COMPETENCY BASED CURRICULUM

DIPLOMA
IN
ELECTRICAL ENGINEERING

(Duration 3 Years)
NSQF Level – 5

Under
Haryana State Board of Technical Education

Developed By

Curriculum Development Center

National Institute of Technical Teachers Training & Research

(Ministry of Education, Government of India)

Sector - 26, Chandigarh, UT, India.

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1. PREFACE

Learning and learning experience are the foundation of any education system. Appropriateness of education and its useful implications stand on the platform of knowledge and skill. But the knowledge and skill cannot be quantified qualitatively without ensuring learning experience. Curriculum is the pathway to select and organise learning experience. It helps the teachers to provide tangible resources, goals and objectives to learners. Curriculum acts as a catalyst to stimulate creativity, innovation, ethics, values, responsibility and many human factors. Curriculum embodies rigour and high standards and creates coherence to empower learner to meet the industrial and societal needs. Curriculum is a central guide for a teacher to plan a standard based sequence for the instructional delivery.

The industrial revolution 4.0 has forced the technical education system to reinvent the curriculum to meet the human resource requirement of the industry. The data driven systems relying on the subjects like machine-learning, Artificial Intelligence, Data Science etc are literally forcing the technical education system to offer different subjects differently to address the emerging challenges. The non-linear way of learning now facilitates students to choose path of knowledge to skill or vice-versa. The bi-directional process requires innovative curriculum design and revision. Diploma programme is now more challenging than ever. The level of skill and knowledge demanded by industry from diploma holders are highly interdisciplinary at the same time address special need. Hence, there is a need to align the curriculum to National Skill Qualification Framework (NSQF).

National Education Policy, NEP-2020 has now opened up diversities for the education system to explore and exploit to make the education relevant. The policy emphasises to inculcate value, ethics, respect to culture and society etc along with industry ready knowledge and skill among the students. The interdisciplinary nature of curriculum, academic bank of credits and integration of technology in teaching-learning envisaged in NEP-2020 make it more challenging for curriculum development. NITTTR, Chandigarh has developed the art of curriculum development over 54 years of its existence. The expertise and experience available in the institute follow time-tested and acclaimed scientific methods to design/revise curriculum. The experienced faculty members entrusted with the curriculum development or revision activities are well-versed with NSQF, NEP and Outcome based education. I am happy to note that **Haryana State Board of Technical Education, Punchkula, Haryana** reposed their confidence on this expertise to develop **AICTE/NSQF/NEP 2020** aligned curriculum for the state. This documented curriculum is an outcome of meticulous planning and discussions among renowned experts of the subject through series of workshops. The effective implementation of this curriculum supported with quality instructional resources will go a long way in infusing the learning experience among learners to make them industry ready.

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2. ACKNOWLEDGEMENT

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3. SALIENT FEATURES

1.	Name	:	**Diploma in Electrical Engineering**
2.	Duration	:	**03 Years**
3.	Hours per week	:	**35 - 40**
4.	Entry Qualification	:	**10th Pass**
5.	Student Intake	:	**As per sanctioned strength**
6.	Pattern	:	**Semester**
7.	Scheme	**:**	**Multipoint Entry and Exit**
8.	NSQF Level	:	**5**
9.	Theory Practical Ratio	:	**40 : 60**
10.	Project Work	:	**Minor and Major Project**
11.	In-house/Industrial Internship	:	**Mandatory after First and Second Year**

4. NSQF COMPLIANCE

National Skill Qualification Framework has defined total Ten Levels. Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Fig.1: NSQF Domains

NSQF LEVEL - 3 COMPLIANCE

The NSQF level - 3 descriptor is as follows:

Process	• Person may carry out a job which may require limited range of activities routine and predictable.
Professional Knowledge	• Basic facts, process and principle applied in trade of employment.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application.
Core Skill	• Communication written and oral, with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Under close supervision. Some responsibility for own work within defined limit.

Fig 2: NSQF Level – 3 Descriptor

Work requiring knowledge, skills and aptitudes at level 3 will be routine and predictable. Job holders will be responsible for carrying out a limited range of jobs under close supervision. Their work may require the completion of a number of related tasks. People carrying out these job roles may be described as "Semi skilled workers". Individuals in jobs which require level 3 qualifications will normally be expected to be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation and should know the basic facts, processes and principles applied in the trade for which they are qualified and be able to apply the basic skills of the trade to a limited range of straightforward jobs in the occupation.

They will be expected to understand what constitutes quality in their job role and more widely in the sector or sub-sector and to distinguish between good and bad quality in the context of the jobs they are given. Job holders at this level will be expected to carry out the jobs they are given safely and securely. They will work hygienically and in ways which show an understanding of environmental issues. This means that they will be expected to take responsibility for their own health and safety and that of fellow workers and, where appropriate, customers and/or clients. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social environment. They should be able to make a good contribution to team work.

NSQF LEVEL - 4 COMPLIANCE

The NSQF level-4 descriptor is given below:

Process	• Work in familiar, predictable, routine, situation of clear choice
Professional Knowledge	• Factual knowledge of field of knowledge or study.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts.
Core Skill	• Communication written and oral, with required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Responsibility for own work and learning.

Fig 3: NSQF Level – 4 Descriptor

Work requiring knowledge, skills and aptitudes at level 4 will be carried out in familiar, predictable and routine situations. Job holders will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. People carrying out these jobs may be described as "skilled workers". Individuals in jobs which require level 4 qualifications should be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation in which they are employed, to appreciate the nature of the occupation and to understand and apply the rules which govern good practice. They will be able to make choices about the best way to carry out routine jobs where the choices are clear.

They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their job roles. Job holders at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They will work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment. They should be able to guide or lead teams on work within their capability.

NSQF LEVEL - 5 COMPLIANCE

The NSQF level-5 description is given below:

Process	• Job that requires well developed skill, with clear choice of procedures in familiar context.
Professional Knowledge	• Knowledge of facts, principles, processes and general concepts, in a field of work or study.
Professional Skill	• A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information.
Core Skill	• Desired mathematical skill; understanding of social, political; and some skill of collecting and organising information, communication.
Responsibility	• Responsibility for own work and learning and some responsibility for others' works and learning

Fig 4: NSQF Level – 5 Descriptor

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning. People carrying out these jobs may be described as "fully skilled workers" or "supervisors".

Individuals employed to carry out these jobs will be expected to be able to communicate clearly in speech and writing and may be required to apply mathematical processes. They should also be able to collect and organise information to communicate about the work. They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise.

In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

5. NATIONAL EDUCATION POLICY (NEP) - 2020

NEP 2020 aims at a comprehensive holistic education to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral - in an integrated manner. A holistic arts education will help develop well-rounded individuals that possess: critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

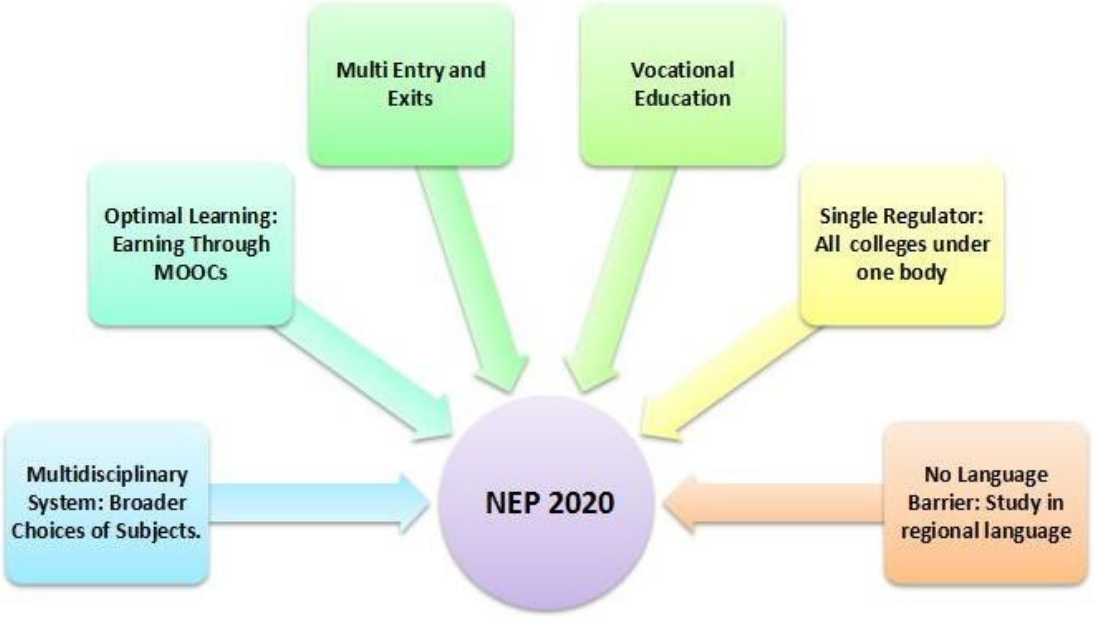

Fig 5: NEP 2020

Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialisation in a subject or subjects. Pedagogy for courses will strive for significantly less rote learning and an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking. The flexible and innovative curriculum shall emphasize on offering credit-based courses and projects in the areas of community engagement and service, environmental education and value-based education. as part of a holistic education, students will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, villages and local communities, etc., as well as

research internships with faculty and researchers at their own or other HEIs or research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Effective learning requires relevant curriculum, engaging pedagogy, continuous formative assessment and adequate student support. The curriculum must be updated regularly aligning with the latest knowledge requirements and shall meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students - thus directly influencing learning outcomes. The assessment methods have to be scientific and test the application of knowledge. Higher Education Institutes should move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs should also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

6. DIPLOMA PROGRAM OUTCOMES

The program outcomes are derived from five domains of NSQF Level namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Acquire knowledge of basic mathematics, sciences and basic engineering to understand Electrical Engineering.

PO2: Identify principles, processes and professional knowledge to solve broad-based Electrical Engineering problems

PO3: To develop special skills required for repairing small electrical domestic appliances, making joints and carrying out work and detecting faults etc. in electrical equipment and circuit.

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO5: Take the responsibility to work as dedicated electrical technician who is capable of identifying solutions to various problems faced by the society.

PO6: Engage in Multi-disciplinary skills, team spirit and leadership qualities with professional ethics, to excel in professional career and/or higher studies in Electrical Engineering

SECOND SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
2.1	* Applied Mathematics -II	4	-	4+0=4	40	-	40	60	-	60	100
2.2	*Applied Physics -II	2	2	2+1=3	40	40	80	60	60	120	200
2.3	Electrical Networks	3	4	3+2=5	40	40	80	60	60	120	200
2.4	Non-conventional Sources of Energy	2	2	2+1 = 3	40	40	80	60	60	120	200
2.5	*Environmental Studies and Disaster Management	2	-	2+0=2	40	-	40	60	-	60	100
2.6	Basic Electrical Workshop	-	8	0+4=4	-	40	40	-	60	60	100
#Student Centred Activities (SCA)		-	6	-	-	-	-	-	-	-	-
Total		**13**	**22**	**21**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

* Common with other diploma programmes.

