.
5. Thermal relay
6. IDMT, DMT relay.
7. Current transformer ratio 10:01
8. Potential transformer ratio 300:115

❖ **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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy.Ex. Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE413E$

COURSE TITLE : ELECTRICAL TESTING AND MAINTENANCE

PREREQUISITE : EE411E

TEACHING SCHEME : TH: 03; TU: 00; PR: 04(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:

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

❖ COURSE OUTCOMES:

After completing this course students will be able–

1. Follow safety procedures while installation, testing, maintenance
2. Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers
3. Follow proper trouble shooting procedures
4. Operate & test AC motors/ transformers
5. Maintain electrical machines.
6. Diagnose faults in motors/ transformers

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1.Electrical Safety	1. State causes of an electrical accident. 2. Describe various methods of artificial respiration. 3.Describe method of removing electrocuted person 4.State safety rules 5.State do's and don'ts 6. Describe procedure for using fire-fighting equipment on electrical fire. 7. Describe procedure of permit system for carryout maintenance work.	1.1 Concept of electrical / mechanical safety, electrical accidents, its causes & preventions 1.2 Electrical shocks and its treatments. Artificial Respiration- -Schaefer's method, Sylvester's method, mouth to mouth respiration Procedure of artificial respiration. 1.3 Do's and don'ts regarding safety in domestic electrical appliances as well for substation/ power station operators. 1.4 Concept of permit system and its preparation and regulation for attending to electrical work in substations/ power stations / overhead lines/ underground cables etc. 1.5 Electrical safety in industry/ power stations/ substations at the time of operation/ control/ maintenance. Fire detection alarm, fire-fighting equipments.	**05**
2.Insulation Testing and Maintenance	1.Stae factors affecting life of insulating materials, 2. Describe method of measurement of insulation resistance. 3. Describe method of Cleaning and drying out insulation 4. Describe method of testing oil as per IS 1866-1961 5. Identify components in given diagram and Identify mistakes in given figure and correct them. 6 Identify condition of insulation from given data. 7. Describe method to improve insulation in above case.	2.1 Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958 2.2 Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectric absorption, iii) Megger and to predict the condition of insulation. 2.3 Reconditioning of insulation - cleaning and drying the insulation, re-varnishing, vacuum impregnation. 2.4 Insulating oil - properties of insulating oil, causes of deterioration of oil, testing of transformer oil as per IS 1866-1961, purification of insulating oil.	**07**

3. Installation and Erection	1. Describe method of foundation for static & rotating electrical machinery. 2.Describe method Align directly coupled drive 3.Describe method of Installation of transformer 4.Name Devices and tools required for loading, unloading, lifting, and carrying heavy equipment	3.1 Concept of foundation for installation of machinery. Requirements of foundation for static & rotating electrical machinery. 3.2 Concept of leveling & aligning. Procedure for leveling & aligning, alignment of direct coupled drive, effects of mis-alignment. 3.3 Installation of transformer as per I.S.-1886-1967 & procedure of installation of transformer. 3.4 Requirements of installation of pole mounted transformer. 3.5 Requirements of installation of rotating electrical machines as per I.S. 900 - 1965 3.6 Devices and tools required for loading, unloading, lifting, and carrying heavy equipments & precautions to be taken while handling them.	**09**
4.Trouble Shooting	1. State Limits of voltage, current, frequency & speed for safe working of electrical machines. 2.StateInternal & external causes for failure 3.List mechanical faults, electrical faults & magnetic faults in the electrical equipment 4. Describe method of using bearing puller, filler guage, megger etc 5. Prepare trouble shooting charts for D.C. Machines, AC Machines & Transformers.	4.1 Limits of voltage, current, frequency and speed for safe working of electrical machines. 4.2 Internal & external causes for failure / abnormal operation of equipments. 4.3 List of mechanical faults, electrical faults and magnetic faults in the electrical equipments remedies, applications. 4.4 Use of tools like bearing puller, filler gauges, dial indicator, spirit level, megger, earth tester, and growler. Common troubles in electrical equipments and machines. 4.5 Preparation of trouble shooting charts for D.C. Machines, AC Machines &Transformers.	**06**
5.Testing	1. State Objectives of testing 2. Describe Routine tests, type tests, supplementary tests, special tests. 3. Describe Direct/ Indirect/ Regenerative test on dc m/c 4. List Tolerances for the various items in respect of	5.1 Concept of testing, Objectives of testing. 5.2 Roles of I.S.S. in testing of electrical equipments. 5.3 Types of tests & concept of them, Routine tests, type tests, supplementary test, special tests 5.4 Methods of testing - Direct/	**15**

	Induction motor, Synchronous machines, D.C. machines. 5. Describe insulation resistance test on transformer 6. Describe different test on induction motor 7. Calculate efficiency,	Indirect/ Regenerative testing. 5.5 Tolerances for the various items in respect of Induction motor, D.C. machines, Synchronous machines 5.6 Testing of transformer as per I.S.1886- 1967 & I.S.2026- 1962. 5.7 Testing of three-phase Induction motor as per I.S.325 - 1970. 5.8 Testing of single-phase induction motor as per I.S.990-1965. 5.9 Testing of synchronous machines as per I.S.S. 5.10 Testing of D.C. machines – a) Direct, Indirect & Regenerative methods of testing, calibrated machines tests. b) Testing of D.C. machines as per I.S.4772.	
6. Maintenance	1. Differentiate between Routine, preventive & breakdown maintenance. 2. State Causes of failure of electrical machines 3. Prepare preventive maintenance schedules for electrical machines. 4. State Factors affecting preventive maintenance schedules. 5. Identify different types of faults **6.** Prepare maintenance Schedule for Distribution transformer, Power transformer, Single phase & three phase Induction motors, , Batteries	6.1 Concept of maintenance, types of maintenance, Routine, preventive & breakdown maintenance. 6.2 Causes of failure of electrical machines. 6.3 Preventive maintenance- advantages and procedure for developing preventive maintenance schedules for electrical machines. 6.4 Factors affecting preventive maintenance schedules. 6.5 Concept of TPM, Pillars of TPM 6.6 Identification of different types of faults developed such as mechanical/ electrical/ magnetic faults due to poor maintenance. 6.7 Maintenance schedules of the following as per I.S.S. a) Distribution transformer as per I.S.1886-1967. b) Single phase & three phase Induction motors as per I.S.900-1965. c) Batteries d) Concept of Machine Condition Monitoring and Fault Diagnostics	**06**
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Determine breakdown strength of transformer oil.	Insulation Testing and Maintenance	**4**
2	Perform insulation resistance test on any one motor/transformer.		**4**
3	Prepare trouble shooting charts for electrical machines such as Transformer, D.C. machines, Induction motor, and Synchronous machines		**8**
4	Measure impedance voltage and load losses of three-phase transformer.	Testing	**4**
5	Find regulation and efficiency of single-phase transformer by direct loading and back-to-back connection method and compare the results.		**8**
6	Determine efficiency of D.C. machine by swin burn's test.		**4**
7	Determine efficiency of D.C. machine by Hopkinson's test.		**8**
8	Perform reduced voltage running up test on three-phase Induction motor as per I.S.325 -1967.		**4**
9	Measure no load losses and no load current of a transformer as per IS.		**4**
10	Perform no load test on single phase Induction motor for the measurements of no load current, power input, speed at rated voltage as per I.S.		**4**
11	Perform temperature rise test on single-phase transformer.		**6**
12	Find efficiency of M.G. set.		**4**
		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	Electrical Safety	04(00)	06(04)	00(00)	**10(04)**
02	Insulation Testing and Maintenance	06(00)	08(06)	06(04)	**20(10)**
03	Installation & Erection	02(00)	04(04)	00(00)	**06(04)**
04	Trouble Shooting	04(04)	04(00)	00(00)	**08(04)**
05	Testing	00(04)	04(04)	12(06)	**16(14)**
06	Maintenance	02(00)	08(04)	00(00)	**10(04)**
	Total	**18(08)**	**34(22)**	**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	2	R	2	2	R	2	2	R	2	3	R	2	6	R	2	4	R	2	5/7
	4	R	2																
02	1	R	4	2	U	4	2	U	4	1	U	4	3	U	4				3/5
03	4	R	4	3	U	4	4	U	4	4	R	4	5	U	4				3/5
04	6	U	4	6	U	4	5	U	4	6	U	4	2	A	4				3/5
05	1	U	6	2	A	6	2	U	6										2/3
06	5	A	6	5	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 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	-	-	-	3	3
2	-	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	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.	Operation &Maintenance of Electrical Equipments Vol-I	B V S Rao, Asia Club House, First Reprint, 2011	8185099022
2	Design &Testing of Electrical Machines	M. V. Deshpande. PHI Learning Pvt. Ltd., 2010.	8120336453, 9788120336452.
3	Switchgear &Protection	Sunil S. Rao Khanna Publisher, First Edition,	10: 8120336607 13: 9788120336605.
4	Installation, Maintenance and Repair of Electrical Machines	M. Gupta, S.K. Kataria & Sons, Edition 2014	10: 9350145464; 13: 978-9350145463
5	Maintenance &Repairs	Rosenberg. Mc GRAW-HILL, 1st Edition, May 2003	9780071396035
6	Preventive Maintenance of Electrical Apparatus	S.K. Sharotri, Glencoe/ Mcgraw- Hill; 2nd Edition , June 1969;	10: 007030839X 13: 978-0070308398

❖ E-REFERENCES:

- *https://www.**youtube**.com/watch?v=nP7oQre_E14* , assessed on 17th September, 2016https://www.**youtube**.com/watch?v=IIGhKLdCk7U, assessed on 17th September, 2016
- https://www.**youtube**.com/watch?v=QK5dMp43NJE, assessed on 17th September, 2016
- https://www.**youtube**.com/watch?v=2o6tB4H04Mw, assessed on 17th September, 2016

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1. Three phase Induction Motor. 3 HP,440V,50 HZ
2. Oil Testing Kit Voltage Range: 0 to 100KV AC· Trip Current: 10 mA
3. Megger 500V, 1000 V
4. Earth tester, Measuring Ranges Earth *Resistance*: 0 to 2Ω, 0 to 20Ω, 0 to 200Ω, 0 to 2 KΩ. *Earth* Voltage: 0 to 300 Vac (40 to 500 Hz).

❖ 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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
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GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME	**:**	**DIPLOMA IN ELECTRICAL ENGINEERING**
LEVEL NAME	**:**	**PROFESSIONAL COURSES**
COURSE CODE	**:**	**EE414E$**
COURSE TITLE	**:**	**ELECTRICAL AND ELECTRONIC WORKSHOP**
PREREQUISITE	**:**	**EE301E**
TEACHING SCHEME	**:**	**TH: 00; TU: 00; PR: 04(CLOCK HRs.)**
TOTAL CREDITS	**:**	**02(1 TH/TU CREDIT = 0 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)**
TH. TEE	**:**	**NIL**
PR. TEE	**:**	**02 HRs (External)**
PT.	**:**	**NIL**

❖ RATIONALE:

Electrical and Electronics Workshop course develops the techniques of electrical and electronics, repairs, faultfinding, testing, fabrication and manufacturing of various items used in electrical and electronics field. This course will help the students to acquire skill and attitudes to discharge the function of supervisor in industry and can start his own small-scale enterprise.