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

Summer Industrial/In-house Training: After 2nd semester, students shall undergo Summer Training **of 4 Weeks.**

8. DIPLOMA PROGRAMME HORIZONTAL AND VERTICAL ORGANISATION OF SUBJECTS

Sr. No.	Subjects	Hours Per Week	
		First Semester	Second Semester
1.	English and Communication Skills - I	4	-
2.	Applied Mathematics - I	4	-
3.	Applied Physics - I	4	-
4.	Principles of Electrical Engineering	7	
5.	Fundamentals of IT	6	-
6.	Engineering Graphics	6	-
7.	Student Centered Activities	4	-
8.	Applied Mathematics-II	-	4
9.	Applied Physics - II	-	4
10.	Electrical Networks	-	7
11.	Non-conventional Sources of Energy	-	4
12.	Environmental Studies and Disaster Management	-	2
13.	Basic Electrical Workshop	-	8
14.	Student Centered Activities	-	6
	Total	**35**	**35**

9. DERIVING CURRICULUM SUBJECT AREAS FROM DIPLOMA PROGRAMME OUTCOMES

The following curriculum subject areas have been derived from Programme outcomes:

Sr. No.	Programme Outcomes	Curriculum Subject Areas
1.	**PO1:** Acquire knowledge of basic mathematics, sciences and basic engineering to understand Electrical Engineering.	● Applied Physics – I ● Applied Mathematics - I ● Applied Mathematics-II ● Applied Physics - II ● Principles of Electrical Engineering ● Engineering Graphics ● Environmental Studies & Disaster Management ● Student Centered Activities
2.	**PO2:** Identify principles, processes and professional knowledge to solve broad-based Electrical Engineering problems	● Applied Physics - I ● Principles of Electrical Engineering ● Electrical Networks ● Applied Physics – II ● Non-Conventional Sources of Energy
3.	**PO3:** To develop special skills required for repairing small electrical domestic appliances, making joints and carrying out work and detecting faults etc. in electrical equipment and circuit.	● Applied Physics - II ● Electrical Networks ● Summer Industrial / In - House Training. ● Engineering Graphics ● Basic Electrical Workshop
4.	**PO4:** Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	● English and Communication Skills - I ● Applied Mathematics - I ● Fundamentals of IT ● Applied Mathematics – II ● Environmental Studies & Disaster Management

5.	**PO5:** Take the responsibility to work as dedicated electrical technician who is capable of identifying solutions to various problems faced by the society.	● Principles of Electrical Engineering ● Basic Electrical Workshop ● Non-Conventional Sources of Energy ● Electrical Networks
6.	**PO6:** Engage in Multi-disciplinary skills, team spirit and leadership qualities with professional ethics, to excel in professional career and/or higher studies in Electrical Engineering	● Multidisciplinary Elective ● Open Elective

FIRST YEAR
NSQF LEVEL - 3

10. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Electrical engineers design, develop, test, and supervise the manufacturing of electrical equipment, such as electric motors, radar and navigation systems, communications systems, or power generation equipment. Electrical engineers also design the electrical systems of automobiles and aircraft.

The electrical engineers are the basic loop that keeps the circle of technology growth moving. India is one of the most fast-paced industrial countries in the world has made progress in the demand for electrical engineers whether in the public sector or private sector.
Students having the diploma in Electrical engineering experience and expansive skill set needed to design and operate electrical systems, such as circuitry, power station generators, flight systems, and computers.

The NSQF Level – 3 pass out students are expected to recall and demonstrate practical routine and repetitive skills, in narrow range of Electrical Engineering. In government and private sectors related to Electrical Engineering, "Semi Skilled workers" are required to carry out a limited range of predictable tasks under close supervision. They are normally expected to communicate clearly in speech and along with knowledge of arithmetic and algebraic processes.

Electrical diploma holder works in variety of environments including manufacturing facilities, government agencies and engineering firms. They have wide scope in Manufacturing Industry: Electrical Power Distribution and Maintenance, Maintenance of Industrial Electrical System, Repair and Maintenance of Electrical Machines and Equipment, Quality Control for Electrical systems, Electrical Safety Measures, Estimate for Electrical Installations

Government Departments such as Electricity Board, MES, PWD, Railways, Air bases, Airports, Defence, Thermal, Hydro and Nuclear Power Stations and other Boards and Corporations: Construction, erection and commissioning of lines and Sub-stations, Electrical Safety measures, Operation and Maintenance of Lines and Sub-stations/underground cables, Tariffs and Calculations of bills for consumption of electricity, Inventory Management, Repair and Maintenance of Electrical Machines/ Equipment, Assist in Operation and maintenance of Generating and sub-stations Hospitals, Commercial Complexes, Service Sector Organizations like Hotels, Tourist-Resorts, high-rise buildings, Cinema/Theater Halls etc: Layout of wiring circuit, planning and execution for Electrical Installation, Standby or captive Power Generation and its Distribution, Preventive maintenance of Electrical Systems of Lifts, Air-Conditioning Plants etc.

11. PROGRAMME OUTCOMES

The programme outcomes are derived from five domains of NSQF Level – 3 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Perform out a task which may require limited range of predictable activities related to the Electrical engineer.

PO2: Acquire knowledge of facts, process and principles related to Electrical engineering for sustainability and employment.

PO3: Demonstrate the ability to identify, formulate and analyze real-life electrical engineering problems.

PO4: Communicate accurately and appropriately and demonstrate professional behavior along with skill of basic arithmetic and algebraic principles, and basic understanding of social and natural environment.

PO5: Be responsible to perform task under close supervision with some responsibility withindefined limit.

12. STUDY AND EVALUATION SCHEME (FIRST YEAR)

FIRST SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
1.1	*English & Communication Skills-I	2	2	2+1=3	40	40	80	60	60	120	200
1.2	*Applied Mathematics - I	4	-	4+0=4	40	-	40	60	-	60	100
1.3	*Applied Physics -I	2	2	2+1=3	40	40	80	60	60	120	200
1.4	Principles of Electrical Engineering	3	4	3+2=5	40	40	80	60	60	120	200
1.5	*Fundamentals of IT	2	4	2+2=4	40	40	80	60	60	120	200
1.6	* Engineering Graphics	-	6	3	-	40	40	60	-	60	100
#Student Centred Activities (SCA)		-	4	-	-	-	-	-	-	-	-
Total		**13**	**22**	**22**	**200**	**200**	**400**	**360**	**240**	**600**	**1000**

* Common with other diploma programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

SECOND SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
2.1	* Applied Mathematics -II	4	-	4+0=4	40	-	40	60	-	60	100
2.2	*Applied Physics -II	2	2	2+1=3	40	40	80	60	60	120	200
2.3	Electrical Networks	3	4	3+2=5	40	40	80	60	60	120	200
2.4	Non-conventional Sources of Energy	2	2	2+1 = 3	40	40	80	60	60	120	200
2.5	*Environmental Studies and Disaster Management	2	-	2+0=2	40	-	40	60	-	60	100
2.6	Basic Electrical Workshop	-	8	0+4=4	-	40	40	-	60	60	100
#Student Centred Activities (SCA)		-	6	-	-	-	-	-	-	-	-
Total		**13**	**22**	**21**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

* Common with other diploma programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

Summer Industrial/In-house Training: After 2nd semester, students shall undergo Summer Training **of 4 Weeks.**

13. HORIZONTAL AND VERTICAL ORGANISATION OF SUBJECTS

Sr. No.	Subjects	Hours Per Week	
		First Semester	Second Semester
1.	English and Communication Skills - I	4	-
2.	Applied Mathematics - I	4	-
3.	Applied Physics - I	4	-
4.	Principles of Electrical Engineering	7	
5.	Fundamentals of IT	6	-
6.	Engineering Graphics	6	-
7.	Student Centered Activities	4	-
8.	Applied Mathematics-II	-	4
9.	Applied Physics - II	-	4
10.	Electrical Networks	-	7
11.	Non-conventional Sources of Energy	-	4
12.	Environmental Studies and Disaster Management	-	2
13.	Basic Electrical Workshop	-	8
14.	Student Centered Activities	-	6
	Total	**35**	**35**

14. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Perform out a task which may require limited range of predictable activities related to the Electrical engineer.	• Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry. • Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry. • Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy. • Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Acquire knowledge and understand the elements of electricity and DC circuits. • Remember the circuit elements and the laws governing the electrical circuits. • Acquire the concept of Electromagnetic Induction and its uses in engineering field.
PO2: Acquire knowledge of facts, process and principles related to Electrical engineering for sustainability and employment.	• Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry • Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem. • Explore the idea of location, graph, and linear relationships between two variables.

	• Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software. • Elaborate scientific work, energy and power, forms of friction and solve problems related to them. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Formulate the engineering problems into mathematical format with the use of differential equations and differential. • Use the differentiation and Integration in solving various Mathematical and Engineering problems. • Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data. • Acquire knowledge and understand the elements of electricity and DC circuits. • Comprehend the concept of Electrostatics and Magentostatics and apply the knowledge. • Explain the various batteries as storage devices and be aware of safe disposal of batteries. • Comprehend various renewable and non-renewable sources of energy. • Gain knowledge about working principle of various solar energy systems. • Acquire the detailed concepts of power generation with the wind energy, ocean energy, hydro, geothermal energy, tidal energy, fuel cell.

PO3: Demonstrate the ability to identify, formulate and analyze real-life electrical engineering problems.	• Apply the knowledge of basic circuital law and simplify the network. • Use various batteries as storage devices and be aware of safe disposal of batteries. • Draw Orthographic views of different objects viewed from different angles. • Draw and interpret sectional views of an object which are otherwise not visible in normal view. • Draw Isometric views of different solids and develop their surfaces. • Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances/ fittings. • Draw orthographic views of different objects by using basic commands of AutoCAD. • Characterize properties of material to prepare new materials for various engineering applications. • Demonstrate a strong foundation on Modern Physics to use at various technical and engineering applications. • Apply the basic principles and solve the A.C. series and parallel circuit. • Recognize the concept of Poly-phase system and compute the electrical parameters. • Identify electronics components like resistors, capacitors, diodes, transistors etc. • Detail the safety precautions and different tools and apply their skills for society. • Detect and rectify various types of faults in house wiring, and contactor control circuits.

	• Repair various domestic appliances and apply knowledge of earthing. • Perform wiring, testing and fault finding of the control circuit process. • Perform single phase and three phase supply and wiring system.
PO4: Communicate accurately and appropriately and demonstrate professional behavior along with skill of basic arithmetic and algebraic principles, and basic understanding of social and natural environment.	• Identify the nuances of Communication, both Oral and Written. • Acquire knowledge of the meaning of communication, communication process and speaking skills. • Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication. • Communicate effectively with an increased confidence to read, write and speak in English language fluently. • Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry. • Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry. • Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem. • Explore the idea of location, graph, and linear relationships between two variables. • Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers. • Handle the computer/laptop/mobiles/Internet Utilities and Install/Configure OS. • Assemble a PC and connect it to external devices.

	• Manage and Use Office practiced Automation Tools. • Develop worksheets and Prepare presentations. • Comprehend the importance of sustainable ecosystem. • Clarify interdisciplinary nature of environmental issues. • Describe corrective measures for the abatement of pollution. • Identify the role of non-conventional energy resources in environmental protection. • Recognize various types of disasters.
PO5: Be responsible to perform task under close supervision with some responsibility withindefined limit.	• Apply the knowledge of basic circuital law and simplify the network. • Use various batteries as storage devices and be aware of safe disposal of batteries. • Calculate the approximate area under a curve by applying integration and numerical methods. • Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data. • Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software. • Demonstrate a strong foundation on Modern Physics to use at various technical and engineering applications. • Comprehend the concept of Electrostatics and Magentostatics and apply the knowledge.

	• Acquire the concept of Electromagnetic Induction and its uses in engineering field • Explain the various batteries as storage devices and be aware of safe disposal of batteries. • Illustrate mesh, nodal methods, different network theorems and applying them to solve DC circuits. • Apply the basic principles and solve the A.C. series and parallel circuit. • Recognize the concept of Poly-phase system and compute the electrical parameters. • Develop basic design of bio gas plant. • Gain knowledge of different energy storage devices used in renewable energy resources • Know the safety precautions and different tools and apply their skills for society. • Detect and rectify various types of faults in house wiring, and contactor control circuits. • Repair various domestic appliances and apply knowledge of earthing • Perform wiring, testing and fault finding of the control circuits process • Perform single phase and three phase supply and wiring system.