❖ COURSE OUTCOMES:

After completing this course students will –

1. Use electrical and electronics workshop tools.
2. Perform different electrical tests
3. Rewind electrical motors and transformer
4. Test different electronics components.
5. Troubleshoot electronic Gadget.
6. Prepare mini project

❖ COURSE DETAILS:

A. THEORY :

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

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
• **Electrical Workshop**			
1.	Use following electrical workshop tools- • Screw driver • Spanners and wrenches • Bearing Puller • Hammers and Mallet	Introduction	**02**
2.	Use following testing tools- • Test lamp • Multi-meter • Megger		**02**
3.	Dissemble the single-phase induction motor. Identify the faults, repair, assemble, and test for performance.	Testing and Repairing	**06**
4.	Dissemble the three-phase induction motor. Identify the faults, repair, assemble, and test for performance.		**06**
5.	Mini Project • Select the project based on rewinding of any one of single-phase motor, three-phase motor, single-phase transformer of small capacity • Prepare flow chart (action plan) for mini project and procure different materials for selected mini-project.	Mini Project	**02**
6.	Perform rewinding of motor/transformer-		**08**
7.	Assemble the job Perform different tests.		**04**
• **Electronics Workshop**			
8.	Practice soldering on zero Printed Circuit Board (PCB).	Introduction	**02**
9.	Dissemble the existing electronic gadget using de-soldering iron. Identify the faulty components and reassemble the circuit.		**02**
10.	Operate following test and measuring equipment referring user's manual. • Multi-meter, • LCR Q meter • Analog and digital IC tester,		**02**

	• Cathode Ray Oscilloscope (CRO), • Function generator.		
11.	Use following tools- • Nose pliers • cutter • stripper • soldering gun • de-soldering pump • De-soldering braid.		**02**
12.	Use- • temperature controlled soldering station • hot air gun • And high speed drill machine.		**02**
13.	Mini Project • Select the project based on semi-conductor devices - • Prepare flow chart (action plan) for mini project and procure different components for selected mini-project.	Mini--project selection, component identification and Testing	**02**
14.	Prepare the PCB • Test visually with magnifier lens. • Perform Continuity and short circuit test of tracks. • Test Component with LCR Q meter, IC Tester, Multi-meter. • Verify specifications, rating, package type, equivalency of component by referring data sheet. • Use various connectors, berg- strip (male, female) whenever necessary.		**08**
15.	Mount and solder the Components on PCB Perform Continuity and short circuit test.	Assembling of components	**06**
16.	Test and troubleshoot the circuit for specific function. Check different parameters like • input ,output signals • voltages • current • Frequency etc. at various test points.	Circuit Testing and trouble shooting	**04**
		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	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 the circuit diagram / sketch	10
2	Performance	20
3	Testing	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	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	-
5	-	3	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.	Study of Home Appliances & Devices	K. B. Bhatiya, Khanna Publisher,	8174092656
2.	Rewinding Small Motors,	K. Wilkinson, Elsevier, 1st Edition,	9781483135380
3.	PCB Technology	Khandpur, Tata McHill,1977	9780070688141
4.	PCB Design &Technology	W.C.Bosshart, Tata McHill , 2nd Edition, 1983	-
5.	Journals of Electronics field like Elektor, Electronics for you , IEEE etc	-	-

❖ **E-REFERENCES:**

- https://www.youtube.com/watch?v=nZGEtpECPQY ,assessed on 30th September, 2016
- https://www.youtube.com/watch?v=vXf71oZbyCA ,assessed on 30th September, 2016
- https://www.youtube.com/watch?v=hmAn4_j4P88 , assessed on 30th September, 2016
- https://www.youtube.com/watch?v=wslYedGKcrE&index=1&list=PLm-Crpu8c7pQBzhmvQwpf1vllq_6Is88M , assessed on 30th September, 2016
- https://www.youtube.com/watch?v=CotSXg8vGjA , assessed on 30th September, 2016https://www.youtube.com/watch?v=yPvYd03cKJU&index=4&list=PLm-Crpu8c7pQBzhmvQwpf1vllq_6Is88M , assessed on 30th September, 2016

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

1. CRO
2. Function generator
3. Soldering and de-soldering gun
4. Drilling machine
5. Temperature controlled soldering station
6. Single–phase induction motor, 1KW, 240V, 1440 rpm
7. Three–phase squirrel cage induction motor, 3KW, 440V, 1440 rpm
8. Electricians tool kit.

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

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2	Dr. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ELECTRICAL ENGG.

LEVEL NAME : PROFESSIONAL COURSES

COURSE CODE : EE415E

COURSE TITLE : SOFTWARES IN ELECTRICAL ENGINEERING

PREREQUISITE : CA201E

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 : NIL

PR. TEE : 02 HRs (Internal)

PT. : NIL

❖ RATIONALE:

Today computer technology is very rapidly developing in any technological and other field and the use of computer is very essential. Use of computer has reduced the labour and time also. To attempt to impart the knowledge of using simulation software for realizing some of the Electrical circuits for the Diploma students.

Software based Laboratory experiments have become current day need due to its impacts on flexible learning of students and understanding abilities. This course gives the exposure of different electrical software's in the field of electrical engineering.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Use different electrical engineering simulation software.
2. Develop and execute simple MATLAB program
3. Create and modify graphs using MATLAB program
4. Design simple electrical and electronics circuit using Simulink.
5. Simulate simple electrical and electronics circuits using Simulink.
6 Use simulation software like PSCAD, PSIM, and LABVIEW.

❖ 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	Install MATLAB software at computer.	Introduction to MATLAB	2
2	Explore the MATLAB working environment like –various windows, creating new file and opening and saving new file.		2
3	Create Arrays-4x5 matrix • Create a One Dimensional Array • Create a Two Dimensional Array • The Transpose operator • Array Addressing-Vector and Matrix • Use a Colon in Addressing Arrays • Add elements to Existing Variables • Delete Elements • Build in function for Handling Arrays	Develop MATLAB program	4
4	Develop a MATLAB program to solve electrical network • Use Mathematical Operations with Arrays • Define two vectors • Define two 2x3 matrices A and B • Subtracting matrix B from matrix A • Define a matrix C that is equal to A+ B		4
5	Develop a program for addition, subtraction and multiplication of two matrices • Create matrix A and matrix B, • Use addition subtraction and multiplication function, • Execute program and • Display result.		4
6	Create and Print Plots • Create a 2-D line plot • Change the aspect ratio of the x-axis and the y-axis • Annotates the x axis • Annotates the y axis	Create and modify graphs using MATLAB program	4

	• Puts a title on the plot, and • Print a hard copy of the plot		
7	Work with Files and Directories • Print working directory • Show the contents of the directory • Make a new directory named lesson • List the contents of the directory again • Copy the file into the directory		**2**
8	Create a virtual Sine Wave with amplitude & frequency variation • Set up the Sine Wave block to use the sin() math library function to calculate block output. • Use Sine Wave block dialog box, set Time to Use external signal so that an input port appears on the block icon. • Connect a clock signal to this input port using a Digital Clock block. • Set the sample time of the clock signal to the sample time of the Sine Wave block.	Simulink	**4**
9	Simulate R-L-C circuit using MATLAB Software • Open the circuit simulator and create a blank circuit. • Use simulink library. • Use simpower system. • Select AC sources. • Build the circuit after placing and connecting all the components. • Run Simulation. • Open an oscilloscope window, View scope. • Check "Show Current" to plot current vs. time. • Save the circuit, as plain text (.txt)		**4**
10	Simulate motor drives using MATLAB Software. • Simulate the simple induction motor drive. • Get the AC4 Model from the Electric Drives Library system. • Connect AC4 Model to a Voltage Source. • Connect AC4 Model to a Mechanical Load • Build Example Circuit. • Define Set Point. • Observe Simulation Results		**4**

11	Simulate Half Wave rectifier • Take suitable power electronics switching device from library along with ac voltage source. • Construct half wave bridge circuit • Develop gate pulse according to switching pattern. • Connect R-L load • Observe waveform.		**2**
12	Simulate Full Wave rectifier • Take suitable power electronics switching device from library along with ac voltage source. • Construct full wave bridge circuit • Develop gate pulse according to switching pattern. • Connect R-L load • Observe full wave rectified voltage & current.		**2**
13	Simulate power system component using power system tools in PSIM. • Study the various elements used in Power system. • Take the reference from help browser. • Try different power system circuit diagrams.	PSIM	**4**
14	Draw one quadrant chopper operation using PSIM Software. • Take suitable switching devices, preferably MOSFET or IGBT. • Take suitable DC source, and load. • Draw one quadrant chopper circuit. • Simulate to observer the output dc voltage as positive along with positive current flowing through load.		**4**
15	Explore the PSCAD working environment like – various windows, creating new file and opening and saving new file.	PSCAD	**4**
16	Develop simple transmission system using PSCAD Software. • Take different AC sources. • Take transmission line & update with various lengths and other details of transmission lines. • Study the power flow details by connecting suitable loads on transmission lines.		**4**

17	Explore the Labview working environment. • Front Panel- Serves as the user interface. • Block Diagram- Contains the graphical source code that defines the functionality of the VI. • Icon and Connector Pane- Identifies the VI so that use the VI inside another VI. • Controls Palette- The Controls palette is available only on the front panel. • Functions Palette - The Functions palette is available only on the block diagram. • Context Help Window- The Context Help window resizes to accommodate each object description		**4**
18	Build the block diagrams using LABVIEW • Relate Front Panel Objects and Block Diagram Terminals • Use Wires to Link Block Diagram Object	LABVIEW	**4**
		Skill Assessment	**2**
		Total	**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 & Printouts	1, 2, 3, 4,5,6
		Journal Writing		Continuous	10	--	Journal & Printouts	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 & 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 program/procedure	10
2	Performance/simulation	20
3	Skills/printouts	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	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.	Getting Started with MATLAB	Rudra Pratap, Oxford University Press Inc., 7th Edition, 2016	10: 0190602066 13: 978-0190602062
2.	MATLAB: An Introduction with Applications	Amos Gilat, Wiley, Fourth Edition, August 2012	10: 8126537205 13: 978-8126537204
3.	Application from Engineering with MATLAB Concepts	Jan Valdman, InTech, Open Access, July 2016	978-953-51-2460-3 978-953-51-2459-7
4.	Introduction to MATLAB	Delores M. Etter, Pearson, 3rd Edition, 2014	10: 013377001X 13: 978-0133770018

❖ **E-REFERENCES:**

- http://nptel.ac.in/courses/103106118/2 , accessed on 5th November, 2016
- https://in.mathworks.com/academia/student_version/?requestedDomain=www.mathworks.com , accessed on 5th November, 2016
- https://www.thorlabs.com/images/TabImages/GuideToLabVIEWandAPT.pdf, accessed on 5thNovember, 2016
- https://hvdc.ca/pscad/pscad-featuresandnews/read,article/7/free-version , accessed on 5th November, 2016
- https://powersimtech.com/try-psim/ , accessed on 5th November, 2016

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

1. Computers resent version
2. MATLAB Software student version
3. PSCAD student version
4. PSIM student version
5. LABVIEW student version
6. Laser Jet Printer
7. DLP

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COURSE CURRICULUM

PROGRAMME	**:**	**DIPLOMA IN ELECTRICAL ENGINEERING**
LEVEL NAME	**:**	**PROFESSIONAL COURSES**
COURSE CODE	**:**	**EE416E$**
COURSE TITLE	**:**	**INDUSTRIAL PROJECT**
PREREQUISITE	**:**	**60 CREDITS**
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 (External)**
PT. EXAM	**:**	**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:

Practical's	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 suggestive list 1. Energy Conservation 2. Energy Auditing 3. Renewable energy sources 4. Industrial Automation 5. Transformer Protection 6. Line Protection 7. Microcontroller based 8. Speed Control of machines by modern techniques 9. Air pollution, water pollution 10. Energy generation from wastage 11. Advanced technique for energy billing 12. Design and fabrication of transformer and Induction motor. 13. Ash controlling 14. Controlling of wastage of stem in Thermal power station 15. Working model of Hydro power station 16. Energy saving in Street lighting. 17. Power factor Improvement 18. Energy Theft 19. Distribution panel Topic any other than listed above can be selected with approval from guide. 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	**6**

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	**4**
3	Perform Project work • Presentation on 30% project work completion • Presentation on 60% project work completion	Project Work	**36**
4	Test Project work	Testing	**6**
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 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**
		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	--	Rubrics, Assessment Sheets & Project Report	1, 2, 3, 4,5,6
		Report Writing		Continuous	10	--	Project Report	1, 2, 3, 4,5,6
				TOTAL	**50**	**20**		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	**100**	**40**	Rubrics & Project Report	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 (Cos)	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
4	-	3	3	3	-	-	-	3	3	3	3	3
5	-	3	-	3	-	-	-	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.	Practical electrical project engineering	L. B. Roe McGraw-Hill, first edition 1978	9780070533929
2	Sensors and Transducers	Patranabis D Prentice-Hall of India Pvt.Ltd, second edition, 2004	9788120321984
3	Principles of industrial instrumentation	Patranabis D, McGraw- Hill , Third edition 2010,	9780070699717
4	PCB Design &Technology	W.C.Bosshart Tata McHill,1984	0074515497
5	PCB Design Software user manual	Myer Kutz, McGraw- Hill	0-07-141041-4

6	Data manuals from different manufacturers	Data Manual	0521202728
7	Hand books on PCB design	Coombs' Printed Circuits Handbook (McGraw-Hill Handbooks)	0071350160
8	Journals On Electrical & Electronics field	Like Electrical India, IEEMA ,Electrical engineering Updates, Elektor, Electronics for you , Electronic product finder	0972-3277.
9	Energy Management and Conservation Handbook,	Frank Kreith, D. Yogi Goswami CRC Press, Second Edition September 1, 2016	9781466585164
10	Energy efficiency & Renewable energy handbook	Frank kreith, d. Yogi Goswami, CRC Press ,Second Edition 2007	978113874911

❖ E-REFERENCES:

- http://www.electricalindia.in/assessed on 18th September 2016
- www.electronics-project-design.com/,*assessed 18th September 2016*.
- *http://electronicsforu.com/ , assessed on 18th September 2016.*
- *http://www.electronicshub.org/electronics-projects-ideas/ , assessed on 20th September 2016*
- *http://nevonprojects.com/project-ideas/electronics-ideas/ , assessed on 20h September 2016*
- *http://www.omnicircuitboards.com/blog/bid/254057/Printed-Circuit-Board-Design-Techniques-and-Best-Practices, assessed on 20th September 2016*
- http://www.electronicshub.org/solar-energy-projects-ideas/ assessed on 18th September 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
5. Power quality Analyzer
6. Luxmeter
7. Other Electrical Meters as per requirement.

❖ **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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Ex Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 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 1. Introduction 2. Literature Survey 3. Methodology/Materials/Methods 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 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	Carmine Gallo, McGraw-Hill Education, 1st 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, 3rd 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 1. Introduction to Industry 2. Safety Practices in Industry 3. Industrial Process 4. Working Experience 5. Results 6. Summary/Conclusion. 7. 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 1. Introduction to Industry 2. Safety Practices in Industry 3. Industrial Process 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 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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**PROFESSIONAL COURSES**
COURSE CODE	**:**	**EE501E$**
COURSE TITLE	**:**	**INDUSTRIAL AUTOMATION**
PREREQUISITE	**:**	**EC305E**
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 (Internal)**
PT	**:**	**01 HR**

❖ RATIONALE:

The purpose of this course is to provide the student with basic skills useful in present industrial Automation Industry in the area of Microcontroller, Programmable Logic Controller (PLC), Distributed Control System (DCS), Supervisory Control and Data Acquisition (SCDA).After completion of this course students will troubleshoot, repair, install and maintain simple to complex automated and control systems. Also identify or solve problems in machines, and other technologies.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply instructions to develop a program for microcontroller.
2. Apply instructions to develop a program for PLC.
3. Develop ladder logic diagram for PLC
4. Interface the peripherals with the microcontroller 8051.
5. Interface the peripherals with the PLC.
6. Use microcontroller and PLC for system control.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Automation	1. State the need for Automation. 2. List the advantages of Automation 3. Mention the requirements of Automation. 4. List the fields of using automation. 5. "Automation is essential to do complicated work." Justify with example.	1.1 Need of automation 1.2 Advantages of automation 1.3 Requirements of automation.	**02**
2. Architecture and assembly language programming of 8051	1. Describe 8051 architecture with block diagram 2. Describe the function of each pins of 8051 chip 3. Describe registers and their functions of 8051 4. Develop the Program of I/O ports for data transfer 5. Develop the Program of timer and counter for required time delay generation. 6. Develop the Program of I/O ports for interfacing external memory	2.1 Architecture of 8051 Block diagram of 8051 , Pin diagram , Internal memory structure (RAM and ROM), Reset and clock, various registers , SFRs, Program status word, Brief study on chip peripherals like I/O ports , timer, counters, serial communication. 2.2 8051 instruction set Overview of 8051 instruction set and addressing modes, Moving the data (Internal and External), Arithmetic instructions, logical operations, JUMP and CALL instructions, Bit level instructions, Stack, subroutine and interrupts, Simple programs based on above instructions.	10
3. 8051 internal and external peripherals interfacing	1. Describe use of microcontroller for switch and LEDs control. 2. Describe use of microcontroller for temperature control of furnace 3. Describe use of microcontroller for Stepper motor control	3.1 8051 internal peripherals and their interfacing I/O ports , counter , timer, Detailed study of related SFRs like TCON, TMOD, Various modes of operation, Serial I/O : Detailed study of related SFRs like SBUF, SCON, Power save mode, PCON register and its various modes, Interrupts- Detailed study of related SFRs like IE, IP, Interrupt vector locations , interrupt priority. 3.2 External peripherals interfacing Interfacing of LED, isolator,	**12**

		relay, Interfacing of D/A Converter DAC - 0808, Interfacing of A/D Converter ADC – 0809, Interfacing of Stepper motor, Interfacing of temperature monitoring and control.	
4. PLC system	1. Draw block diagram of various PLC modules and explain them in brief. 2. State the ways of Interfacing of input, output analog and digital devices to PLC. 3. Describe the methods of Interfacing of Input, output analog and digital devices to PLC. 4. Describe the function of five common types of registers used in PLC and describe its applications. 5. Develop ladder logic for flip flops (RS, ONE SHOT, D, T, and J-K) in PLC. 6. Describe PLC delay timer and counter functions 7. Describe how different simple arithmetic operations can be performed by PLC. 8. Describe how logical operations can be performed by PLC. 9. Formulate the applications of advanced PLC functions. 10. Describe PLC sequencer functions devices to PLC. (if correct)	4.1 PLC system: • applications of PLC • PLC modules: I/O module, Communication module, PID module • Input analog and digital devices • Output analog and digital devices • PLC registers, • PLC timer function, • PLC counter function, • PLC simple arithmetic and logical functions, • PLC ladder logic diagram, • Advanced PLC functions like SKIP, MASTER CONTROL RELAY, JUMP with non return, jump with return • Sequencer function	**10**
5.PLC Programming and Applications	1. Draw neat sketches of PLC process applications. 2. Identify Input and Output devices for the given application. 3. Develop simple ladder Logic diagram for PLC process. 4. State the trouble shooting	**5.1**PLC application: • Bottling filling plant • Material handling elevator • 2-axis robot with sequencer control • Level control **5.2** Troubleshooting	**08**

	steps for any PLC system.		
6. DCS and SCADA	1. Describe concept of DCS. 2. Draw and describe hierarchy of DCS. 3. List and describe functions of each level of DCS. 4. Summarize functions each component of SCADA system. 5. Describe architecture of SCADA system. 6. Describe how PLC can interfacing with SCADA	6.1 Distributed Control System: • Introduction to DCS • Concept of DCS • Hierarchy of DCS • Function of each level of DCS. 6.2 Data Acquisition system (SCADA): • Block diagram of SCADA, Remote terminal unit(RTU) • Features of SCADA • Significance of SCADA • Selection criteria of SCADA • Distributed SCADA system • Applications of SCADA system • Interfacing SCADA with PLC	**06**
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Develop assembly language program for arithmetic and logic operation with 8051 simulator.	Architecture and assembly language programming of 8051	**04**
2.	Develop assembly language program for study of timer/ counter in mode 1 and 2 using simulator.		**04**
3.	Interface seven segment LED display with 8051 kit.	8051 internal and external peripherals interfacing	**02**
4.	Interface LCD display with 8051 kit.		**04**
5.	Control speed of stepper motor using 8051 kit.		**04**
6.	Draw a ladder logic diagram for two different examples.	PLC system	**02**
7.	Perform 2-axis robotic arm control using PLC.	PLC Programming and Applications ns	**02**
8.	Perform water level control using PLC.		**02**
9.	Identify the components of SCADA system.	DCS and SCADA	**02**
10.	Develop interfacing program of PLC with SCADA		**04**
		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	Automation	00(02)	06(04)	04(00)	**14(06)**
02	Architecture and assembly language programming of 8051	02(00)	06(08)	06(00)	**14(08)**
03	8051 internal and external peripherals interfacing	04(00)	04(04)	06(06)	**14(10)**
04	PLC system	04(02)	04(00)	04(06)	**12(08)**
05	PLC Programming and Applications	04(04)	04(00)	00(00)	**08(04)**
06	DCS and SCADA	04(00)	08(04)	00(00)	**12(04)**
	Total	**18(08)**	**32(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	2	R	2	3	R	2	3	R	2	6	R	2	6	R	2	1	R	2	**5/7**
	4	R	2																
02	4	R	4	6	U	4	3	U	4	1	U	4	2	U	4				**3/5**
03	5	R	4	4	U	4	5	U	4	3	U	4	5	R	4				**3/5**
04	6	U	4	1	A	4	4	A	4	2	U	4	6	U	4				**3/5**
05	1	U	6	3	A	6	3	A	6										**2/3**
06	2	U	6	2	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	Performance	20
2	Report writing	10
3	Viva voce	20
	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	-	2	-	3	-	-	3	-	-	2	-	-
2	-	2	-	3	-	-	-	-	-	2	-	-
3	-	2	-	3	-	-	-	-	2	-	-	-
4	-	2	3	3	2	-	-	3	3	-	-	-
5	-	2	3	3	2	-	-	3	3	-	-	3
6	-	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.	The 8051 Microcontroller Architecture, Programming and Applications	Ayala, Kenneth J. Penram International Publishing (I) Pvt. Ltd. New Delhi	9781401861582
2.	Fundamentals of Microprocessors and Microcontrollers	Ram, B. Dhanpat Rai Publications, New Delhi	9788189928605
3.	Microprocessor and its applications with 8051Microcomputer	Gaonkar R.S.Prentice Hall of India, New Delhi	978-81-87972-88-4
4.	The 8051 Microcontroller and Embeded systems	M. A. Mazadi , J. G. Mazadi Pearson Education, 2007	9788131710265
5.	Programmable Logic Controllers And Applications	Webb, John W, Ronald Reis. A. Prentice Hall of India, New Delhi, (latest Edition)	9780136794080
6.	Programmable Logic Control, Principles and Applications	NIIT, Prentice Hall of India, New Delhi, 2005.	81-203-2525-7

❖ E-REFERENCES:

- www.keil.com/ , assessed on 24th September, 2016
- www.allaboutcircuits.com, assessed on 24th September, 2016
- www.nmbtc.com, assessed on 24th September, 2016
- http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/Course_home1_1.htm, assessed on 24th September, 2016

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1. Microcontroller 8051 kit with necessary accessories.
2. Kit for add on cards for performing different applications of PLC.
3. Add on cards for interfacing different types of inputs and out puts.
4. Power supply for above kits and applications

❖ 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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. Manish Karandikar	Managing Director	Embedded Creations , Nagpur

14	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
15	Mr. B. P. Bale	Dy.Ex. Engineer	MSDCL, Nagpur
16	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**ELECTIVECOURSES**
COURSE CODE	**:**	**EE502E**
COURSE TITLE	**:**	**SUB-STATION PRACTICE**
PREREQUISITE	**:**	**EE301E**
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:

This course is designed for getting the knowledge of substation equipments operation and maintenance. This course will be useful for students to work in substation safely.