FIRST SEMESTER

1.1	English & Communication Skill-I	12-14
1.2	Applied Mathematics-I	15-18
1.3	Applied Physics-I	19-22
1.4	Principles of Electrical Engineering	23-26
1.5	Fundamentals of IT	27-30
1.6	Engineering Graphics	31-33

1.1 ENGLISH & COMMUNICATION SKILLS – I

L	P
2	2

RATIONALE

Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life –personal, social and professional. This course is intended to break fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework. This course is designed to help students to acquire the concept of communication and develop an ability or skills to use them effectively to communicate with the individuals and community.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Identify the nuances of Communication, both Oral and Written.

CO2: Acquire knowledge of the meaning of communication, communication process and speaking skills.

CO3: Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication.

CO4: Communicate effectively with an increased confidence to read, write and speak in English language fluently.

DETAILED CONTENTS

UNIT I

Reading

1.1 Techniques of reading: Skimming and Scanning

1.2 Extensive and Intensive Reading: Textual Study

1.3 Homecoming – R.N. Tagore

1.4 Life Sketch of Sir Mokshagundam Visvesvarayya

1.5 Life Sketch of Dr. Abdul Kalam

1.6 Narayan Murthy's speech at LBSNA, Dehradun

UNIT II

Fundamentals of Communication

2.1 Concept and Process of Communication

2.2 Types of Communication (Verbal Communication)

2.3 Barriers to Communication
2.4 Speaking Skill: Significance and essentials of Spoken Communication
2.5 Listening Skill: Significance and essentials of Listening

UNIT III

Grammar and Usage

3.1 Nouns
3.2 Pronouns
3.3 Articles
3.4 Verbs(Main and Auxiliary)
3.5 Tenses

UNIT IV

Writing Skills

4.1 Significance, essentials and effectiveness of Written Communication
4.2 Notice Writing
4.3 Official Letters and E-mails.
4.4 Frequently-used Abbreviations used in Letter-Writing
4.5 Paragraph Writing
4.6 Netiquettes

PRACTICAL EXERCISES

1. Reading

Reading Practice of lessons in the Lab Activity classes.

i. Comprehension exercises of unseen passages along with the lessons prescribed.
ii. Vocabulary enrichment and grammar exercises based on the selected readings.
iii. Reading aloud Newspaper headlines and important articles.

2. Fundamentals of Communication

i. Introducing oneself, others and leave- taking(talking about yourself)
ii. Just a minute (JAM) sessions: Speaking extempore for one minute on given topics
iii. Situational Conversation: Offering-Responding to offers; Congratulating; Apologizing and Forgiving; Complaining; Talking about likes and dislikes, Self-introduction Mock Interviews

3. Grammar and Usage

i. Written and Oral Drills will be undertaken in the class to facilitate holistic linguistic competency among learners.
ii. Exercises on the prescribed grammar topics.

4. Writing Skills

i. Students should be given Written Practice in groups so as to inculcate team-spirit and collaborative learning .
ii. Group exercises on writing paragraphs on given topics.
iii. Opening an e-mail account, receiving and sending emails

RECOMMENDED BOOKS

1) Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 2", M/S Abhishek Publications, Chandigarh.
2) V Sasikumar & PV Dhamija, "Spoken English", Tata MC Graw Hills, New Delhi, Second Edition.
3) JK Gangal, "A Practical Course in Spoken English", PHI Learning Pvt. Ltd., New Delhi.
4) NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5) RC Sharma and Krishna Mohan, "Business Correspondence & Report writing", Tata MC Graw Hills, New Delhi, Fourth Edition.
6) Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
7) Nira Konar, "Communication Skills for professionals", PHI Learning Pvt. Ltd., New Delhi.
8) Krishna Mohan & Meera Banerji, "Developing Communication Skills", Macmillan Publishers India Ltd., New Delhi, Second Edition
9) M. Ashraf Rizwi, "Effective Technical Communication", Tata MC Graw Hills, New Delhi.
10) Andrea J Rutherfoord, "Basic Communication Skills for Technology", Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced as exercises in the Lab regularly for development of communication skills in the students. The students should be involved in activities to enhance their personality skills. This subject contains four units of equal weightage.

1.2 APPLIED MATHEMATICS - I

L	P
4	-

RATIONALE

Contents of this course provide fundamental base for understanding engineering problems and their solution algorithms. Contents of this course will enable students to use basic tools like logarithm, binomial theorem, matrices, t-ratios and co-ordinates for solving complex engineering problems with exact solutions in a way which involve less computational task. By understanding the logarithm, they will be able to make long calculations in short time and it is also a pre-requisite for understanding Calculus.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry.

CO2: Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry

CO3: Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem.

CO4: Explore the idea of location, graph, and linear relationships between two variables.

CO5: Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

DETAILED CONTENTS

UNIT I

Algebra

1.1 Complex Numbers: definition of complex number, real and imaginary parts of a complex number, Polar and Cartesian Form and their inter conversion, Conjugate of a complex number, modulus and amplitude, addition subtraction, multiplication and division of complex numb

1.2 Logarithms and its basic properties

UNIT II

Binomial Theorem, Determinants and Matrices

2.1 Meaning of ${}^{n}P_{r}$ & ${}^{n}C_{r}$ (mathematical expression). Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion up to 3 terms - without proof), first binomial approximation with application to engineering problems.

2.2 Determinants and Matrices – Evaluation of determinants (upto 2nd order), solution of equations (upto 2 unknowns) by Crammer's rule, definition of Matrices and its types, addition, subtraction and multiplication of matrices (upto 2nd order).

UNIT III

Trigonometry

3.1 Concept of angle, measurement of angle in degrees, grades, radians and their conversions.

3.2 T-Ratios of Allied angles (without proof), Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa

3.3 Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.

UNIT-IV

Co-ordinate Geometry

4.1 Cartesian and Polar co-ordinates (two dimensional), Distance between two points, mid-point, centroid of vertices of a triangle.

4.2 Slope of a line, equation of straight line in various standards forms (without proof); (slope intercept form, intercept form, one-point form, two-point form, symmetric form, normal form, general form), intersection of two straight lines, concurrency of lines, angle between straight lines, parallel and perpendicular lines, perpendicular distance formula, conversion of general form of equation to the various forms.

UNIT V

Geometry of Circle and Software

Circle

5.1 General equation of a circle and its characteristics. To find the equation of a circle, given:

i. Centre and radius
ii. Three points lying on it
iii. Coordinates of end points of a diameter

Software

5.2 **MATLAB Or SciLab software –** Theoretical Introduction, MATLAB or Scilab as Simple Calculator (Addition and subtraction of values –Trigonometric and Inverse Trigonometric functions) – General Practice

RECOMMENDED BOOKS

1. R. D. Sharma, "Applied Mathematics – I & II for Diploma Courses", Dhanpat Rai Publications.
2. "Mathematics for Class XI", NCERT Publication, New Delhi.
3. "Mathematics for Class XII", NCERT Publication, New Delhi.
4. H. K Dass, "Applied Mathematics for Polytechnics", CBS Publishers & Distributers.
5. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics – I", CBS Publisher, New Delhi.
6. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –II", CBS Publisher, New Delhi.
7. G. B. Thomas, R. L. Finney, "Calculus and Analytic Geometry", Addison Wesley, Ninth Edition.
8. B S Grewal, "Elementary Engineering Mathematics", Khanna Publishers, Delhi, Thirty-fifth Edition.
9. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, Second Edition, 2003.
10. SS Sabharwal & Dr Sunita Jain, "Applied Mathematics Vol. I & II", Eagle Parkashan, Jalandhar.
11. S Kohli, "Engineering Mathematics Vol. I & II", IPH, Jalandhar.
12. Reena Garg & Chandrika Prasad, "Advanced Engineering Mathematics", Khanna Publishing House, New Delhi
13. R. Pratap, "Getting Started with MATLAB 7", Oxford University Press, Seventh Edition.
14. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://www.scilab.org

INSTRUCTIONAL STATREGY

This is theoretical subject and contains five units of equal weight age.

Basic elements of algebra, trigonometry and co-ordinate geometry can be taught in the light of their applications in the field of engineering and technology. By laying more emphasis on applied part, teacher can also help in providing a good continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics related to Algebra, Trigonometry and Coordinate Geometry that the industry requires. Examples to be used should be related to engineering.

Useful software MATLAB or open source software SciLab can be taught theoretically by books/online literatures and basic operations can be shown practically with practical software laboratory or small mobile apps of these software or authentic Trial version of MATLAB/ SciLab software. Students should be able to relate to the actual use of these examples and the way mathematical calculations will help them in doing their job.

1.3 APPLIED PHYSICS-I

L	P
2	2

RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various fields of technical are given prominence in the course content.

COURSE OUTCOMES

After completing this subject, student should be able to:

CO1: Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy.

CO2: Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications.

CO3: Elaborate scientific work, energy and power, forms of friction and solve problems related to them.

CO4: Comprehend properties of matter and effect of temperature on various matter and phenomenon.

CO5: Demonstrate the use of physical principles and analysis in various fields of technology.

DETAILED CONTENTS

UNIT I

Unit and Dimensions

1.1 Definition of Physics, physical quantities- fundamental and derived

1.2 Units: fundamental and derived

1.3 System of units: CGS, FPS, MKS, SI

1.4 Dimension, dimensional formulae and SI units of physical quantities-distance, displacement, area, volume, density, velocity, acceleration, linear momentum, force, impulse, work, power, energy, pressure, surface tension, stress, strain)

1.5 Dimensional equations, principle of homogeneity of dimensional equation

1.6 Application of dimensional analysis: checking the correctness of physical equation, conversion of system of unit (force, work, acceleration)

UNIT II

Force and Motion

2.1 Scalar and vector quantities– definition and examples, representation of vector, types of vector (unit vector, position vector, co-initial vector, collinear vector, co-planar vector)

2.2 Vector algebra- addition of vectors, Triangle & Parallelogram law (statement and formula only),

2.3 Scalar and vector product (statement and formula only)

2.4 Force and its units, resolution of force (statement and formula only)

2.5 Newton's laws of motion (statement and examples)

2.6 Linear momentum, Law of conservation of linear momentum (statement and examples), Impulse

2.7 Circular motion: definition of angular displacement, angular velocity, angular acceleration, frequency, time period; Relation between linear and angular velocity, centripetal and centrifugal forces (definition and formula only), application of centripetal force in banking of road

2.8 Rotational motion: definition with examples

2.9 Definition of torque, angular momentum, moment of inertia and its physical significance

UNIT III

Work, Power and Energy

3.1 Work- definition, symbol, formula and SI unit, types of work (zero work, positive work and negative work) with example

3.2 Friction– definition and its simple daily life applications

3.3 Power- definition, formula and units

3.4 Energy- definition and its SI unit, examples of transformation of energy.

3.5 Kinetic energy- definition, examples, formula and its derivation

3.6 Potential energy- definition, examples, formula and its derivation

3.7 Law of conservation of mechanical energy for freely falling bodies (with derivation)

3.8 Simple numerical problems based on formula of Power and Energy

UNIT IV

Properties of Matter

4.1 Elasticity and plasticity- definition, deforming force, restoring force, example of elastic and plastic body

4.2 Definition of stress and strain, Hooke's law, modulus of elasticity

4.3 Pressure- definition, atmospheric pressure, gauge pressure, absolute pressure, Pascal's law

4.4 Surface tension- definition, SI unit, applications of surface tension, effect of temperature on surface tension

4.5 Viscosity: definition, unit, examples, effect of temperature on viscosity

UNIT V

Heat and Temperature

5.1 Definition of heat and temperature (on the basis of kinetic theory)

5.2 Difference between heat and temperature

5.3 Principle and working of mercury thermometer

5.4 Modes of transfer of heat- conduction, convection and radiation with examples.

5.5 Properties of heat radiation

5.6 Different scales of temperature and their relationship

PRACTICAL EXERCISES

1. Familiarization of measurement instruments and their parts (for example - vernier calliper, screw gauge, spherometer, travelling microscope etc.), and taking a reading. (compulsory to all students)
2. To find diameter of solid cylinder using a vernier calliper
3. To find internal diameter and depth of a beaker using a vernier calliper and hence find its volume.
4. To find the diameter of wire using screw gauge
5. To find thickness of paper using screw gauge.
6. To determine the thickness of glass strip using a spherometer
7. To determine radius of curvature of a given spherical surface by a spherometer.
8. To verify parallelogram law of force
9. To determine the atmospheric pressure at a place using Fortin's Barometer
10. To determine force constant of spring using Hooke's law
11. Measuring room temperature with the help of thermometer and its conversion in different scale.