This course is also useful to improve the quality of power system. In this course new type of substation like Gas insulated substation is also included.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Follow safety rules for Substation
2. Apply principles of substation earthing and neutral grounding.
3. Follow maintenance procedure in substations.
4. Perform various tests in Substation.
5. Prepare maintenance schedule and interpret layouts in substation.
6. Prepare visit report.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Sub-stations and its Safety	1. State the various names of equipments used in substation. 2. State the classification of sub-station. 3. Justify the safety requirement for sub-station. 4. Describe the layout of switch yard equipment. 5. State the types of temperature Class 6. Define the weather Protection 7. Describe the various techniques for Explosion Protection 8. State the Group Classification inflammable gas /vapour	1.1 Definition of substation. 1.2 Switching Sub-stations. 1.3 Typical sub-stations in distribution system. 1.4 Classification of sub-station. 1.5 Requirements of Electrical safety. 1.6 Temperature class (Ignition Group). 1.7 Weather protection. 1.8 Explosion protection techniques. 1.9 Group classification of inflammable gas/vapour	04
2. Sub-Station Earthing	1. Justify the safety requirement for sub-station. 2. Describe the layout of switch yard equipment. 3. Definition of earthing. 4. State the types of earthing. 5. Define various terms related to earthing. 6.Describe the procedure to measure the earth resistance using earth tester	2.1 Equipment earthing 2.2 Functions of Sub-stations earthing system. 2.3 Connection of electrical equipment to station earthing system. 2.4 Sub-station earthing system. 2.5 Earth electrodes. 2.6 Integrated earthing systems for two or more installations. 2.7 Step potentials and touch potentials. 2.8 Earth resistance of earthing systems. 2.9 Earth resistance measurement. 2.10 Earth screen.	**12**
3. Neutral Grounding (Earthing)	1. State the neutral grounding. 2. State the advantages and	3.1 Definition of neutral grounding. 3.2 Disadvantages of ungrounded systems.	**8**

	disadvantages of neutral grounding. 3. Describe the connection of arc suppression coil. 4. State the earthing transformer. 5. Determine reactance of coil.	3.3 Advantages of neutral grounding. 3.4 Types of grounding. 3.5 Reactance in neutral connection. 3.6 Connection of arc suppression coil. 3.7 Neutral point earthing of transformer L.V. circuits. 3.8 Neutral grounding practice. 3.9 Earthing transformer. 3.10 Ratings of neutral devices.	
4. Sub-station Equipments and Bus bar layout	1. State the various names of equipments. 2. Describe the location of relays, C.B. C.T. &P.T. 3. State the Bus- Bar and its arrangement I switch yard. 4. Describe the layout of switch yard equipment. 5. Describe the maintenance zone. 6. State the isolated phase Bus systems.	4.1 Requirements of isolators & its rating. 4.2 Ratings of relays. 4.3 Layout the switch yard equipments 4.4Location of Relays, C.B., C.T. &P.T. 4.5 Bus bar arrangements in switch yards. 4.6 Bus bar systems recommended for large important sub-stations. 4.7 Maintenance zoning. 4.8 Used a load break switches. 4.9 Isolated phase Bus systems. 4.10 Continuous housing types isolated phase basis.	**8**
5. Maintenance	1. State the various types of maintenance. 2. State the guidelines of maintenance of switch gear. 3. Describe the maintenance of SF6 circuit breaker. Relays &Isolators. 4. Describe the troubles and periodic check. 5. Describe the installation of circuit breaker and relays.	5.1 Break Down Maintenance versus preventive maintenance. 5.2 Inspections, servicing, overhaul. 5.3 Guidelines of maintenance of switch gear. 5.4 Field quality plans. 5.5 Maintenance of SF6 circuit breaker. Relays & Isolators 5.6 Typical maintenance of record card. 5.7 Insulation resistance measurement at site. 5.8 Likely troubles and essential periodic checks. 5.9 Installation of Draw out metal clad switch gear. 5.10 Installation of outdoor circuit breaker and relays.	**10**

6. Gas Insulated sub-station	1. Describe Gas Insulated sub-station. 2. Describe the Single line diagrams of sub-station. 3. Describe the SF_6 insulated switch gear. 4. Describe the Installation and maintenance of GIS.	6.1 Gas Insulated Substation (GIS). 6.2 Single line diagrams of sub-station. 6.3 SF_6 insulated switch gear. 6.4 Partial discharge monitoring. 6.5 Loss measurement and temperature rise tests. 6.6 Installation and maintenance of GIS.	**6**
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Prepare Visit report of 33/11KV sub-station	Sub-station Equipments and Bus bar layout	4
2	Prepare maintenance schedule of 33/11KV sub-station.		2
3	Prepare Visit report of HVDC sub-station.		4
4	Measure the earth resistance of 33/11KV substation	Sub-Station Earthing	2
5	Prepare report on earthing of 11 KV pole mounted sub-station	Neutral Grounding (Earthing)	4
6	Measure insulation resistance of transformer using Megger.	Sub-Station Earthing	2
7	Perform specific gravity test and measure battery voltage and prepare maintenance schedule of Battery	Maintenance	2
8	Perform dielectric test on transformer oil (BDV test).	Maintenance	2
9	Interpret layout of 132 kV Substation and list detailed specifications of equipments used.	Sub-stations and its Safety	4
10	Prepare a report on maintenance of circuit breakers in sub station	Maintenance	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	Sub-stations and its Safety	02(00)	04(04)	00(00)	06(04)
02	Sub-Station Earthing	04(00)	06(08)	06(00)	16(08)
03	Neutral Grounding (Earthing)	00(02)	04(00)	06(06)	10(08)
04	Sub-station Equipments and Bus bar layout	04(02)	08(04)	00(00)	12(06)
05	Maintenance	02(04)	08(00)	06(06)	16(10)
06	Gas Insulated sub-station	02(00)	08(04)	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	4	R	2	4	R	2	5	R	2	6	R	2	3	R	2	5/7
	4	R	2																
02	1	U	4	2	R	4	3	U	4	1	U	4	2	U	4				3/5
03	4	U	4	4	U	4	5	U	4	2	U	4	4	U	4				3/5
04	5	U	4	6	U	4	6	U	4	5	R	4	6	U	4				3/5
05	2	U	6	2	A	6	3	A	6										2/3
06	3	A	6	5	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 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	-	1	-	-	3	-	3
2	-	3	-	-	-	-	-	-	-	3	-	3
3	-	3	-	-	-	-	-	-	-	3	-	3
4	-	3	1	1	-	-		2	2	3	-	3
5	-	3	1	-	-	-	-	2	2	3	-	3
6	-	3	-	-	-	-	-	2	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.	Generation Of Electrical Energy	B.R.Gupta, Eurasia Publishing House (Pvt.) Ltd, Third Edition, 1996.	81-219-0102-2
2.	Principles Of Power System	V.K. Mehta, S.Chand & Co.Ltd, Reprint, 1996.	81-219-0594-X
3.	A Course in Electrical Power	M. L.Soni, P.V.Gupta, U.S. Bhatnagar, Dhanpat Rai & Co. (P) Ltd., First Edition ,1997-98	10: 8177000209 / 13: 9788177000207
4.	Switchgear Protection and Power Systems	Sunil S. Rao, Khanna Publisher, 13th Edition, 2008	**10:** 8174092323 **13:** 978-8174092328
5.	Elements of Electrical Power Station Design	M.V. Deshpande, Prentice Hall India Learning Private Limited, 2009	10: 812033647X 13: 978-8120336476
6.	Power Plant Engineering	G.R. Nagpal, S.C. Sharma, Khanna Publishers-Delhi, 2012	10: 8174093095 13: 978-8174093097

❖ E-REFERENCES:

- http://www.substation-safety.com/ assessed on 5/7/2017
- https://www.slideshare.net/mvrkprasad/earthing-concepts assessed on 5/7/2017
- https://www.youtube.com/watch?v=q_GuBwEuFNM assessed on 5/7/2017
- https://www.youtube.com/watch?v=4vvKhDq5iFo assessed on 5/7/2017
- https://www.youtube.com/watch?v=HvD2rZ4q2us&list=PL1n6bMgJuaXUOCqs9hTFUygHw9yfjwRQI assessed on 5/7/2017
- www.srldc.org/var/ftp/comml/.../vol2.../2EHV%20susbattions_psjg_apr11.doc, assessed on 5/7/2017

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1. Oil testing kit
2. Hydrometer
3. Earth tester
4. Megger
5. CT and PT

❖ 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. D.D.Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A. M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr,. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Ex. Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**ELECTIVE COURSES**
COURSE CODE	**:**	**EE503E$**
COURSE TITLE	**:**	**RENEWABLE ENERGY SOURCES**
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:

Renewable energy is crucial in mitigating climate change. Renewable technologies will also yield a cleaner environment and job opportunities. Therefore, Government of India focusing on the generation of energy through renewable sources of energy. Therefore, this course is designed for electrical diploma student to explore possibility of harnessing electrical energy from renewable sources such as solar thermal, solar photovoltaic, Wind, biomass, other renewable sources and also from waste.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply principles and systems of power generation from renewable energy sources
2. Select proper renewable energy systems
3. Evaluate various parameters of various renewable systems
4. Operate, Maintain and Troubleshoot solar systems
5. Identify the workings of renewable energy systems
6. Prepare visit report.

❖ **COURSE DETAILS:**

A. THEORY :

Units	**Specific Learning Outcomes (Cognitive Domain)**	**Topics and subtopics**	**Hrs.**
1.Introduction	1. State world-wide energy problems 2. State the meaning of carbon credits. 3. State necessity of renewable energy sources 4. State types of renewable energy sources 5. Describe the working of renewable energy sources with the help of block diagram.	1.1 World and Indian Energy Scenario 1.2 Energy Problem, 1.3 Energy and Environment, climate change, Carbon Credits 1.4 Need for Renewable Energy 1.5 Types of renewable energy sources 1.6 Electricity generation from following renewable sources, block diagram and description. • Ocean Thermal Energy Conversion • Geo-thermal • Micro-hydro Generation	04
2.Solar Photo Voltaic	1. Define terms related to solar radiation 2. Describe the principle of solar cell 3. State types of Solar Cells and their Conversion Efficiency 4. Analyze factors affecting electricity generated by a solar cell 5. State factors affecting electricity generated by PV module 6. Estimate number of modules to be connected in series and parallel and their total power 7. Describe solar PV system 8. State the General considerations for PV system installation 9. State safety to be observed while installation, troubleshooting and maintenance of Standalone Solar PV system	2.1 Solar radiation • Solar spectrum, extraterrestrial radiation, radiation on the earth surface. • Terms related to solar radiation-radiation, irradiation, insolation, beam radiation; diffuse radiation, Solar constant, solar radiation at a given location, annual radiation in solar radiation, optimal tilt for solar equipment, monthly averaged global radiation at optimal tilt. **2.2** Solar Cell - • Solar Cell- Generation principle • Parameters of solar Cell, • Types of Solar Cells and their Conversion Efficiency, • Factors affecting electricity generated by a solar cell 2.3 Solar PV Module- • Rating of PV Module, • Standard PV module parameters, • Factors affecting electricity generated by PV module • Measurement of V_{sc} and $_{Isc}$	**12**

		2.4 Solar PV Array- • Connections of module in series • Connections of module in parallel • Connections of module in series- parallel, estimation of number of modules to be connected in series and parallel and their total power 2.5 Solar PV Systems- • Block diagram, • Components- Battery, Inverter, charge controller, maximum power point tracking (MPPT), their description 2.6 Standalone Solar PV system- • Installation- preparation for installation, General considerations for installation , • Maintenance • Troubleshooting • Safety- Electrical and mechanical	
3 Solar Thermal Technologies	1. State principle of conversion of solar radiation into heat 2. Describe various types of solar collectors. 3. State relative advantages and disadvantages of various types of solar collectors. 4. Describe various types of water heating system. 5. Select proper size of SWHS. 6. Calculate payback period of SWHS. 7. Describe solar thermal power plant.	3.1 Solar Thermal Technologies- • Principle of conversion of solar radiation into heat, • Types of collectors-flat-plate collectors, Concentrating collectors- Focusing, and non-focusing type, • Relative advantages and disadvantages. 3.2 Solar water heating System (SWHS) • Flat plate collector, components, description and features. • Evacuated tube type, components, description and features. • Selection of size of solar water heating System • Economics of solar water heating System • Calculation of payback period 3.3 Solar thermal power plant	**08**

		• Block diagram, components, description and features.	
4. Wind Energy	1. Define various terms related to wind energy. 2. State drag and lift principle 3. Classify WPPs. 4. Describe various controls of WPP. 5. Describe various types of WPP based on electrical generators. 6. State site selection criteria for WPP 7. State various problems associate with grid connection	4.1 Wind Energy Basic • Power in wind- power density, energy content Annual mean wind speed and its potential value • Betz's Law • Principle of wind energy conversion- Drag and Lift .principle 4.2 Wind Power Plant (WPP) • Classification of WPP, • Wind Machines-Horizontal axis machines, Vertical axis machines • Components of WPP • Necessity of speed control of wind turbine, • Methods of control of WPP- Yaw control, pitch control 4.3 Types of Electrical Generators in WPPs • Type 1, Block diagram, components, description and features. • Type 2, Block diagram, components, description and features. • Type 3, Block diagram, components, description and features. • Type 4, Block diagram, components, description and features. 4.4 Site selection criteria of WPP, Problems associated with grid connection.	**08**
5.Hydrogen Energy and Fuel Cells	1. State merits of hydrogen over other fuels. 2. Describe various methods of hydrogen production, storage and transportation. 3. Define various terms related to fuel cell. 4. State difference between fuel cell and battery. 5. Describe principle of fuel cell. 6. Compare various types of	5.1 Hydrogen energy- • Merits of hydrogen over other fuels • Comparison of hydrogen properties with Petrol Gasoline, Methane, Methanol • Merits of hydrogen over other fuels, application of hydrogen, future application of hydrogen. • Different methods of hydrogen production, Electrolysis of water- Fundamentals of	**08**

	fuel cells.	Electrolysis, chemical reaction, Electrolysis Methods- Tank type Electrolizer, Bipolar electrolyzer Description, advantages and limitations. • Hydrogen storage- Necessity and methods, their description, advantages and limitations. • Hydrogen transportation methods, their description, advantages and limitations. 5.2 Fuel Cells- • Definition of fuel, cell, fuel cell, Difference between fuel cell and battery, Fuel cell Terminology • Principle of operation of Fuel Cell, fuel cell construction • Types of Fuel cells, comparison of different types of fuel cell • Advantages & Disadvantages of fuel cell, Application of fuel cells.	
6. Waste to Energy	1. State necessity and advantages of waste to energy and green fuels 2. Classify waste 3. Describe waste to energy conversion process. 4. Describe bio-mithenation process. 5. Describe transesterification. 6. Compare bio-diesel with high-speed diesel.	6.1 Waste to Energy Technologies • Waste Generation Trends in India • Estimated Potential in India • Advantages of setting up of waste-to-energy projects • Classification of waste- Agriculture waste, Animal Manure, Forestry Waste, Municipal Waste, Industrial Waste, Biomass Waste, Biomedical Waste 6.2 Waste to energy conversion process • Solid waste- combustion, Gasification, pyrolysis • Oil crops- Extraction- Esterification • Sugar Crops- Fermentation • Wet Biomass- Anaerobic digestion 6.3 Bio-methenation • Block diagram, • Electricity generation process description, • Advantages and limitations 6.4 Biodiesel	**08**

		• Necessity of green fuel, Advantages. • Seeds for extraction of bio-diesel. • Trans-esterification process, block diagram and description • Comparison of bio-diesel with high-speed diesel.	
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	**Specific Learning Outcomes (Psychomotor Domain)**	**Units**	**Hrs.**
1.	Determine various parameters of solar PV module	Solar Photovoltaic	2
2	Test the effect of Light, temperature and shadow on the electricity generator by solar PV system		2
3	Connect the solar PV modules in series and parallel.		2
4	Design solar PV system for residential/ commercial unit.		2
5	Troubleshoot PV system		2
6	Design solar water heating system and calculate its payback period	Solar Thermal Technologies	2
7	Maintain solar water heating system		2
8	Measure wind speed using anemometer at different height and select suitable wind turbine.	Wind Energy	2
9	Identify different components of wind Power Plants		2
10	Prepare a visit report on wind power plant or Prepare a report on Wind Power Plant by observing video CD.		4
11	Prepare a visit report on biogas operated power plant or Prepare a report on biogas operated Power Plant by observing video CD.	Waste to Energy	4
12	Prepare biodiesel from edible oil and analyze its properties.		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)	04(00)	00(00)	**06(04)**
02	Solar Photovoltaic	02(00)	08(04)	06(04)	**16(08)**
03	Solar Thermal Technologies	02(02)	04(00)	06(06)	**12(08)**
04	Wind Energy	04(02)	08(06)	00(00)	**12(08)**
05	Hydrogen Energy and Fuel Cells	02(04)	06(04)	04(00)	**12(08)**
06	Waste to Energy	02,04(00)	06(04)	00(00)	**12(04)**
	Total	**18(12)**	**36(18)**	**16 (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	3	R	2	**5/7**
	4	R	2																
02	1	U	4	2	U	4	2	U	4	2	U	4	1	R	4				**3/5**
03	4	R	4	4	U	4	4	U	4										**3/5**
04	3	U	4							5	R	4	5	U	4				**3/5**
05	5	U	6	6	U	6	4	U	6										**2/3**
06	2	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 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	-	-	3	-	-	-	-	3	-	3
2	-	3	-	-	3	-	-	-	-	3	-	3
3	-	3	-	-	3	-	-	-	-	3	-	3
4	-	3	2	2	3	-	-	2	2	3	-	3
5	-	3	2	2	3	-	-	2	2	3	-	3
6	-	3	2	2	3	-	-	2	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.	Renewable Energy Technologies- A Practical guide for beginners	Chetan Singh Solanki, PHI Learning Pvt. Ltd., First, 2008.	978-81-203-3434-2
2.	Solar Energy: Principles of Thermal Collection and Storage	S.P. Sukhatme, McGraw-Hill Education (India), 3rd Edition, 2009	10: 0070142963 13: 978-0070142961
3.	Solar Photovoltaic: Fundamentals, Technologies and Application	Chetan Singh Solanki, PHI Learning Pvt. Ltd., 3rd Edition, 2015	8120351118, 978-81-203-5111-0
4.	Wind Power Plants and Project Development	Joshua Earnest , Tore Wizelius, PHI Learning Pvt. Ltd., 2nd Edition, 2015	978-81-203-5127-1
5.	Renewable Energy Sources and Emerging Technologies	D.P.Kothari, K.C.Singal, Rakesh Ranjan, PHI Learning Pvt. Ltd., 2nd Edition, 2015	978-81-203-4470-9

6.	Solar Photovoltaic Technology and System: A Manual for Technicians, Trainers and Engineers	Chetan Singh Solanki, PHI Learning Pvt. Ltd., 5th Edition, 2016	978-81-203-4711-3

❖ **E-REFERENCES:**

- https://www.youtube.com/watch?v=mDWSW8BAM3U, assessed on 6thNovember, 2017
- https://www.youtube.com/watch?v=jswDvFzGoO4, assessed on 6thNovember, 2017
- https://www.youtube.com/watch?v=qSWm_nprfqE, assessed on 6thNovember, 2017
- https://www.youtube.com/watch?v=Il0Dw3vfjZk, assessed on 6thNovember, 2017
- https://www.youtube.com/watch?v=lmtOuAed5nM, assessed on 6thNovember, 2017
- https://www.youtube.com/watch?v=1wk8_IDVu38, assessed on 6thNovember, 2017

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

1. Solar Photovoltaic Training Kit prepared by IIT, Mumbai
2. Mono-crystalline Solar PV module, 50Wp
3. Poly- crystalline Solar PV module, 50Wp
4. Concentrated Solar Power (CSP) system 1 Kw with all accessories
5. Wind Turbine 1 Kw with all accessories

❖ **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. D.D.Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K.M.Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R.I.Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M.C.Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S.P.Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R.S.Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G.V.Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H,N.Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N.H.Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

12	Msr. A.P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head Electrical Engineering	Lecturer, Government Polytechnic, Amravati

(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	**:**	**DIPLOMA IN ELECTRICAL ENGG.**
LEVEL NAME	**:**	**ELECTIVE COURSES**
COURSE CODE	**:**	**EE504E$**
COURSE TITLE	**:**	**ILLUMINATION ENGINEERING**
PREREQUISITE	**:**	**EE404 E**
TEACHING SCHEME	**:**	**TH: 03; TU: 00; PR: 02(CLOCK HRs.)**
TOTAL CREDITS	**:**	**04(1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT = 2 CLOCK HR.)**
TH. TEE	**:**	**03 HRs**
PR. TEE	**:**	**02 HRs (External)**
PT.	**:**	**01 HR**

❖ RATIONALE:

Electrical engineering students should develop skills in the field of illumination engineering. This course imparts the concept, principle and design of illumination schemes. After completion of this course diploma engineering students will able to design and installed recent trends in illumination engineering and work as supervisor in this field.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply different laws, terminology related to illumination engineering to different applications.
2. Suggest suitable luminaries for different applications
3. Select appropriate control gear for selected illumination scheme
4. Measure illumination level.
5. Conduct illumination assessment at workplace.
6. Design Illumination scheme for indoor and outdoor units.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Fundamentals of Illumination.	1.Define various parameters/ terminologies related to illumination. 2.State the laws of illumination. 3.Calculate the number of lamps required for particular application. 4.Solve numerical related to illumination.	1.1Electromagnetic spectrum, Types of lights: a. Visible light b. Ultraviolet light c. Infrared light 1.2 Nature of light, Colour of radiant energy. 1.3Theories Of Light- A) Reflection Of Light. B) Refraction Of Light. C) Double Refraction. 1.4Terminology Used In Illumination Such As- Light, Luminous Flux, Solid Angle, candle power, Luminous Intensity ,Radiant efficiency, Luminous Efficacy Of Source And Radiation, Lumen, Illumination Or Luminance, Lux, Space-Height Ratio, Utilization Factor, Depreciation Factor. 1.5 Laws Of Illumination-Inverse Square Law, Cosine Law-Numerical based On Illumination received directly underneath, Illumination received on horizontal screen and screen moved horizontally at certain distance. 1.6Factorsaffecting the illumination. 1.7Different types Of lighting arrangements, design consideration Of good lighting scheme, advantages Of good illumination scheme. 1.8 Lighting system consideration for different occupancies. 1.9 Numerical based On calculation of number Of lamps required for particular place.	**08**
2. Lamps and Lighting	1. Define terminologies related to lamp. 2. Choose different	2.1 Various types of light sources 2.2Terminology related to lamps and auxiliary apparatus-	**08**