RECOMMENDED BOOKS

1. "Text Book of Physics for Class XI (Part-I, Part-II)", N.C.E.R.T., Delhi.
2. Dr. HH Lal, "Applied Physics, Vol. I and Vol. II", TTTI Publications, Tata McGraw Hill, Delhi.
3. AS Vasudeva, "Applied Physics – I", Modern Publishers, Jalandhar.
4. R A Banwait, "Applied Physics – I", Eagle Prakashan, Jalandhar.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.

6. C. L. Arora, “Practical Physics”, S Chand Publication.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. The Physics Classroom
3. https://www.khanacademy.org/science/physics

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students. Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

1.4 PRINCIPLES OF ELECTRICAL ENGINEERING

L	P
3	4

RATIONALE

This is a basic technology subject. This subject will help the students to develop certain technology related skill. This subject includes DC, magnetism, electromagnetism etc. This is one of the important core engineering subjects for electrical engineers. The main objective of this subject is to enhance the basic knowledge and skill. Learning of this course will also help the students to understand the basics of electrical engineering i. e. basic concept in electrical & magnetic circuits.

COURSE OUTCOMES

At the end of this subject, the student will be able to:

CO1: Acquire knowledge and understand the elements of electricity and DC circuits.
CO2: Remember the circuit elements and the laws governing the electrical circuits.
CO3: Comprehend the concept of Electrostatics and Magentostatics and apply the knowledge.
CO4: Acquire the concept of Electromagnetic Induction and its uses in engineering field.
CO5: Explain the various batteries as storage devices and be aware of safe disposal of batteries.

DETAILED CONTENTS

UNIT I

Electrical Fundamentals

1.1 Nature of Electricity, Charge, free electrons, Electric potential and potential difference, Electric current, Electrical Energy, Electrical power and their unit.

1.2 Resistance: Definition, Unit, Laws of resistance, conductivity and resistivity, Effect of temperature on resistance, Temperature coefficient of resistance, Types of resistance & their applications, Color coding of resistance.

1.3 Rating and wattages of Electrical appliances, heating effect of Electrical current.

1.4 Introduction to Capacitors, capacitance, Variable capacitor, Factors affecting capacitance of a capacitor.

1.5 Capacitance of parallel plate capacitor

1.6 Grouping of capacitors: capacitors in series, parallel, series-parallel.

1.7 Energy stored in capacitor, Charging and discharging of a capacitor.

UNIT II

DC Circuits

2.1 Ohm's law with practical implementation.

2.2 Definition of DC circuit, types of DC circuits: series circuit, parallel circuit, series-parallel circuit.

2.3 Concept of voltage source & current source, connections and their conversions.

2.3 Wheatstone Bridge.

2.4 Kirchhoff's Laws-KVL and KCL.

2.5 Star – Delta connections and their conversion.

UNIT III

Electrostatics & Magnetostatics

3.1 Concepts of Electrostatics, Coulomb's law.

3.2 Concept of magnetism, Magnetic field, Magnetic lines of force

3.3 Definition of Electromagnetism, magnetic effect of electric current, direction of magnetic field and current: right hand rule, right hand cork screw rule.

3.4 Magnetic field due to circular coil, solenoid,

3.5 Current carrying conductors in a magnetic field and methods to find its direction, applications.

3.6 Force between two parallel current carrying conductors. Analogy between electric and magnetic circuit. Definition of Magnetic circuit, terms related to magnetic circuits: magneto-motive force (MMF), flux, magnetic flux density, reluctance, permeability, field intensity, relation between magnetic flux density, permeability, field intensity.

UNIT IV

Electro-Magnetic Induction

4.1 Determination of Ampere Turns, Series & parallel magnetic circuits, Concept of magnetic leakage, useful flux & Air Gap.

4.2 Magnetic curve (B-H curve) - cause of Hysteresis, Hysteresis loss, significance of Hysteresis loss, magnetic hysteresis loop for hard and soft magnetic materials.

4.3 Faraday's laws of electro-magnetic induction.

4.4 Direction of Induced emf and current: Lenz's law, Fleming's right Hand rule

4.5 E.M.F induced in a conductor: Dynamically induced emf, Statically induced emf: Self-induced emf and Mutual induced emf, Expression for self-inductance, mutual inductance.

4.6 Energy stored in an Inductor, Eddy currents, Eddy current losses.

UNIT V

Batteries

5.1 Electrolysis, Faradays law of electrolysis, important terms related to electrolysis, electroplating.

5.2 Concept of Cell: definition, emf of cell, internal resistance of cell, terminal potential of cell, types of cell (primary and secondary cell), grouping of cell (series grouping, parallel grouping, series-parallel grouping).

5.3 Concept of Battery: Definition, types of battery like Lead-Acid, Nickel-Cadmium, Lithium ion batteries with their Construction, working principle and applications.

5.4 Charging methods of storage battery and charging indications.

5.5 Characteristics of battery: voltage, capacity, efficiency

5.6 Care and maintenance of battery

5.7 Introduction to maintenance free batteries.

5.8 Disposal of batteries

PRACTICAL EXERCISES

1. Familiarization of basic components/equipment like ammeter, voltmeter, watt meter, resistance, capacitor, inductor, energy meter, power factor meter, CRO, multi-meter etc and their operation, uses .
2. Determine the value of resistance using colour coding method.
3. Observation of change in resistance of a bulb in hot and cold conditions, using voltmeter and ammeter.
4. To charge and discharge a capacitor and to show the graph on C.R.O.
5. Verification of laws of capacitors in series and parallel.
6. To verify ohm's law by drawing a graph between voltage and current.
7. Verification of Kirchhoff’s Current Law in a dc circuit.
8. Verification of Kirchhoff’s Voltage Laws in a dc circuit.
9. Measurement of current and voltage in series resistive circuit.
10. Measurement of current and voltage in parallel resistive circuit.
11. To find the ratio of inductance of a coil having air-core and iron-core respectively and to observe the effect of introduction of a magnetic core on coil inductance.
12. Verification of Faraday's law of electromagnetic induction.
13. To obtain BH curve of a magnetic material.
14. Demonstration of parts of a battery and find the specific gravity of battery.
15. Demonstration of charging and discharging of Battery and measure the terminal voltage during charging and discharging condition.

RECOMMENDED BOOKS

1. B. L. Theraja and A. K. Theraja, “ABC of Electrical Engineering”, S Chand Publishers, New Delhi, 2014 Edition.
2. S. K. Bhattacharya, “Basic Electrical and Electronics Engineering”, Pearson Education India, 2012 Edition.
3. DP Kothari and Nagrath, “Basic Electric Engineering”, Tata McGraw Hill, 2009.
4. V. Mittle and Arvind Mittle, “Basic Electrical Engineering”, Mc Graw Hill Companies, 2005 Edition.
5. V. K. Mehta & Rohit Mehta, “Basic Electrical Engineering”, S. Chand & Co, 2006.
6. Tarlok Singh, “Fundamentals of Electrical Engineering”, S. K. Kataria & Sons, 2020.
7. SK Bhattacharya, KM Rastogi, “Experiments in Basic Electrical Engineering”, New Age International (P) Ltd. Publishers, New Delhi, 2011.

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

1. Teachers may take help of various models and charts, you-tubes video's, e-learning resources while studying the contents of the subject to the students so that the concepts should be clear. More emphasis should be laid on discussing and explaining practical applications.
2. Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles.
3. Preparing students to apply the technological method of problem solving to a real life problems. This quality is buildup in the students when students practice the numerical problems of the subject. Teachers should motivate students to solve the numerical problems of subject. Teachers must ask 30% of numerals problems in sessional test and final semester exam of this subject.
4. Teachers should expose to different learning tools used in respective labs, Operational safety and Procedure to be followed in the laboratory. Students may ask to make micro projects by using the idea as learning in the subject.
5. Activity- Theory - Demonstrate/practice approach may be followed throughout the courses so that learning may be skill and employ-ability based.
6. Teachers take assignments, seminar, quiz, viva-voce etc. to enhance the learning ability of the students.
7. Students must have to perform at least 12 experiment in the laboratory.

1.5 FUNDAMENTALS OF IT

L	P
2	4

RATIONALE

Information technology has great influence on all aspects of life. Almost all work places and living environment are being computerized. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concepts of information technology and its scope, operating a computer: use of various office management tools, using internet and mobile applications etc. This course is intended to make new students comfortable with computing environment - Learning basic computer skills, learning basic application software tools, Understanding Computer Hardware, Cyber security awareness.

COURSE OUTCOMES

At the end of the subject student will be able to:

CO1: Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers
CO2: Handle the computer/laptop/mobiles/Internet Utilities and Install/Configure OS
CO3: Assemble a PC and connect it to external devices
CO4: Manage and Use Office practiced Automation Tools
CO5: Develop worksheets and Prepare presentations

DETAILED CONTENTS

UNIT I

Basics of Computer

Brief history of development of computers, Definition of Computer, Block diagram of a Computer, Hardware, Software, Booting: Cold and Hot Booting, Interaction between the CPU and Memory with Input/Output devices, Function of CPU and major functional parts of CPU.

Memory, Bit, Nibble, Byte, KB, MB, GB, TB, PB, Functions of memory, Use of storage devices in a Computer, List types of memory used in a Computer, Importance of cache memory, CPU speed and CPU word length

UNIT II

Basic Internet Skills

Understanding browser, Introduction to WWW, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals. Advantages of Email, Various email service providers, Creation of email id, sending and receiving emails, attaching documents with email and drive.

Effective use of Gmail, G-Drive, Google Calendar, Google Sites, Google Sheets, Online mode of communication using Google Meet & WebEx.

UNIT III

Basic Logic building

Introduction to Programming, Steps involved in problem solving, Definition of Algorithm, Definition of Flowchart, Steps involved in algorithm development, differentiate algorithm and flowchart, symbols used in flowcharts, algorithms for simple problems, flowcharts for simple problems, Practice logic building using flowchart/algorithms

UNIT IV

Office Tools

Office Tools like LibreOffice/OpenOffice/MSOffice.

OpenOffice Writer – Typesetting Text and Basic Formatting, Inserting Images, Hyperlinks, Bookmarks, Tables and Table Properties in Writer

Introducing LibreOffice/OpenOffice *Calc*, Working with Cells, Sheets, data, tables, using formulae and functions, using charts and graphics.

OpenOffice Impress – Creating and Viewing Presentations, Inserting Pictures and Tables, Slide Master and Slide Design, Custom Animation.

UNIT V

Use of Social Media

Introduction to Digital Marketing – Why Digital Marketing, Characteristics of Digital Marketing, Tools for Digital Marketing, , Effective use of Social Media like LinkedIn, Google+, Facebook, Twitter, etc.: Features of Social media, Advantages and Disadvantages of Social Media.