Accessories	luminaries as per requirement of installation. 3. Describe construction and working of various luminaries. 4. Select lighting scheme as per condition and application. 5. Compare various luminaries 6. Identify mountings arrangement for light sources. 7. Collect technical data of lamps and lighting accessories. 8. Describe the effect of light sources on environment.	Luminous elements, filament, straight filament, single coil filament, coiled coil filament, Bulb, Clear Bulb, Frosted bulb, Opal Bulb, Coated Bulb, Reflectorized bulb, Enameled Bulb, Colored Bulb, Hard Glass Bulb, Cap; Base, Screw Cap, Bayonet Cap, Shell Cap, Pin Cap, Pre-focus Cap, Bayonet Pin, Contact Plate, Pin, Lamp holder, Main Electrode (ofa Discharge Lamp, Starting Electrode (of a Discharge Lamp), Arc Tube, Emissive Material 2.3 Construction, operation, lumens per watt and application of- Incandescent, Fluorescent, sodium vapour, mercury vapour, Metal halide, CFL lamps, LED lamps. 2.4Comparison between lamps on the basis of color of light, lumens per watt, life in hours, maintenance, cost etc. 2.5Lighting schemes: selection of lamp, illumination efficiency , glare and power consumption, a. Direct & Indirect b. Semi direct & semi indirect c. General lighting scheme 2.6Lighting calculation methods, a. Watt per squre meter method b. Lumens or light flux method c. Point to point method – Simple numerical. 2.7Environmental Effects Of Light Sources	
3.Illumination Control and Control Circuits	1. State the purpose of lighting control. 2. Describe lighting control methods. 3. Draw control circuit for lamps. 4. Describe the methods of light control. 5. Select controlling methods of brightness/colour of light source as per requirements. 6. Select proper light source	3.1Purpose and principle of lighting control. 3.2 Energy Benefits of Light Control 3.2 Working principle and operation of 1.Dimmer -Resistance type dimmer 2. Dimmer Transformer a) Auto transformer dimmer b) Two winding transformer dimmer 3.3 Electronic Dimmer : working	**06**

	as per application. 7. Design control circuit for illumination.	principle and operation a. Thyristor operated dimmer b. Triac operated dimmer 3.4 Enhancing Lighting control. 3.5. Methods used for light control- i. Manual Control ii. Automatic Control 3.6 a) Manual Control- (i) On /Off from single or multiple positions using fixed switches. (ii) On /Off using infrared remote controller. (iii) On /Off / dimming from fixed switch position. (iv) Multiple lighting scene control using infrared remote controller. b) Automatic Control- (i) Time switch (ii) Occupancy sensors (iii) Daylight sensor (vi) Dimming (v) Reduced voltage 3.7 a)Control circuits for lamps : single lamp controlled by single switch, two switches. b) Single Lamp control by two point method, three point method & four point method.	
4. Design Of Illumination Scheme for interior Application.	1. State standards of interior illumination. 2. Select lux level required for every working plane as per application 3.Describe the methods of designing illumination scheme 4. Design illumination scheme for Residential, Commercial, Industrial unit.	4.1 Standards for various situations of Interior Illumination. 4.2 Methods for Designing illumination schemes 4.3 Design Techniques. 4.4 Design considerations for Interior location of Residential, Commercial, Industrial premises. 4.5 Design Illumination scheme for different Interior locations of Residential, Commercial, Industrial unit. a. Commercial- Lighting Layouts, Lighting requirements for shop interiors, illumination level required for shop/mall. b. Residential- Illumination level required for different areas of	**12**

		home, numerical based on design it. c. Industrial- a) Factors Of Good Lighting- i. Adequate quantity of illumination, ii. Good quality of illumination b) General Considerations of design for lighting.	
5. Design Of Illumination Scheme for Outdoor Installation	1. State general and specific requirement of outdoor lighting scheme. **2.** Design of simple illumination scheme**.** **3.** Locate specific mountings of lighting sources for outdoor applications	5.1 General Requirements For Lighting Schemes 5.2 Specific Requirements For Above Schemes. 5.3 Outdoor factory Lighting- I. General Lighting Requirements and types of installation- a) General lighting b) Local lighting c) Emergency lighting d) Industrial lighting fittings- i. Standard reflector ii. Diffusing fitting iii. Concentrating reflectors iv. Enclosed diffusing fittings v. Angle reflectors II. Recommended Values For Illuminance. III. Lighting Design methods- numerical on point to point method. 5.4 Street Lighting- a. Main objects of street lighting. b. Road classifications according to BIS, Pole Arrangement. c. Terminology related to street and street lighting d. Types of fixtures used and their suitable application. e. Lamp And Luminaries selection, illumination level for street lighting and mounting height of lamps. f. Different Design Procedures, Beam Lumen Method, Point By Point Method, Numerical Based On Point By Point Method.	**08**

		5.5 Design Problems On Simple Illumination Scheme	
6. Lighting For special Applications	1. State the requirement of special lighting application. 2. Describe special lighting schemes for health care centre / hospitals and metro rail platform. 3. Select recommended luminaries for hospital. 4. Describe luminaries required for special purpose.	**Lighting schemes and general requirements for,** 6.1Health care centre / hospitals- a) i. Lighting of patients' rooms- a. Lighting for the general wards. b. Maternity department ii. Lighting Of special rooms-Operation theatre b) Recommended Illumination values and glare index for different areas in a hospital according to IS 3646(Part 1) 6.2Special purpose lamps used in photography, video films, sports lighting indoor and outdoor games. Lumen per watt for special purpose lamp. 6.3Metro railway platform lighting-Types of luminaries required for metro platform lighting, recommended level of illumination, watt per lumen for luminaries used for platform lighting of Metro railway	**06**
		Total Hrs.	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Measure Illumination level by lux meter.	Fundamentals of Illumination.	2
2.	Calculate and compare luminous efficiency of incandescent and compact fluorescent lamp.	Lamps and Lighting Accessories	2
3.	Compare performance of magnetic and electronic ballast with respect to energy saving		2
4.	Prepare a report of luminaries available in the market & collect the technical data		2
5.	Evaluate performance of 40 watt incandescent lamp, 8-12 watt CFL and 6-7 watt LED lamp		2
6.	Measure illumination received exactly underneath 18 watt CFL lamp and when surface is moved horizontally using laws of illumination.	Fundamentals of Illumination	2
7.	Design illumination scheme for any one of the following. (A) Mall (B) Cloth shop (C) Restaurant (D) Showroom. and Draw installation Plan	Design Of Illumination Scheme for interior Application	6
8.	Design an illumination scheme for a medium size workshop and Draw installation Plan	Design Of Illumination Scheme for Outdoor Installation	6
9.	Visit to metro rail station and design an illumination scheme. Prepare a detailed report.	Lighting For special Applications	**6**
		Skill Assessment	**2**
		Total Hrs.	**32**

❖ 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			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Fundamentals of Illumination.	00(02)	04(04)	06(00)	10(06)
02	Lamps and Lighting Accessories	02(02)	08(04)	00(00)	10(06)
03	Lighting Control	00(00)	04(04)	06(00)	10(04)
04	Design Of Illumination Scheme for interior Application	06(04)	10(00)	00(06)	16(10)
05	Design Of Illumination Scheme for Outdoor Installation	04(04)	04(00)	06(06)	14(10)
06	Lighting For special Applications	06(00)	04(04)	00(00)	10(04)
	Total	**18(12)**	**34(16)**	**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	4	R	2	4	R	2	4	R	2	6	R	2	1	R	2	**5/7**
	2	R	2																
02	1	U	4	2	U	4	2	U	4	1	U	4	2	U	4				**3/5**
03	3	U	4	4	U	4	5	R	4	3	U	4	4	R	4				**3/5**
04	6	R	4	6	U	4	5	U	4	6	U	4	5	R	4				**3/5**
05	1	A	6	3	A	6	4	A	6										**2/3**
06	4	U	6	5	A	6	5	A	6										**2/3**

T= Unit/Topic Number L= Level of Question M= Marks

R-Remember U-Understand A-Analyze/ Apply

❖ SCHEME OF PRACTICAL EVALUATION:

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment's. writing procedure etc.	10
2	Performance(i.e. assembling, dismantling, testing & fault finding)	20
3	Skills and Results	10
4	Viva voice	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	-	3	-	-	-	-	-	-	-	-	-	-
4	-	3	2	2	-	-	2	2	2	2	-	2
5	-	3	2	2	-	-	2	2	2	2	-	2
6	-	3	2	2	-	-	2	2	2	2	1	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.	Applied Illumination Engineering	Jack L. Lindsey, Publisher: Fairmont Pr; 2nd edition, November, 1996	10:0881732125 13:978-0881732122
2.	Lighting Engineering: Applied calculations	R.H. Simons, Robert Bean	0750650516
3.	Handbook of Applied photometry	Casimer M. Decusatis	1563964163
4.	Illuminating Engineering	Kamlesh Roy Publisher: Laxmi Publication, 2006	9789380386553
5.	Electrical Estimating and costing	Surjitsingh, Dhanpat Rai & co., 2011 Edition.	13-1234567150995
6.	Electrical Design Estimating and Costing	K.B. Raina and Dr. S.K.Bhattacharya New Age International Ltd., First Edition:1991Reprint:2011	81-224-0363-8 978-81-224-0363-3
7.	National Lighting Code 2010, SP: 72 -2010	Bureau Of Indian Standards, New Delhi, 2010	-

❖ E-REFERENCES:

- http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Illumination%20Engg/New_index1.html assessed on 24 Jun 2016
- http://nptel.ac.in/courses/108105060/ assessed on 24 Jun 2016
- https://www.youtube.com/watch?v=fQrZMMWo1mA *on 27 Jun 2016.*
- http://www.learnerstv.com/video/Free-video-Lecture-5780-Engineering.htm, assesed on 27 Jun 2016.
- http://personal.cityu.edu.hk/~bsapplec/basic.htm*on 27 Jun 2016.*
- http://www.boles.de/teaching/mm/pages/light-fundamentals.html on 27 Jun 2016.
- http://www.electrical4u.com/road-lighting-design/ 22/07/2016
- https://www.youtube.com/watch?v=WzSsWpK_3xA 27/7/2016
- http://www.myopencourses.com/subject/illumination-engineering-1 27/7/2016
- http://freevideolectures.com/Course/2344/Illumination-Engineering 27/7/2016
- http://electrical-engineering-portal.com/7-key-steps-in-lighting-design-process, assessed on 19/9/2016
- https://law.resource.org/pub/in/bis/S05/is.sp.72.2010.pdf assessed on 22/9/2016
- https://www.youtube.com/watch?v=fQrZMMWo1mA, assessed on 23/9/2016.
- https://www.youtube.com/watch?v=FjdQoBO22vk, assessed on 23/9/2016.
- https://www.youtube.com/watch?v=WUxwNUdGycI, assessed on 23/9/2016.
- https://www.youtube.com/watch?v=mB573i9S39A, assessed on 23/9/2016
- https://www.youtube.com/watch?v=SFXxjejtsCI, assessed on 23/9/2016.
- https://www.youtube.com/watch?v=cAE7st7DiOo, assessed on 23/9/2016
- http://www.lutron.com/en-US/Education - training/Pages/LCE/ GreenBenefits.aspx , assed on 26/9/206
- *www.**lighting**lab.fi/IEAAnnex45/guidebook/6_**lighting**%20**control**.pdf*, assessed on 26/9/2016

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1. Lux meter- Display: 3-1/2 digit 18mm LCD, Ranges: 0 - 50,000 Lux.3 ranges, Sampling rate: 0.4second, Operating Temperature: 0 ~ 50 °C (32 ~ 122 °F), Accuracy: ±5%.
2. Various types of ballasts
3. Various types of lamps
4. Lighting accessories
5. Lighting fixtures.
6. Lighting control gears.

❖ **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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Ex .Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.**
LEVEL NAME	**:**	**PROFESSIONAL COURSES**
COURSE CODE	**:**	**EE505E$**
COURSE TITLE	**:**	**ELECTRICAL DRIVES AND CONTROL**
PREREQUISITE	**:**	**EE406E**
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 in Electrical program students are employed in various industries, state electricity boards, railways etc. for process control, power generation, traction control, etc. In that, they are required to maintain, operate & control various electrical drives. Therefore, these students must have the knowledge of Electrical drives, their operation and applications with characteristics, their control using magnetic contactors and solid state devices in different processes.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Select proper Electrical drive according to requirement of process
2. Select proper controls- Magnetic contactor type or solid-state type for Electrical drive
3. Recommend control system for electrical drives
4. Operate electrical drives motor for different load conditions.
5. Perform braking of drives motor
6. Control electrical drives motor for different load conditions.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs
1. Characteristics of Electrical Motors	1. Describe methods of reversing and speed control of various motors. 2. Describe methods of electric breaking of various motors. 3. Calculate speed and slip of Three Phase Induction Motors 4. Calculate time constant and losses	1.1 Starting & Running Characteristics Of DC Motors, Three Phase Induction Motors, & Synchronous Motors 1.2 Reversing & Speed Control Of DC Motors, Three Phase Induction Motors, & Synchronous Motors 1.3 Electric Braking Of DC Motors, Three Phase Induction Motors (Numerical)	8
2. Electric Drives	1. State classification of electrical drives. 2. State types of mechanical load. 3. Describe methods of matching speed- torque characteristics of motor with load. 4. Calculate speed and slip 5. Select electrical drives for particular application	2.1 Introduction, Comparison Of AC Versus Dc Drives, Classification of Electric Drives, Basic Elements of An Electric Drive 2.2 Type of Mechanical Load, Load Torque Variation With Speed, Constant Power Loads, Load Torque Variation With Time, Four Quadrant Operation of Load Drives, Starting Conditions of Load, Matching of Speed Torque Characteristics With Load	6
3. Magnetic Control Of Electric Motors	1. Describe control circuit for starting, reversing and braking of various motors. 2.State types of Contactors & Relays	3.1 Dc Contactors & Relays- Advantages Of Magnetic Control, Magnetic Structure, Contact Structure, Arc Interruption, Contactor Ratings, Interlocks, Relaying Contactors & Control Relays, Time Delay Relays, Voltage & Current Relays 3.2 Ac Contactors & Relays- Magnetic Structure, Contact Structure, Arc Interruption, Rating Of Contactor, Interlocks, High Voltage Contactors, Control Relays,	6

		Timing Relays 3.3 Control Circuits For Automatic Starting, Reversing & Braking Of Dc Motors Using Dc Contactors & Relays 3.4 Control Circuits For Automatic Starting, Reversing & Braking Of 3-Phase Induction Motors Using Ac Contactors & Relays	
4. Solid State Control Of Electric Motors	1. Describe methods of control of various drives. 2.State types of convertors 3. Describe Dynamic & Regenerative Braking of various dc motors. 4.Describe starting methods and control methods of 3-Phase Induction Motors	4.1 Dc Motor Drives- Control Of Dc Separately Excited & Series Motors By- • Phase Control Converter- • Single Phase Drives- One Quadrant & Two Quadrant Operation • Three Phase Drives- Semi Converters & Full Converters Dual Converter- Single Phase & Three Phase Dc Choppers Reversible Drives- Reversible Drive Using- • Phase Controlled Converters • Armature Current Reversal • Dual Converter • Field Current Reversal • Choppers Dynamic & Regenerative Braking Of Dc Separately Excited & Series Motors Using Thyristor, Phase Lock Loop Control Method Of Dc Motor 4.2 Induction Motor Drives- Starting Of Induction Motor Using Soft Starter. Control Of 3-Phase Induction Motors By- • Stator Voltage Variation • Variable Voltage Variable Frequency Supply	10

		• Variable Current Variable Frequency Supply • Slip Power Recovery Scheme • Rotor Resistance Variation By Chopper Dynamic Braking & Four-Quadrant Operation	
5. Microprocessor &Plc Control Of Electric Motor	1. Draw block diagrams 2. Describe methods of control of various motor drives using Microprocessor and PLC.	5.1 Control Of Dc Drives Using Microprocessor And Plc. (Block Diagram Only) 5.2 Control Of Induction Motor Drives Using Microprocessor And Plc. (Block Diagram Only)	6
6. Selection Of Electric Drives	1. State electric features of motor for its selection in various drives. 2.Select drives for Specific Applications 3.Select motor for given application 4. Calculate efficiency of given motor.	6.1 Heating & Rating of Motor-Requirement Of A Drive Motor, Heating & Cooling Of Motor, Selection Of Motor & It's Rating Based On Classes Of Duty- Continuous, Short Time, Intermittent (Numerical Based On It), Standard Ratings Of Motor, Load Equalization, Effect Of Fly-Wheel 6.2 Mechanical Features-Enclosure, Bearings, Transmission Of Drive, Noise 6.3 Drives for Specific Applications- Common Drive Motors, Their Electrical Features, & Applications. Considerations & Choice Of Motor For Cranes & Hoists, Lifts, Lathes, Milling & Grinding Machines, Planners, Punches & Shears, Blowers & Fans, Drilling Machines, Air Compressors, Domestic Appliances, Electrical Traction, Centrifugal Pumps, Machine-Tools, Belt Conveyors, Flour Mill, Wood	12

		Working Machinery, Printing Machinery, Textile Mills, Steel Rolling Mills, Paper Mills, Sugar Mills, Coal Mining, Turbo Compressors, Ship Propulsion, Aircrafts Etc.	
			Total Hrs. **48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical's	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Control the speed of DC motor by single-phase full wave SCR converter.	Characteristics of Electrical Motors	**2**
2	Perform Counter current braking of DC motor		**2**
3	Perform Dynamic braking of DC motor		**2**
4	Control the speed of DC motor by SCR chopper	Solid State Control of Electric Motors	**2**
5	Perform DC dynamic braking of three-phase induction motor		**2**
6	Perform Regenerative braking of three-phase induction motor		**2**
7	Control the speed of three phase induction motor by stator voltage variation using SCR		**2**
8	Control the speed of three-phase induction motor by variable voltage variable frequency supply		**4**
9	Control the speed of three-phase slip ring induction motor by rotor resistance variation using chopper		**2**
10	Perform automatic DOL starting, reversing & braking of three-phase induction motor	Solid State Control Of Electric Motors	**2**
11	Perform automatic star-delta starting, reversing & braking of three-phase induction motor.		**2**
12	Control DC motor using PLC.	Microprocessor & PLC Control of Electric Motor	**2**
13	Control induction motor using PLC.		**2**
14	Perform automatic starting, reversing & braking of DC motor using contactors & relays	Magnetic Control of Electric Motors	**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	Characteristics Of Electrical Motors	02(00)	04(00)	06(06)	**12(06)**
02	Electric Drives	02(00)	00(04)	06(00)	**08(04)**
03	Magnetic Control Of Electric Motors	02(06)	08(00)	00(00)	**10(06)**
04	Solid State Control Of Electric Motors	10(04)	04(04)	00(00)	**14(08)**
05	Microprocessor &PLC Control Of Electric Motor	02(02)	08(04)	00(00)	**10(06)**
06	Selection Of Electric Drives	00(00)	10(04)	06(06)	**16(10)**
	Total	**18(12)**	**34(16)**	**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
	5	R	2																
02	1	U	4	3	U	4	4	U	4	2	U	4	4	U	4				3/5
03	4	R	4	3	U	4	4	U	4	3	R	4	5	U	4				3/5
04	4	R	4	5	U	4	6	U	4	4	R	4	6	U	4				3/5
05	1	A	6	2	A	6	1	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-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	-	-	-	-	-	-	-	-	3	3
2	-	3	-	-	-	-	-	-	-	-	3	3
3	-	3	-	-	-	-	-	-	-	-	3	3
4	-	3	2	2	-	-	-	2	-	2	3	3
5	-	3	2	2	-	-	-	2	-	2	3	3
6	-	3	2	2	-	-	-	2	-	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.	Electric Drives- Concepts & Application	V. Subrahmanyam, Tata McGraw-Hill *Publishing* Company; 1st edition 1996	10: 0074603701; 13: 978-0074603703;
2.	Generation, Distribution & Utilization of Electrical Energy	C.L. Wadhwa , New Academic Science; 3rd Revised Edition , January 2011	10: 1906574766; 13: 978-1906574765;
3.	Magnetic Control of Industrial Motors	Heumann, John Wiley & Sons; London: Chapman & Hall,1st Edition 1947	10: 0471383465 13: 9780471383468
4.	Utilization of Electric Power & Electric Traction	J.B. Gupta, M. Gupta, S.K. Kataria & Sons; 3 rd Edition, 2013	10: 9350142589; 13: 978-9350142585;

❖ E-REFERENCES:

- https://www.youtube.com/watch?v=-xebh8wU8gY, assessed on 17th September, 2016
- https://www.youtube.com/watch?v=fWyzPdyCAzU, ,assessed on 17th September, 2016
- https://www.youtube.com/watch?v=bCEiOnuODac, ,assessed on 17th September, 2016
- http://www.electrical4u.com/electrical-power-transformer-definition-and-types-of-transformerhttp://nptel.ac.in/courses/108108076/16, assessed on 17th September, 2016

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION

1. Auto transformer (Dimmerstat), single-phase, Input-240 V, Output 0-270 V, current rating - 4A, portable table model.
2. Auto transformer (Dimmerstat), three-phase Input-440 V, Output 0-470 V, current rating - 12A, table model.
3. D.C. series Motor, Voltage rating 220 Volts, Power rating1 KW
4. Single phase transformer, 2 KVA, 230/115 V
5. Three-phase squirrel cage induction motor,440 volts, 2.7 KW, 1440 rpm, (Six terminals brought out in terminal box), With star/ delta starter.

❖ 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. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
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9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
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11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Ex .Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head 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 ELECTRICAL ENGG.

LEVEL NAME : ELECTIVE COURSES

COURSE CODE : EE506E$

COURSE TITLE : ENERGY CONSERVATION AND AUDIT

PREREQUISITE : EE402E

TEACHING SCHEME : TH: 03; TU: 00; PR: 02 (CLOCK HRs.)

TOTAL CREDITS : 05 (1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT = 2CLOCK HR.)