PRACTICAL EXERCISES

1. Browser features, browsing, using various search engines, writing search queries
2. Visit various e-governance/Digital India portals, understand their features, services offered
3. Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognize various ports/interfaces and related cables, etc.
4. Using Administrative Tools/Control Panel Settings of Operating Systems

5. Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6. Explore features of Open Office tools and MS-Office, create documents, create presentation, create spread sheet, using these features, do it multiple times
7. Working with Conversion Software like pdfToWord, WordToPPT, etc.
8. Working with Mobile Applications – Searching for Authentic Mobile app, Installation and Settings, Govt. of India Mobile Applications
9. Creating email id, sending and receiving mails with attachments.
10. Using Google drive, Google calendar
11. Create Flow chart and Algorithm for the following

i. Addition of n numbers and display result
ii. To convert temperature from Celsius to Fahrenheit
iii. To find Area and Perimeter of Square
iv. Swap Two Numbers
v. find the smallest of two numbers
vi. Find whether given number is Even or Odd
vii. To print first n even Numbers
viii. find sum of series 1+2+3+…..+N
ix. print multiplication Table of a number
x. generate first n Fibonacci terms 0,1,1,2,3,5…n (n>2)
xi. sum and average of given series of numbers
xii. Factorial of number n (n!=1x2x3x…n)
xiii. Armstrong Number
xiv. Find whether given number is Prime or not

RECOMMENDED BOOKS

1. R.S. Salaria, “Computer Fundamentals”, Khanna Publishing House.
2. Ramesh Bangia, “PC Software Made Easy – The PC Course Kit”, Khanna Publishing House.
3. Online Resources, Linux man pages, Wikipedia
4. Mokhtar Ebrahim and Andrew Mallett, “Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming”.
5. Vikas Gupta, “Comdex Hardware and Networking Course Kit” Dream Tech press, New Delhi, 2008.
6. Sumitabha Das, “UNIX concepts and applications” Tata McGraw Hill, New Delhi, 2008, Fourth Edition.

SUGGESTED WEBSITES

1. https://nptel.ac.in/courses/106/106/106106222/ - NPTEL Course on Modern Application Development
2. https://onlinecourses.swayam2.ac.in/aic19_de01/preview -
3. https://spoken-tutorial.org/ - Tutorials on Introduction to Computers, HTML, LibreOffice Tools, etc.
4. NOTEPAD++
5. https://tms-outsource.com/blog/posts/web-development-ide/

INSTRUCTIONAL STRATEGY

This is a skill based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weight age.

1.6 ENGINEERING GRAPHICS

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RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawings is their day to day responsibility. The subject is aimed at developing basic graphic skills in the students so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation. The emphasis, while imparting instructions, should be to develop conceptual skills in the students following BIS SP 46 – 1988.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Draw Orthographic views of different objects viewed from different angles.

CO2: Draw and interpret sectional views of an object which are otherwise not visible in normal view.

CO3: Draw Isometric views of different solids and develop their surfaces.

CO4: Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances /fittings.

CO5: Draw orthographic views of different objects by using basic commands of AutoCAD.

DETAILED CONTENTS

UNIT I

1. Introduction to Engineering Drawing and Graphics

1.1 Introduction to use and care of drawing instruments, drawing materials, layout and sizes of drawing sheets and drawing boards.

1.2 Symbols and conventions-

a) Conventions of Engineering Materials, Sectional Breaks and Conventional lines.
b) Civil Engineering Sanitary fitting symbols
c) Electrical fitting symbols for domestic interior installations.

1.3 Geometrical construction-geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagons, pentagons bisecting a line and arc , division of line and circle with the help of drawing instruments.

2. Technical Lettering of Alphabet and Numerals

Definition and classification of lettering, Free hand (of height of 5,8,12 mm) and instrumental lettering (of height 20 to 35 mm): upper case and lower case, single and double stroke, vertical

and inclined (Gothic lettering) at 75 degree to horizontal and with suitable height to width ratio 7:4.

3. Dimensioning

3.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions).

3.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., countersunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches.

4. Scales

4.1 Scales –Needs and importance (theoretical instructions), Type of scales, Definition of Representative Fraction (R.F.) and Length of Scale.

4.2 To draw/construct plain and diagonal scales.

UNIT II

1. Orthographic Projections

1.1 Theory of orthographic projections (Elaborate theoretical instructions).

1.2 Three views of orthographic projections of different objects of given pictorial view of a block in 1st and 3rd angle.

1.3 Projection of Points in different quadrant

1.4 Projection of Straight Line (1^{st} angle)

i. Line parallel to both the planes.

ii. Line perpendicular to any one of the reference plane and parallel to others

iii. Line inclined to any one of the references and parallel to another plane.

1.5 Projection of Plane – Different lamina like square rectangular, triangular, circle and Hexagonal pentagon. Trace of planes (HT and VT).

1.6 Identification of surfaces.

2. Sectioning

2.1 Importance and salient features

2.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections (theoretical only).

2.3 Orthographic sectional views of different objects.

UNIT III

1. Introduction of projection of right solids such as prism & pyramid (square, Pentagon, Hexagonal) cube, cone & cylinder (Axes perpendicular to H.P and parallel to V.P.)

2. Introduction of sections of right solids - Section planes, Sections of Hexagonal prism, pentagon pyramid, cylinder and cone (Section plane parallel to anyone reference planes and perpendicular to V.P. and inclined to H.P.)

3. Development of Surfaces – Development of lateral surfaces of right solids like cone, cylinder, pentagonal prism, pyramid and hexagonal pyramid (Simple problems)

UNIT IV

Isometric Views

1. Fundamentals of isometric projections and isometric scale.
2. Isometric views of different laminas like circle, pentagon and hexagon.
3. Isometric views of different regular solids like cylinder, cone, cube, cuboid, pyramid and prism.
4. Isometric views from given different orthographic projections(front, side and top view)

UNIT V

Introduction to AutoCAD

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets of different objects on AutoCAD (given pictorial/isometric view of a block). AutoCAD skill of student is evaluated in internal assessment only not in external exam.

RECOMMENDED BOOKS

1. A Text Book of Engineering Drawing by Surjit Singh; Dhanpat Rai & Co.,Delhi
2. Engineering Drawing by PS Gill; SK Kataria & Sons, NewDelhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt;Charotar Publishing House Pvt. Ltd.,Anands
4. Engineering Drawing and Graphics using AutoCAD by T. Jeyapoovan,Vikas Publishing House Pvt, Ltd Noida.
5. A Text Book of Engineering Drawing by S.R.Singhal and O.P.Saxena, Asian Publisher, Delhi
6. Engineering Drawing by RB Gupta, Satya Prakashan, New Delhi

INSTRUCTIONAL STRATEGY

Teacher should show model of realia of the component/part whose drawing is to be made. Emphasis should be given on cleanliness, dimensioning and layout of sheet. Focus should be on proper selection of drawing instruments and their proper use. First angle projection is to be followed. Minimum of 20 sheets to be prepared and at least 2 sheets on AutoCAD**.** Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students. This subject contains five units of equal weight age.

SECOND SEMESTER

2.1 APPLIED MATHEMATICS – II

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RATIONALE

Applied mathematics forms the backbone of engineering students. Basic elements of Differential calculus, Integral calculus and Differential Equations have been included in this course. This will develop analytical abilities to apply in engineering field and will provide continuing educational base to the students.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Formulate the engineering problems into mathematical format with the use of differential equations and differential

C02: Use the differentiation and Integration in solving various Mathematical and Engineering problems.

CO3: Calculate the approximate area under a curve by applying integration and numerical methods.

CO4: Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data.

CO5: Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

DETAILED CONTENTS

UNIT I

Differential Calculus

1.1 Definition of function; Concept of limits (Introduction only) and problems related to four standard limits only.

1.2 Differentiation of x^n, sin x, cos x, e^x by first principle.

1.3 Differentiation of sum, product and quotient of functions.

UNIT II

Differential Calculus and Its Applications

2.1 Differentiation of trigonometric functions, inverse trigonometric functions. Logarithmic differentiation, successive differentiation (upto 2nd order)

2.2 Application of differential calculus in:

(a) Rate measures (b) Maxima and minima

UNIT III

Integral Calculus

3.1 Integration as inverse operation of differentiation with simple examples.

3.2 Simple standard integrals and related problems, Integration by Substitution method and Integration by parts.

3.3 Evaluation of definite integrals with given limits.

Evaluation of $\int_0^{\pi/2} \sin^n x.\, dx$, $\int_0^{\pi/2} \cos^n x\, dx$, $\int_0^{\pi/2} \sin^m x\, \cos^n x\, dx$

using formulae without proof (m and n being positive integers only) using pre-existing mathematical models.

UNIT IV

Application of Integration, Numerical Integration and Differential Equations

4.1 Applications of integration: for evaluation of area under a curve and axes (Simple problems).

4.2 Numerical integration by Trapezoidal Rule and Simpson's $1/3^{rd}$ Rule using pre-existing mathematical models.

Differential Equations

4.3 Definition, order, degree, Type of differential Equations, linearity, Formulation of ordinary differential equation (up to 1^{st} order), solution of ODE (1^{st} order) by variable separation method.

UNIT V

Statistics and Software

Statistics

5.1 Measures of Central Tendency: Mean, Median, Mode

5.2 Measures of Dispersion: Mean deviation, Standard deviation

Software

5.3 SciLab software – Theoretical Introduction.

5.4 Basic difference between MATLAB and SciLab software,

5.5 Calculations with MATLAB or ScilLab - (a) Representation of matrix (2×2 order), (b) Addition, Subtraction of matrices (2×2 order) in MATLAB or SciLab

RECOMMENDED BOOKS

1. R. D. Sharma, "Applied Mathematics – I & II for Diploma Courses", Dhanpat Rai Publications.
2. "Mathematics for Class XI", NCERT Publication, New Delhi.
3. "Mathematics for Class XII", NCERT Publication, New Delhi.
4. H. K Dass, "Applied Mathematics for Polytechnics", CBS Publishers & Distributers.
5. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –I", CBS Publisher, New Delhi.
6. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –II", CBS Publisher, New Delhi.
7. G. B. Thomas, R. L. Finney, "Calculus and Analytic Geometry", Addison Wesley, Ninth Edition.
8. B S Grewal, "Elementary Engineering Mathematics", Khanna Publishers, Delhi, Thirty-fifth Edition.
9. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics" Narosa Publishing House, New Delhi, Second Edition, 2003.
10. SS Sabharwal & Dr Sunita Jain, "Applied Mathematics Vol. I & II", Eagle Parkashan, Jalandhar.
11. S Kohli, "Engineering Mathematics Vol. I & II", IPH, Jalandhar.
12. Reena Garg & Chandrika Prasad, "Advanced Engineering Mathematics", Khanna Publishing House, New Delhi.
13. R. Pratap, "Getting Started with MATLAB 7", Oxford University Press, Seventh Edition.
14. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. https://www.scilab.org
2. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

This is theoretical subject and contains five units of equal weight age.

Basic elements of Differential Calculus, Integral Calculus, and Differential Equations can be taught in the light of their applications in the field of engineering and technology. By laying more stress on applied part, teachers can also help in providing continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts

through multiple problem solving based on the topics that the industry requires. For example they need to know how to use mathematical models that use integration as opposed to learning how integration can be used. Useful authenticated software MATLAB or open source software SciLab can be taught theoretically by books/online literatures and basic operations can be shown practically with practical software laboratory or small mobile apps of these software or authentic Trial version of MATLAB/ SciLab software. Diploma students need to know which tools to use and how to do the job.

2.2 APPLIED PHYSICS-II

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RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various technical fields are given prominence in the course content to prepare students for various technical applications.

COURSE OUTCOMES

At the end of this subject, the students will be able to:

CO1: Differentiate between types of waves and their motion.
CO2: Illustrate laws of reflection and refraction of light.
CO3: Demonstrate competency in phenomena of electrostatics and electricity.
CO4: Characterize properties of material to prepare new materials for various technical applications.
CO5: Demonstrate a strong foundation on Modern Physics to use at various technical applications.

DETAILED CONTENTS

UNIT I

Wave Motion and its Applications

1.1 Waves: definition, types (mechanical and electromagnetic wave)
1.2 Wave motion- transverse and longitudinal with examples, terms used in wave motion like displacement, amplitude, time period, frequency, wavelength, wave velocity; relationship among wave velocity, frequency and wave length
1.3 Simple harmonic motion (SHM): definition, examples
1.4 Cantilever: definition, formula of time period (without derivation)
1.5 Free, forced and resonant vibrations with examples
1.6 Sound waves: types (infrasonic, audible, ultrasonic) on the basis of frequency, noise, coefficient of absorption of sound, echo

UNIT II

Optics

2.1 Reflection and refraction of light with laws, refractive index

2.2 Lens: introduction, lens formulae (no derivation), power of lens and simple numerical problems

2.3 Total internal reflection and its applications, critical angle and conditions for total internal reflection

2.4 Superposition of waves (concept only), definition of Interference, Diffraction and Polarization of waves

2.5 Introduction to Microscope, Telescope and their applications

UNIT III

Electrostatics and Electricity

3.1 Electric charge, unit of charge, conservation of charge

3.2 Coulomb's law of electrostatics

3.3 Electric field, electric lines of force (definition and properties), electric field intensity due to a point charge

3.4 Definition of electric flux, Gauss law (statement and formula)

3.5 Capacitor and capacitance (with formula and unit)

3.6 Electric current and its SI Unit, direct and alternating current

3.7 Resistance, conductance (definition and unit)

3.8 Series and parallel combination of resistances

3.9 Ohm's law (statement and formula)

UNIT IV

Classification of Materials and their Properties

4.1 Definition of energy level, energy bands

4.2 Types of materials (conductor, semiconductor, insulator and dielectric) with examples, intrinsic and extrinsic semiconductors (introduction only)

4.3 Introduction to magnetism, type of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials with examples

4.4 Magnetic field, magnetic lines of force, magnetic flux

4.5 Electromagnetic induction (definition)

UNIT V

Modern Physics

5.1 Laser: introduction, principle, absorption, spontaneous emission, stimulated emission, population inversion

5.2 Engineering and medical applications of laser

5.3 Fibre optics**:** introduction to optical fibers (definition, principle and parts), light propagation, fiber types (mono-mode, multi-mode), applications in medical, telecommunication and sensors

5.4 Nanotechnology: introduction, definition of nanomaterials with examples, properties at nanoscale, applications of nanotechnology (brief)

PRACTICAL EXERCISES

1. Familiarization with apparatus (resistor, rheostat, key, ammeter, voltmeter, telescope, microscope etc.)
2. To find the time period of a simple pendulum.
3. To study variation of time period of a simple pendulum with change in length of pendulum.
4. To determine and verify the time period of Cantilever.
5. To verify Ohm's laws by plotting a graph between voltage and current.
6. To study colour coding scheme of resistance.
7. To verify laws of resistances in series combination.
8. To verify laws of resistance in parallel combination.
9. To find resistance of galvanometer by half deflection method.
10. To verify laws of reflection of light using mirror.
11. To verify laws of refraction using glass slab.
12. To find the focal length of a concave lens, using a convex lens.

RECOMMENDED BOOKS

1. "Text Book of Physics for Class XII (Part-I, Part-II)", N.C.E.R.T., Delhi.
2. Dr. HH Lal, "Applied Physics, Vol. I & II", TTTI Publications, Tata McGraw Hill, Delhi.
3. AS Vasudeva, "Applied Physics –II", Modern Publishers, Jalandhar.
4. R A Banwait, "Applied Physics – II", Eagle Prakashan, Jalandhar.
5. N Subrahmanyam, Brij Lal and Avadhanulu, "A text book of OPTICS", S Chand Publishing, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
7. M H Fulekar, "Nanotechnology: Importance and Applications", IK International Publishing House (P) Ltd., New Delhi.
8. C. L. Arora, "Practical Physics", S Chand Publication.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students.

Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

2.3 ELECTRICAL NETWORKS

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RATIONALE

This course intends to teach the students facts, concepts and principles of circuits and circuit analysis so that he/she can use the knowledge in acquiring supervisory skill to assist in carrying out the analysis & investigation work.

COURSE OUTCOMES

At the end of this subject, the student will be able to:

CO1: Understand mesh, nodal methods, different network theorems and applying them to solve DC circuits.
CO2: Remember the concept of ac circuit, resonance, power factor and their significance.
CO3: Apply the basic principles and solve the A.C. series and parallel circuit.
CO4: Recognize the concept of Poly-phase system and compute the electrical parameters.

DETAILED CONTENTS

UNIT I

DC Network Theorems

1.1 Mesh analysis
1.2 Nodal analysis using voltage and current sources
1.3 Superposition theorem
1.4 Thevenin theorem
1.5 Norton theorem
1.6 Maximum power transfer theorem
1.7 Active and passive network, Linear and Non Linear network

UNIT II

AC Fundamentals

2.1 Generation of alternating Voltage and current. Difference between ac and dc, Equation of alternating quantity.
2.2 AC Terminology: waveform, cycle, frequency, time period, amplitude, instantaneous value, alternation, and their important relations (time period and frequency, angular velocity and frequency etc.)

2.3 Values of alternating voltage and current: Instantaneous value, peak value average value, r.m.s. value, form factor and peak factor
2.4 Vector representation of alternating quantities
2.5 Concept of phase, phase difference and phasors
2.6 Representation of electrical quantities through phasors
2.7 Addition of two alternating quantities: parallelogram method, component method

UNIT III

Single Phase AC Series Circuits

3.1 A.C circuit containing pure Resistance, Inductance, Capacitance with the concept of power consumed, phase Angle, inductive and capacitive reactance etc.
3.2 AC series circuit: R-L, R-C, R-L-C along with the concept of phasor diagram, phase angle , Impedance, impedance triangle, power, power triangle etc.
3.3 Concept of True power, apparent power and reactive power, Power factor and its significance, disadvantages of low power factor, cause of low power factor, improvement of power factor.
3.4 Active and reactive components of current
3.5 Resonance in RLC series circuit, Quality (Q) factor

UNIT IV

Single Phase AC Parallel Circuits

4.1 Concept of AC parallel circuit
4.2 Methods of solving parallel AC circuit: vector method, admittance method, symbolic or J-method
4.3 Parallel Resonance, Q-factor
4.4 Comparison of series and parallel resonance.
4.5 Introduction to transient and Harmonics in A.C. circuits

UNIT V

Polyphase Circuit

5.1 Principle of generation of 3 –ø alternating emf.
5.2 Advantages of Polyphase circuit over single phase circuit, Phase Sequence.
5.3 Types of three phase connections-Star connection and delta connection.
5.4 Concept of balanced and unbalanced load.
5.5 Relation between phase and line quantities of star and delta connection.

PRACTICAL EXERCISES

1. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying mesh analysis.
2. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying node analysis.
3. Verification of Superposition Theorem.
4. Verification of Thevenin's theorem.
5. Verification of Norton's Theorems.
6. Verification of Maximum Power transfer Theorem.
7. Observe the wave shape of an alternating supply on CRO and calculate average, RMS value, frequency and time period.
8. Measure input current, power, power factor of R-L series circuit and draw the power triangle.
9. Measure input current, power, power factor of R-C series circuit and draw the power triangle.
10. Measure input current, power, power factor of R-L-C series circuit and draw the power triangle.
11. Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor.
12. To determine current, p.f., active, reactive and apparent power in R-C parallel A.C. circuit.
13. To determine current, p.f., active, reactive and apparent power for given R-L-C parallel circuit with series connection of resistor and inductor in parallel with capacitor.
14. Use variable frequency supply create resonance in given parallel R-L-C circuit or by using variable inductor or capacitor.
15. Verify the relationship between phase and line values of current and voltages and power in balanced and unbalanced star connected load.
16. Verify the relationship between phase and line values of current and voltages and power in balanced and unbalanced delta connected load.

RECOMMENDED BOOKS

1. Ashfaq Husain, "Networks & Systems", Khanna Book Publishing, New Delhi, 2019.
2. D.Roy Chouhary, "Networks and System", New Age International Publishers, 1988.
3. B.R Gupta, Singhal, Vandana, "Fundamentals of Electrical Network", S.Chand and Co., New Delhi, ISBN: 978-81-219-2318-7, 2005.
4. S.B Lal Saxena, K Dasgupta, "Fundamentals of Electrical Engineering", Cambridge University Press Pvt. Ltd., New Delhi, ISBN: 978-11-0746-435-3.

5. B. L Theraja, A. K Theraja, "A Text Book of Electrical Technology Vol-I", S. Chand & Co. Ramnagar, New Delhi, ISBN: 9788121924405.
6. A Sudhakar, S. Palli Shyammohan, "Circuit and Network", McGraw Hill Education, New Delhi, ISBN: 978-93-3921-960-4.
7. David A Bell, "Electric Circuits", Oxford University Press New Delhi, ISBN: 978-01-954-2524-6.
8. R.L Boylested, "Introductory Circuit Analysis", Wheeler, New Delhi, ISBN: 978-00-231-3161-5.
9. V.N Mittle, Arvind Mittle, "Basic Electrical Engineering", McGraw Hill Education, Noida, ISBN: 978-00-705-9357-2.
10. S.N Sivanandam, "Electric Circuit Analysis", Vikas Publishing House Pvt. Ltd, Noida, ISBN: 978-81259-1364-1.
11. S. Salivahanan, S Pravinkumar, "Circuit Theory", Vikas Publishing House Pvt. Ltd, Noida; ISBN:978-93259-7418-0.

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

1. Teachers may take help of various models and charts, you-tubes video's, e-learning resources while studying the contents of the subject to the students so that the concepts should be clear. More emphasis should be laid on discussing and explaining practical applications.
2. Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles.
3. Preparing students to apply the technological method of problem solving to a real life problems. This quality is buildup in the students when students practice the numerical problems of the subject. Teachers should motivate students to solve the numerical problems of subject. Teachers must ask 30% of numerals problems in sessional test and final semester exam of this subject.
4. Teachers should expose to different learning tools used in respective labs, Operational safety and Procedure to be followed in the laboratory. Students may ask to make micro projects by using the idea as learning in the subject.
5. Activity- Theory - Demonstrate/practice approach may be followed throughout the coursesso that learning may be skill and employ-ability based.
6. Teachers take assignments, seminar, quiz, viva -voce etc. to enhance the learning ability of the students.
7. Students must have to perform at least 12 experiment in the laboratory.

2.4 NON-CONVENTIONAL SOURCES OF ENERGY

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RATIONALE

Since the conventional energy resources are under fast depletion, it is high time to tap the non-conventional energy sources. The electrical Diploma holder must be aware about the renewable energy resources like solar energy, wind energy, geothermal energy, ocean energy, hydro energy which is used for number of applications such as power generation, heating, cooling etc. This subject aim is to develop the skill required for renewable energy resource, so that they help the society for fulfilling the energy demand which is increasing day by day.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Comprehend various renewable and non-renewable sources of energy

CO2: Gain knowledge about working principle of various solar energy systems

CO3: Acquire the detailed concepts of power generation with the wind energy, ocean energy, hydro, geothermal energy, tidal energy, fuel cell.

CO4: Develop basic design of bio gas plant.

CO5: Gain knowledge of different energy storage devices used in renewable energy resources.

DETAILED CONTENTS

UNIT I

Introduction to Energy and Solar Energy

1.1 **Classification of Energy Resources:** Conventional Energy Resources, Non-conventional Energy Resources, Roles and responsibility of Ministry of New and Renewable Energy Sources. Needs of renewable energy. Targets and Present Status of Renewable Energy Sources in India.

1.2 **Solar Energy:** Introduction, potential of solar energy in India, Solar Radiation, Principle of conversion of solar radiation into heat, construction and working principle of photo-voltaic cell. Solar cell materials, Difference between solar cell, panel, array, module, Characteristics, important terms related to solar energy, Efficiency of Solar Cells. Applications of solar energy like solar PV system (standalone and grid connected), solar water heating system, solar furnaces, solar cookers, solar lighting, solar water pumping system, solar still. Government schemes and policies.

UNIT II

Bio-Energy and Hydro Energy

2.1 **Bio-Energy:** Introduction, Biomass energy, Photosynthesis process, Biomass fuels, Biomass energy conversion technologies and applications, Biomass Gasification, Types and application of gasifier, Types of biogas plants, Factors affecting biogas generation, Environmental impacts and benefits, Future role of biomass , Biomass potential and programs in India.