TH. TEE : 03 HRs

PR. TEE : 02 HRs (External)

PT. : 01 HR

❖ 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. To maintain the growth of development, electricity generation will be required to be increased by proper utilisation of renewable and non-renewable sources of energy .At the same time its conservation and audit should be done to increase the efficiency of electrical power system. After completion of this course diploma engineering students must use various techniques and methods of energy conservation. Also they should able to perform energy audit and its implementation.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify energy losses and Select energy conservation technique in various sectors
2. Calculate payback period of energy efficient machines and equipments
3. Calculate energy saving through tariff structure.
4. Select & use efficient luminaries for lighting system
5. Use energy conservation equipments
6. Prepare energy audit report.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Energy Conservation in Lighting Systems.	1. State present energy scenario. 2. State need of energy conservation and energy audit. 3. Define terms related to Illumination. 4. State procedures for assessing existing lighting System in a facility. 5. Identify energy conservation techniques / methods in lighting system 6.Describe energy conservation techniques / methods in lighting system 7. Calculate payback period of energy efficient luminaries.	1.1 Energy conservation act, programs of BEE for energy conservation. 1.2 Need of energy conservation 1.3Recommended Luminance Levels) 1.4 Procedure for assessing existing lighting System in a facility. 1.5Energy conservation techniques / methods in lighting system by. -Replacing lamp sources -Using Energy efficient luminaries -Using light control gears/ circuits -Installation of exclusive transformer/ servo stabilizer for lighting -Periodic survey and adequate maintenance program.	**06**
2. Energy Conservation in Motor and Transformer	1. Describe different energy conservation methods/techniques for electrical motors 2. State opportunities for energy conservation in transformer 3. Describe different energy conservation methods/techniques for transformers	2.1.Energy Conservation Methods/Techniques for Electrical motors by, -Improving power quality -Matching motor rating with required load -Minimizing idle and redundant running of motor. - Operating in star mode - Rewinding of motors - Improving mechanical power & transmission efficiency - Use of high efficiency or Energy efficient motors -Using energy conservation equipment like Soft starters, Automatic power factor controller, Variable Frequency Drives. - Periodical maintenance 2.2 Energy Conservation Methods/Techniques for	**12**

		Transformers, - Using Energy efficient transformer - Using Amorphous core for Transformers - Epoxy Resin cast / Encapsulated Dry type Transformer -Periodic maintenance	
3 Energy Conservation In Transmission And Distribution systems	1. Identify technical and commercial losses of Transmission and Distribution system. 2.Describe different energy conservation opportunities In Transmission and Distribution Systems	Energy Conservation opportunities In Transmission and Distribution Systems by - 3.1 Overcoming technical losses 3.2 Compensating Reactive power flow 3.3 Demand side management. 3.4 Optimization of system voltage 3.5 Balancing of phase currents. 3.6 Reducing commercial losses.	**06**
4. Energy Conservation In Industries	1. State classification of Consumers (LT & HT). 2. State energy cost and Recent MSEDCL tariffs 3. State application of Tariff System to reduce Energy bill 4. Describe energy conservation by improving load factor and power factor. 5. Calculate Energy Conservation by power factor and load factor	4.1Classification of Consumers-Low Tension and High Tension, Energy cost and Recent Maharashtra State Electricity Distribution company Limited tariffs 4.2 Application of Tariff System to reduce Energy bill, energy Conservation in industry by-TOD tariff, Power factor tariff 4.3 Energy Conservation in industry by -Improving load factor -Demand side management, maximum demand controller(Simple numerical) 4.4 Energy conservation opportunities in pumping systems. 4.5Tips for energy saving in fans and blowers. 4.6 Energy saving measures for DG sets.	**06**
5. Energy Conservation by Cogeneration And Environmental	1. Define Co-generation 2. State need for cogeneration 3. Classify cogeneration systems on the basis of the sequence of energy use 4. Identify advantages of cogeneration 5. Find out factor governing	5.1Need for cogeneration 5.2 Classification of Cogeneration Systems On the basis of the sequence of energy use, - Topping cycle. - Bottoming Cycle 5.3 Advantages of cogeneration 5.4 Factor governing selection of	**08**

Issues	selection of cogeneration Systems 6. State Relation between energy and environment. 7. Identify environment and social concerns related to energy utilization in Industry 8. Describe global environmental issues.	cogeneration Systems. 5.5 Relation between Energy and Environment 5.6 Environment and social concerns related to energy utilization in Industry 5.7 Global Environmental issues, - Causes and effects of Ozone layer depletion. - Causes, effect and remedy for Global warming. (The Green House Gas effect).	
6. Energy audit	1.State the need of energy audit 2. Use of energy audit instruments 3. State the procedure of Energy audit. 4. State role of energy manager. 5. Calculate payback period.	6.1 Energy audit, need, types. 6.2Energy audit instruments and their use. 6.3Procedure of Energy audit (walk through audit & detailed audit.) 6.4 Energy management, role of energy manager. 6.5. Payback period and Return on Investment ,ABC analysis (Numerical)	**10**
		Total Hrs.	**48**

❖ LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Measure illumination level of working place with the help of Digital Lux Meter	1. Energy conservation in lighting systems. .	2
2.	Use power guard meter for measurement of different electrical quantities		4
3.	Calculate energy saving by using electronic ballast as compared to conventional chokes		2
4.	Calculate energy saving in lighting system by retrofitting tube lights with LED lamps. Also calculate payback period.		4
5.	A case study on energy conservation in street lighting of your institute		
6.	A case study on energy conservation in energy efficient motor.	2.Energy conservation methods/techniques for electrical motor and transformer	2
7.	A case study on energy conservation in industry	3.Energy Conservation In Industries	
8.	Prepare report on visit to cogeneration /captive power plant.	5.Energy conservation by cogeneration and environmental issues	4
9.	Prepare Energy audit report of your institute/ Industry/ Hospital /Residence /small workshop/hostel.	6.Energy audit	6
10.	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 (collect the technical data) iii) Market survey on energy efficient motors and transformers .(collect the technical data) iv) Energy tariff system in India v) Energy conservation equipments vi) Energy Management vii) Energy Audit on any institute /industry ix) Energy conservation act 2003	All topics	6
		Skill Assessment	**2**
		Total Hrs.	**32**

❖ 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			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Energy conservation in lighting systems.	02(00)	04(06)	04(00)	**10(06)**
02	Energy conservation in electrical motor and transformer	04 (00)	08(06)	04 (04)	**16 (10)**
03	Energy conservation in transmission and distribution systems	06 (02)	04(04)	00 (00)	**10(06)**
04	Tariff and energy conservation in industries	00(02)	04(04)	06(00)	**10(06)**
05	Energy conservation by cogeneration and environmental issues	02(04)	08(00)	00 (00)	**10(04)**
06	Energy audit	02(04)	06(00)	06 (04)	**14(08)**
	Total	**16(12)**	**34(20)**	**20(08)**	**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	6	R	2	2	U	2	3	R	2	**5/7**
	4	R	2																
02	2	R	4	1	U	4	5	U	4	3	U	4	4	U	4				**3/5**
03	3	R	4	3	U	4	4	U	4	5	R	2	6	R	4				**3/5**
04	5	U	4	2	A	4	1	A	4	2	A	4	6	A	4				**3/5**
05	2	U	6	6	U	6	2	U	6										**2/3**
06	4	A	6	6	A	6	1	U	6										**2/3**

T= Unit/Topic Number L= Level of Question M= Marks

❖ SCHEME OF PRACTICAL EVALUATION:

S.N.	Description	Max. Marks
1	Market Survey, collection of information of energy efficient equipment's/ luminaries. etc.	10
2	Performance, calculation of payback period	20
3	Skills and Results	10
4	Viva voice	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
2	-	3	-	-	3	3	-	-	-	-	3	3
3	-	3	-	-	3	-	-	-	-	-	-	3
4	-	3	2	-	-	3	2	2	2	2	-	3
5	-	3	2	2	3	3	2	2	2	2	3	3
6	-	3	2	2	3	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.	Generation and Utilisation of Electrical Energy	D. Srilatha S. Sivnagraju M. Balasubbareddy, Pearson, New Delhi 2010	8131798771, 9788131798775 978-81-317-6774-O
2.	India – The Energy Sector	P.D. Henderson, World Bank Publication, Oxford University Press, 1975.	0-19-521598-2-
3.	Energy Management Handbook	W.C Turner, John Wiley and Sons Wiley Press Eighth Edition, 2015	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, 4th Edition, 2016	-

6	Renewable Energy Technologies- A Practical guide for beginners	Chetan Singh Solanki, Prentice-Hall of India PVT. Ltd., First, 2008.	13-978-81-203-3434-2-
7	Non-Conventional Energy Resources	D.S.Chauhan, S.K.Srivastava, New Age International (P) Ltd. Publishers, Second Edition, 2011.	13-978-81-224-1768-5
8	Renewable Energy Sources & Conversion Technology	N.K. Bansal, Kleemann, Meliss Tata McGraw Hill , 1975 first edition	0074600230, 9780074600238.
9	Illuminating Engineering	Kamlesh Roy Laxmi Publication Edition: Second, 2006	9789380386553

❖ **E-REFERENCES:**

- http://www.electrical-installation.org/enwiki/Energy_saving_opportunities_-Lighting , assessed on 1st October, 2016
- https://www.google.co.in/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=energy + conservation + in+ tran , assessed on 1st October, 2016
- http://www.hammondpowersolutions.com/files/HPS_Brochure_EnergyEfficient_Distribution_Transformer.pdf , assessed on 1st October, 2016
- http://www.hammondpowersolutions.com/files/HPS_Brochure_EnergyEfficient_Distribution_Transformer.pdf , assessed on 1st October, 2016
- http://www.p2pays.org/energy/motors/index.asp , assessed on 1st October, 2016

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

1. Lux meter- Display: 3-1/2 digit 18mm LCD, Ranges: 0 - 50,000 Lux.3 ranges, Sampling rate: 0.4second, Operating Temperature: 0 ~ 50 °C (32 ~ 122 °F),
2. Ammeter MI 0-5-10 A
3. Voltmeter MI 0-150-300 V
4. Wattmeter 0-3000 W
5. Digital Multi-meter- 24V-250V AC/DC, Accuracy- 0.5% ± 1 digit
6. Tong tester ACA: 3/15/60A + 5% ACV: 300/600V + 5%, Size: 120x70x35mm
7. Power Guard 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	Dr. D. D. Lulekar	Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr. A.M. Arekar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs. K. M. Gaidhane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

5	Mr. R. I. Kamble	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr. M. C. Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs. S. P. Thote	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Dr. R. S. Surjuse	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr. G. V. Gotmare	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
10	Mr. H, N. Kharkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
11	Mr. N. H. Adkine	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
12	Mrs. A. P. Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
13	Mr. R. Y. Ghormade	Head Electrical Engineering	Dharampeth Polytechnic, Nagpur
14	Mr. B. P. Bale	Dy. Ex. Engineer	MSDCL, Nagpur
15	Dr. S. S. Bharatkar	Head Electrical Engineering	Government Polytechnic, Amravati

(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., 1st 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. SurendraGole	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. 4th 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, 11th 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, 5th 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.

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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 Jan2016

❖ 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)**

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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 itis 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 resister, capacitor, inducer, 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. 3rdEdition,	**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.comassessed on 4th May 2016
- ❖ Websites www.electroschematics.comassessed on 4th May 2016
- ❖ Websites www.hobbyelectronics.inassessed 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.

(Member Secretary PBOS) **(Chairman PBOS)**

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	Dharmpeth 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.

(An Autonomous Institute of Govt. of Maharashtra)

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 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, 2nd 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, 12th edition	81-20300716-X

❖ **E-REFERENCES:**

http://books.google.co.oin/books/isbn=9380026757 , assessed on 17thMarch 2016

http://www.youtube.com/watch?v=101M1kaZIFg , assessed on 27thApril 2016

http://www.youtube.com/watch?v=1HuxDVpy_iv , assessed on 27thApril 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

(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/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-maintanence.html , assessed on 20th April2016

https://www.youtube.com/watch?v=a0rEXzyX0-8, assessed on 20th April2016

❖ **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 Upadhay	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.

(An Autonomous Institute of Govt. of Maharashtra)

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, 20th 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-maintanence.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. Atulupadhay	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:

Practicals	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 Dantyagi : 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 , DhanpatRai Publishing Company (P) Limited,2009	9788187433224
4.	Automotive Mechanics	S. Srinivisan,Tata McGraw – Hill, 2nd 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: 100-140PSI. 2 Press plates included (designs may vary) Air inlet fitting: 1/4" NPT
- ❖ Socket/ Impact wrenches-¼", 3/8", ½" and 3/4"
- ❖ Torque wrenches- 3/8", ½"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 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 foe 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.energy managertraining.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.Adkine	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 Electrical Engineering Program

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

Mission of the Electrical Engineering Program

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

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

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

M4 : To inculcate moral values & professional ethics.

Program Educational Objectives - PEOs

PEO1 : To provide solid fundamentals in science and humanity.

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

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

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

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

Program Specific Outcomes - PSOs

PSO1 : Maintain Electrical Equipment

PSO2 : Maintain Electrical Power Systems

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 preperation and the ability to engage in independent and life-long learning in context of technological changes.



GOVERNMENT POLYTECHNIC

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