2.2 **Hydro Energy:** Introduction, Capacity and Potential, Hydro Power Plant (mini and micro), Environmental and social impacts.

UNIT III

Wind Energy and Geothermal Energy

3.1 **Wind Energy:** Introduction, Wind energy conversion system, windmills, types of wind mills, selection of site, electricity generation from wind energy, Wind Energy potential and Scenario in India.

3.2 **Geothermal Energy:** Introduction , Geothermal Resource Utilization like hydrothermal, Geo-pressured hot dry rock, magma, Geothermal based Electric Power Generation, Associated Problems, environmental Effects, prospects of geothermal energy in India.

UNIT IV

Tidal Energy and Mhd

4.1 **Tidal Energy:** Introduction, Capacity and Potential, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants.

4.2 **Ocean Energy:** Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation, prospects of OTEC in India.

4.3 **MHD power generation**: Principle of working of Magneto Hydro Dynamic (MHD) Power Generation, materials for MHD generators and future prospects, performance and limitations.

UNIT V

Fuel Cell and Energy Storage Devices

5.1 **Fuel Cells:** Fuel cell definition, difference between batteries and fuel cells, Principle of working of fuel cells ,types of fuel cell, power generation by fuel cell ,conversion efficiency, applications, advantages and disadvantages of fuel cell .

5.2 **Energy Storage:** Need of energy storage, Different modes of energy storage, Flywheel storage, Superconducting Magnet Energy Storage (SMES) systems, Capacitor, battery, Super capacitor. Comparison and application.

PRACTICAL EXERCISES

1. Visit the website of Ministry of New and Renewable Energy Sources and prepare the Datasheet of Potential, Present and Future Scenario of Renewable energy sources in India.
2. Familiarization with the different components used in solar PV plant (standalone and grid connected system), solar water heating system, solar cooker, solar lighting etc.
3. Calculate power flow of a stand-alone PV system with DC load, AC load and battery.
4. To demonstrate "I-V Characteristics and Efficiency of 1kWp Solar PV System" with varying radiation and temperature level.
5. Assemble the components of solar home lighting system & study the system.
6. Assemble the components of solar water heating system system & study the system.
7. Identify Troubleshoot solar PV panel, inverter and solar smart metering system.
8. Identify the specified components of a 1 KW Small Wind Turbine (SWT) system and study them.
9. Estimation of wind speed using anemometer.
10. Study of charging and discharging behavior of a capacitor.
11. Study of charging characteristics of a Ni-Cd battery using solar photovoltaic panel.
12. Identify the prime mover /turbines used in different renewable energy sources for power generation and study them.
13. Study the Performance of fuel cell.
14. Identify the routine maintenance parts of the micro hydro power plant after watching a video.

- Visit nearby renewable power plant and write specification of each components used in that plant.

RECOMMENDED BOOKS

1. S. P. Sukhatme, "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. B. H. Khan, "Non-Conventional Energy Resources", The McGraw Hill.
3. J. W. Twidell & A. Weir, "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.
4. S. P. Sukhatme and J.K. Nayak, "Solar Energy – Principles of Thermal Collection and Storage", Tata McGraw-Hill, New Delhi.
5. Garg, Prakash, "Solar Energy, Fundamentals and Applications", Tata McGraw Hill.
6. G.D. Rai, "Non-Conventional Energy Sources", Khanna Publications, New Delhi, 2011.
7. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 1996.
8. K. C. Khandelwal & S. S. Mahdi, "Biogas Technology – A Practical Handbook", Tata Mc Graw Hill.

9. G. N. Tiwari, “Solar Energy – Fundamentals Design, Modeling & Applications”, Narosa Publishing House, New Delhi, 2002.
10. Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.
11. Frank Krieth & John F Kreider, “Principles of Solar Energy”, John Wiley, New York.
12. N. K. Bansal, “Renewable Energy Sources and Conversion Technology”, Manfred Kleemann, Michael Meliss, Tata McGraw Hill Publishing Co. Ltd New Delhi.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

The teacher should make the students aware about the depletion of energy sources and the availability of alternate sources of energy their feasibility and limitations. The need for adopting non-conventional energy sources should be made clear to students. Teacher must give practical application of these energy sources in nearby surrounding areas. Visit nearby renewable energy source plants to enhance the real time practical skill in the students.

2.5 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

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RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industrial and construction activities so that he/she may help in balancing the ecosystem and controlling pollution by various control measures. The course is intended to provide a general concept in the dimensions of environmental pollution and disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.

COURSE OUTCOMES

After undergoing the subject, the student will be able to:

CO1: Comprehend the importance of sustainable ecosystem.
CO2: Clarify interdisciplinary nature of environmental issues.
CO3: Describe corrective measures for the abatement of pollution.
CO4: Identify the role of non-conventional energy resources in environmental protection.
CO5: Recognize various types of disasters.

DETAILED CONTENTS

UNIT I

Introduction

1.1 Basics of ecology, eco system- concept, and sustainable development, Sources, advantages, disadvantages of renewable and nonrenewable energy.
1.2 Rain water harvesting
1.3 Deforestation – its effects & control measures

UNIT II

Air and Noise Pollution

2.1 Air Pollution: Source of air pollution. Effect of air pollution on human health, economy, Air pollution control methods.
2.2 Noise Pollution: Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimizing noise pollution.

UNIT III

Water and Soil Pollution

3.1 Water Pollution: Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of DO, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

3.2 Soil Pollution :Sources of soil pollution, Effects and Control of soil pollution, Types of Solid waste- House hold, Industrial, Agricultural, Biomedical, Disposal of solid waste, Solid waste management E-waste, E – waste management

UNIT IV

Impact of Energy Usage on Environment

Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings, Concept of Carbon Credit & Carbon footprint.

UNIT V

Disaster Management

A. Different Types of Disaster:

Natural Disaster: such as Flood, Cyclone, Earthquakes and Landslides etc.

Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc.

B.Disaster Preparedness:

Disaster Preparedness Plan

Prediction, Early Warnings and Safety Measures of Disaster

Psychological response and Management (Trauma, Stress, Rumour and Panic)

RECOMMENDED BOOKS

1. S.C. Sharma & M.P. Poonia, “Environmental Studies”, Khanna Publishing House, New Delhi.
2. BR Sharma, “Environmental and Pollution Awareness”, Satya Prakashan, New Delhi.
3. Dr. RK Khitoliya, “Environmental Pollution”, S Chand Publishing, New Delhi.
4. Erach Bharucha, “Environmental Studies”, University Press (India) Private Ltd., Hyderabad.
5. Suresh K Dhamija, “Environmental Engineering and Management”, S K Kataria and Sons, New Delhi.

6. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.
7. Dr. Mrinalini Pandey, “Disaster Management”, Wiley India Pvt. Ltd.
8. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill Education (India) Pvt. Ltd.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies and Disaster Management like expert lectures, seminars, visits etc. may also be organized This subject contains five units of equal weightage.

2.6 BASIC ELECTRICAL WORKSHOP

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RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers or artisans working under him. In addition to these persons, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively in addition to conceptual understanding of the method or procedure he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, faultfinding, wiring in electrical appliances and installations.

COURSE OUTCOMES

After undergoing the subject, students will be able to:

CO1: Know the safety precautions and different tools and apply their skills for society.
CO2: Detect and rectify various types of faults in house wiring, and contactor control circuits.
CO3: Repair various domestic appliances and apply knowledge of earthing
CO4: Perform wiring, testing and fault finding of the control circuits process
CO5: Perform single phase and three phase supply and wiring system.

PRACTICAL EXERCISES

UNIT I

Electrical Safety Measures and Identification of Common Electrical Materials/Tools

1.1 Study safety measures while working or handing the electrical equipments.
1.2 Use of fire extinguisher during electric fire.
1.3 Study the methods to take restoration of person suffering from electric shock.
1.4 Identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, 1-pole, 2-pole and 3-pole MCB, RCCB & ELCB, fuses, cleats, clamps and allied items, tools and accessories.
1.5 Identification ,use and connections of various types of switches such as: normal/miniature toggle, slide, push button piano key, rotary, SPST, SPDT, DPST, DPDT, band selector, multi-way Master Mains Switch.
1.6 Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs.
1.7 Identification and familiarization of following electrical wiring tools with respect to their usage: Screw drivers (different sizes), Insulated Pliers, Cutter, Sniper, Screw Driver (Star

Screw Driver), L- Keys, Soldering Iron, soldering wire, flux, Drilling machines and Drilling Bits, Voltage/line tester, Insulation remover, Standard Wire Gauge .

UNIT II

House Wiring

2.1 Soldering wire jointing of different types such as straight joint/ married joint, T joint, Western union joint, pigtail joint.

2.2 Making of extension board containing two 5A and one 15A plug points.

2.3 To make a single phase main distribution board with five outgoing circuits for light and fan load including main switch and fuse (only internal connection).

2.4 Fault detection and repair of domestic electric installation.

2.5 Fault detection and its repair in institution's workshop installations.

2.6 Carrying out house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-caping. Demo of conduit wiring through junctions.

UNIT III

Domestic Appliances

3.1 Winding/re-winding of a fan (ceiling and table)/ motor and BLDC

3.2 Repair and maintenance of domestic electric appliances, i.e. electric iron, geyser, fan, heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnace etc.

3.3 Dismantling and assembly of voltage stabilizers

3.4 Assembly and interchange wiring of fluorescent tube light, CFL lamp etc.

3.5 Earth resistance measurement and earthing processes.

3.6 To carry out pipe/plate earthing for a small house and 3-phase induction motor. Testing the earthing using earth tester.

UNIT IV

Professional Equipments and Control

4.1 Coil winding for small transformer or alarm bell.

4.2 Assembling small transformer cores from the given lamination plates.

4.3 Assembling small battery charger.

4.4 Connections of single phase and 3-phase motors, through an appropriate starter and to change their direction of rotation.

4.5 Wiring, testing and fault finding of the following contactor control circuits operating on 3-phase supply:

a) Remote control circuits
b) Time delay circuits
c) Inter locking circuits
d) Sequential operation control circuits

4.6 Dismantling/assembly of star-delta and DOL starter.
4.7 Design a printed circuit Board (PCB) for voltage regulator using zener diode.
4.8 Armature winding of 3 phase induction motor.

UNIT V

Power Supply Connection

5.1 Connecting single phase energy meter with supply and load. Reading and working out power consumption and cost of energy.
5.2 Introduction to single phase and three phase supply and wiring system. Importance of three phase supply (RYB) & its sequence and wiring system.
5.3 Connecting Generator and 3 phase wiring through Change over Switch.
5.4 Power cable jointing using epoxy based jointing kits.
5.5 Demonstration of laying of underground cables at worksite.

RECOMMENDED BOOKS

1. SK Bhattacharya, “Electrical and Electronic Engineering Materials”, Khanna Publishers, New Delhi.
2. Grover and Jamwal, “Electronic Components and Materials”, Dhanpat Rai and Co., New Delhi.
3. Sahdev, “Electrical Engineering Materials”, Uneek International Publications, Jalandhar.
4. SM Dhir, “Electronic Components and Materials”, Tata Mc Graw Hill, New Delhi.
5. PL Kapoor, “Electrical Engineering Materials”, Khanna Publishers, New Delhi.
6. BR Sharma and Others, “Electrical and Electronics Engineering Materials”, Satya Parkashan, New Delhi.
7. E-books/e-tools/relevant software to be used as recommended by CTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students. All the experiments are to be performed by the students. There are five units of equal weightage. The teacher should also engage the students in various Hands on Practice/Training of Students during Educational Tour, Seminar/ Assignment Event, Students Quiz**.**

EFFECTIVE IMPLEMENTATION
&
EVALUATION TOOLS

28. ASSESMENT TOOLS & CRITERION

The assessment is carried out by conducting:

1. Formative assessments
2. Summative assessments

1. FORMATIVE ASSESSEMENT

The **formative assessment** will be evaluated on the basis of the internal assessments for theory subjects and practical by the concerned teachers for evaluating the knowledge and skill acquired by students and the behavioral transformation of the students. This **internal assessment** is primarily carried out by collecting evidence of competence gained by the students by evaluating them at work based on assessment criteria, asking questions and initiating formative discussions to assess understanding and by evaluating records and reports, and sessional marks are awarded to them.

2. SUMMATIVE ASSESSMENT

The **summative assessment** will include end semester examination for theory part for each candidate and practical examination with viva voice. Each Performance Criteria will be assigned marks proportional to its importance and proportion of marks for Theory and Skills Practical for each subject should be laid down.

The following assessment tools are used for effective student evaluation:

1. Theory Examinations
2. Practical Work
3. Internships
4. Professional Industrial Training
5. Project Work (Minor & Major)
6. Massive Open Online Courses (MOOCs)
7. Viva Voce
8. Case Studies

1. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems.

The **formative evaluation** for theory subjects may be caused through

i. Sessional /class-tests,
ii. Quizzes,
iii. Assignments,
iv. Seminars/ Presentations
v. Attendance
vi. Case Studies

For **Summative evaluation** of theory, the question paper may comprise of three sections.

i. It should contain objective type question and multiple choice questions. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.
ii. It should contain short answer questions.
iii. Descriptive type questions , with some internal choice of the questions set may be given in this section

2. Practical Assessment

Evaluation of students performance in practical work (Laboratory experiments, Workshop practical /field exercises) aims at assessing students ability to apply or practice the concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. This will comprise of a creation of mock environment, wherever applicable in the skill lab which is equipped with all required equipment for development of desired skills. Candidate's soft skills, communication, aptitude, safety consciousness, quality consciousness etc. will be ascertained by observation and will be marked in observation checklist along with the assessment of Job carried out in labs and maintenance of Lab Record files.

Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject. The end product will be measured against the specified dimensions and standards to gauge the level of his skill achievements

3. Internship

The two mandatory internships after I Year and II Year of the programme are to be assessed in 3rd and 5th semester subsequently. The internships should be preferably done in the field/ in the industry, can be in house depending upon the stream and availability of resources in and around the institute.

Every faculty should be assigned the students and made responsible for the evaluation and assessment of the internship. Formative assessment should be taken from the industry/institute/ department on the basis of performance, behavior and learning capabilities. Summative evaluation may comprise of weightages on the basis of report submission/ presentation followed by viva-voce of the relevant subject.

4. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject.

The formative assessment should include the evaluation from the employer where the student is doing his training or Project work in the ratio of 40:60. The final assessment will be the combination of the employer assessment and evaluation by the faculty of the institute which shall include report submission/ presentation/ seminar followed by viva-voce of the relevant subject.

5. Project Work Assessment

The purpose of evaluation of project work is to assess student's ability to apply, in an integrated manner, knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The project work assigned should be of

relevance to the core skill, state of the art topics and the project areas that are pertaining to enhance job skill and enhance occupational opportunities. For both, minor and major project, Formative and summative evaluation may comprise of weightages to performance on task, quality of product, nature and relevance of project and general behavior.
The formative assessment should include the continuous assessment based on the work allocated and mid semester viva voice or presentation. The final assessment will be the combination of the project undertaken, report submission and should be followed by viva-voce of the relevant subject.

In case of the assessment of this component, the team of examiners should be constituted on 50 – 50 % basis. i.e. half of the examiners in the team should be invited from outside the institute conducting examination.

6. MOOC COURSES (Open Elective and Multi-Disciplinary Elective)

Massive Open Online Courses (MOOCs) platforms promise open, online courses to massive numbers of students as they are free to join, they provide a wide range of courses, they allow for space and time flexibility and their participants can benefit from various online communication tools and access to quality content.

The coordinating Department/Centre/Office shall monitor every student to adopt the courses online of their choice and preference on Swayam portal. The duration of courses will vary depending on the level and credit points. Courses offered in the duration of 4-10 weeks for 2 to 3 credits at diploma level are to be opted. Students, after they have registered, can get a certificate after attending the classes and submitting the assignments/quizzes and qualifying nationwide exam conducted written exam at the institute close to the one where the student is enrolled.

On successful completion of each course, the institution offering the MOOCs course would issue the certificate, along with the number of credits and grades, through which the student can get credits transferred into his marks certificate issued by his parent institution. Guidelines for credit sharing will be issued by concerned Regulators such as UGC, AICTE, etc. for consideration by various Institutes. There may be standard norms for the host Institution to conduct the course that may include continuous evaluation through assignments, online quizzes, case studies, online writing exercises, term examinations, student feedback, online forum management, etc.

The coordinating Department/Centre/Office of the respective department shall monitor every student and submit to the Office of Examinations, a score sheet (marks card) during the last 10 days prior to the close of the even semester.

7. Viva Voce

This tool will be used to assess the conceptual understanding and the behavioral aspects as regards the job role and the specific task at hand. It will also include questions on safety, quality, environment and equipment's etc. Ask questions on non-prescribed tasks to ensure that the learners have complete knowledge on the assessment

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the marks scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA\ (Si) = \sum(Ci \times Gi) / \sum Ci$$

where Ci is the number of credits of the ith course and Gi is the marks scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

29. TEACHING LEARNING TOOLS FOR EFFECTIVE IMPLEMENTATION

For effective implementation of curriculum, the faculty and staff of institutions have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that only a proper mix of different teaching methods in all these places of instruction can bring the changes in students behavior as stipulated in the curriculum document. It is important to understand curriculum document holistically and further be aware of intricacies of Teaching-Learning Tools for achieving curriculum objectives. Given below are certain recommendations which may help in carrying out teaching-learning effectively:

PROGRAMME LEVEL RECOMMENDATIONS

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.

2. An academic plan needs to be prepared at institute level. The Head of the institute have a great role to play in its dissemination and percolation up to grass-root level.

3. Head of Department are required to prepare academic plan at department level referring to institutional academic plan.

COURSE LEVEL RECOMMENDATIONS

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives. Teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period which is made available to them in the academic plan at Board level. With the amount of time to their credit, it is essential for them to use it judiciously by planning all above activities properly and ensure execution of

the plan effectively. Following is the gist of suggestions for subject teachers for effective utilization of Teaching Learning Tools to achieve the course objectives:

1. Teachers need to ensure attainment of course outcomes so as to help the students achieve program outcomes and also meet the desired learning outcomes in five domains of NSQF i.e. Process, Professional knowledge, Professional skills, Core skills and Responsibility.

2. Teachers are required to prepare a course plan, taking into account number of weeks available and courses to be taught.

3. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan.

4. Teachers are required to plan for expert lectures from field/industry. For this, necessary steps need to be taken such as planning in advance, identifying field experts, making correspondence to invite them, taking necessary budgetary approval etc.

5. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The assignments and seminars can be thought of as terminal outcome of library experiences.

6. Concept based industrial/field visits may be planned and executed for such contents of course which are abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

7. Lot of focus needs to be laid on skill development. There is need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning and experiential learning effectively. The development and use of lab manuals will enable the institutes to provide lab experiences effectively.

8. Emphasis should to lay on developing soft skills like communication skills, personality Development, self-learning, inter personal skills, problem solving, and creativity etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

10. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

11. Students be made aware about issues related to ecology and environment, safety, concern f for wastage of energy and other resources etc.

12. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be o offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

13. For effective implementation of Massive Open Online Courses (MOOCs), a faculty member in the department may be identified and given the responsibility to coordinate various activities related to MOOCs. The concerned faculty member will facilitate in registration of students for MOOCs. The faculty member will also be responsible for compiling the result of students on the completion of MOOCs and pass on the information to the concerned authority.

14. Flexibility has been provided in the curriculum for the students to choose a course related to the discipline as per their interest. For effective implementation of discipline-specific electives, the institute should identify some courses from the list of courses prescribed in the curriculum. The courses should be selected and offered keeping in mind the interest of students, infrastructure and expertise available in and around the institute related to the courses. Option for discipline-specific elective may be taken from students through a form and a course, with more than 10 students opting for it, may be run.

15. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

16. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

17. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

18. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

30. LIST OF EXPERTS & REVIEWERS

1. Dr. Nidhi Aggarwal, Deputy Secretary (Acd), Haryana State Board of Technical Education, Panchkula.

2. Sh. Hitesh Kumar, Deputy Secretary (T & P), Haryana State Board of Technical Education, Panchkula.

3. Sh. Rajiv Sharma, Lecturer, Electrical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

4. Sh. Rajesh Kamboj, Lecturer, Electrical Engineering Department, Government Polytechnic, Nilokheri, Haryana.

5. Sh. Rajesh Chopra, Lecturer, Electrical Engineering Department, Government Polytechnic, Nilokheri, Haryana.

6. Sh. Deepak Kumar, Lecturer, Electrical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

7. Dr. Neeraj Kumar, Lecturer, Electrical Engineering Department, Government Polytechnic. Nanakpur.

8. Sh. Surender Malik, Lecturer, Electrical Engineering Department, Government Polytechnic, Ambala, Haryana.

9. Jitendra Virmani, Senior Technical Officer, Central Scientific Instruments Organisation, Chandigarh.

10. Mr. Rangachar Bhardwaj, Project Engieer, MV Drives, R&D, ABB India, Bangalore.

11. Smt. Pushpa Rani, Senior Lecturer, Applied Science Department, Government Polytechnic, Sonipat, Haryana.

12. Smt. Krishna Bhoria, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.

13. Smt. Preetpal Kaur, Guest Faculty, Applied Science Department, Government Polytechnic, Ambala, Haryana.

14. Ms. Monika, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

15. Dr. Neena Sharma, English Department, MCM College, Chandigarh.

16. Sh. PK Singla, Associate Professor, Education & Educational Management Department, NITTTR, Chandigarh.

17. Dr. Bhajan Lal, Lecturer, Applied Science Department, Government Polytechnic, Sirsa, Haryana.

18. Sh. Anil Nain, Lecturer, Applied Science Department, Government Polytechnic, Hisar, Haryana.

19. Dr. Sarita Mann, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.

20. Smt. Bindu Verma, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

21. Mr. Satyawan Dhaka, Senior Lecturer, Applied Science Department, Government Polytechnic, Nilokheri.

22. Mrs. Sapna Sang, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla.

23. Mr. Ravi Bansal, Lecturer, Applied Science Department, Government Polytechnic, Manesar.

24. Mrs. Kiran, Lecturer, Applied Science Department, Government Polytechnic, Sonepat.

25. Dr. Naveen Jha, Assistant Professor, Department of Mathematics, Government Engineering College, Bharatpur.

26. Dr. Vidhi Grover, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla.

27. Mr. Tavinder Singh, Lecturer, Applied Science Department, Government Polytechnic, Sirsa.

28. Ms. Sunita Rani, Lecturer, Applied Science Department, Government Polytechnic, Ambala.

29. Mr. Subhash Chandra Bhoria, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Hisar.

30. Mr. Jagjit Singh Narang, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Ambala.

31. Mr. Pardeep Kumar, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri.

32. Dr. Pankaj Sharma, Professor, Applied Science Department, NITTTR, Chandigarh.

33. Dr. Ashok Kumar, Associate Professor, Applied Science Department, NITTTR, Chandigarh.

34. Mr. KG Srinivasa, Professor, Information Management & Emerging Engineering, NITTTR, Chandigarh.

35. Dr. Ritula, Faculty, Associate Professor, Electrical Engineering Department, Chandigarh.

36. Dr. KC Lachhwani, Assistant Professor, Applied Science, NITTTR, Chandigarh

37. Dr. Rajesh Mehra, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh.

38. Dr. AB Gupta, Professor, Curriculum Development Centre, NITTTR, Chandigarh.

39. Dr. SK Gupta, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

40. Dr. Meenakshi Sood, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

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