Rationale
Interpersonal communication is a natural and necessary part of organizational life. Yet, communicating effectively can be challenging because of our inherent nature to assume, overreact to and misperceive what actually is happening. Poor communication or lack of communication is often cited as the cause of conflict and poor teamwork. In today’s team-oriented workplace, managing communication and developing strategies for creating shared meaning are crucial to achieving results and creating successful organizations. The goal of the Communicating Effectively in English course is to produce civic-minded, competent communicators. To that end, students must demonstrate oral as well as written communication proficiency. These include organizational and interpersonal communication, public address and performance.

Objectives of Course in Communicating Effectively in English for the First Year (I & II Semesters) are:

* Understanding how communication works
* Gaining active listening and responding skills
* Understanding the importance of body language
* Acquiring different strategies of reading texts
* Increasing confidence by providing opportunities for oral and written expressions
DETAILED CONTENTS FOR FIRST SEMESTER

1. SEMESTER 48 HRS

1. COMMUNICATION SKILLS 6 hrs

1.1 Verbal and Non-verbal Communication
1.2 Process of Communication
1.3 Barriers to Communication; Overcoming Strategies
1.4 Listening and Speaking Skills and Sub-Skills

2. Spoken English-Introduction, Features of Spoken English

(Note: This module is only for practice. This should not be included in the final examination)

2. DEVELOPING ORAL COMMUNICATION SKILLS 8 hrs

2.1 Greeting, Starting a Conversation
2.3 Introducing Oneself
2.4 Introducing Others
2.5 Leave Taking
2.6 Thanking, Wishing Well
2.7 Talking about Oneself
2.8 Talking about Likes and Dislikes

3. GRAMMAR AND USAGE 12 hrs

3.1 Punctuation
3.2 Articles-a, an, the
3.3 Framing Questions
3.4 Verbs-Classification: Main Verb, Auxiliary Verb, Transitive & Intransitive Verbs, Phrasal Verbs
3.5 Word Formation

4. WRITING SKILLS 10 hrs

4.1 Writing Paragraphs
4.2 Picture Composition
# 5. READING SKILLS

**5.1 Vocabulary Enhancement**

**5.2 Techniques of Reading: Skimming, Scanning, Intensive and Extensive Reading**

**NOTE:** The Reading Skills of the learners (along with vocabulary enhancement) will be through reading thematic articles/essays and/or stories.

## Section I

**Theoretical Concepts of Communication Skills**

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**Oral Communication Skills**

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1.2 APPLIED MATHEMATICS – I

RATIONALE
Applied Mathematics forms the backbone of engineering discipline. Basic elements of permutations and combinations, trigonometry, vector, complex number and statistics have been included in the curriculum as foundation course and to provide base for continuing education to the students.

DETAILED CONTENTS
1. Algebra (20 hrs)
   1.1 Permutations and Combinations, Value of \(^n\text{p}_r\) and \(^n\text{c}_r\), its properties and simple problems
   1.2 Binomial theorem (without proof) for positive integral index (expansion and general term); Binomial theorem for any index (expansion only) first and second binomial approximation with application to engineering problems
   1.3 Partial fractions (linear factors, repeated linear factors, non reducible quadratic factors)
   1.4 Determinants and Matrices – expansion of determinants (upto third order) using sarrus rule, expansion method and pivotal’s condensation method. Properties of determinants, solution of equations (upto 3 unknowns) by Cramer’s rule. Definition of matrix, addition, subtraction and multiplication of matrices (upto third order). Inverse of a matrix by adjoint method and elementary row transformations. Solution of
1.5 Logarithms: general properties of logarithms, calculations of engineering problems using log tables

2. Trigonometry (11 hrs)

2.1 Addition and subtraction formulae, product formulae and their application in engineering problems. Transformation from product to sum or difference of two angles or vice versa, multiple and sub-multiple angles

2.2 Conditional identities, solution of triangles (excluding ambiguous cases).

2.3 Graphs of \( \sin x, \cos x, \text{ and } \tan x, e^x \)

3. Vectors (11 hrs)


4. Complex Numbers (9 hrs) Definition, Real and Imaginary parts of a complex number, Polar and Cartesian representation of a complex number and conversion from one form to the other, conjugate of a complex number, modulus and argument of a complex number, addition, subtraction, multiplication and division of a complex number.

5. Statistics and Probability (13 hrs)

Evaluation of standard deviation and process capabilities. Rank, Rank correlation, probability: definition and laws on probability, concept of random variable, probability distribution (Binomial, Poisson and Normal) and their applications. Drawing control charts for average (\( \bar{x} \)) and range (R)
RECOMMENDED BOOKS

1. Applied Mathematics Vol. I by SS Sabharwal and Others by Eagle Prakashan, Jalandhar

2. Applied Mathematics Vol. II by SS Sabharwal and Others by Eagle Prakashan, Jalandhar


5. Applied Mathematics Vol. I by RD Sharma


1.3 APPLIED PHYSICS - I

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

DETAILED CONTENTS
1. Unit and Dimensions. (8 hrs)
   1.1 Physical quantities
   1.2 Fundamental and derived units
   1.3 Systems of unit (CGS, MKS and SI units)
   1.4 Dimensions and dimensional formulae of physical quantities (area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, surface tension, coefficient of viscosity and strain)
   1.5 Principle of homogeneity
   1.6 Dimensional equations and their uses with examples.
   1.7 Limitations of dimensional analysis.

2. Force and Motion (9 hrs + 6 hrs + 8 hrs)
   2.1 Scalar and vector quantities - examples, addition and multiplication of vectors, scalar product and vector product of vectors
   2.2 Force, resolution and composition of forces – resultant, parallelogram law of forces, friction, law of friction and type of friction.
   2.3 Equilibrium of forces, Lami’s theorem
2.4 Newton’s Laws of motion – concept of momentum, determination of force equation from Newton’s second law of motion, Newton’s third law of motion Conservation of momentum, impulse and impulsive forces, simple numerical problems.

2.5 Projectile, horizontal and oblique projections and equation of Trajectory (Derivation) Derivation of time of flight, maximum height and horizontal range

2.6 Circular motion (Definition)
Relation between linear and angular velocity and linear acceleration and angular acceleration

2.7 Centripetal force (derivation) and centrifugal force Banking of roads.

2.8 Rotational Motion 6 hrs
Definition of torque, moment of inertia, radius of gyration, Derivation of rotational kinetic energy and angular momentum, Conservation of angular momentum (qualitative) related problems.

2.9 Planetary Motion 8 hrs
Newton’s law of gravitation, Kepler’s law of planetary motion, Escape velocity (derivation), Artificial satellites and related problems.

3. Work, Power and Energy (8 hrs)

3.1 Work: definition and its units.

3.2 Work done against friction in moving an object on horizontal and inclined plane (incorporating frictional forces)

3.3 Power: definitions and its units, calculation of power in simple cases.

3.4 Energy: Definitions and its units: Types: Kinetic energy and Potential energy, with examples and their derivation.

3.5 Principle of conservation of mechanical energy (for freely falling bodies), transformation of energy from one form to another and related problems.
4. Properties of Matter (9 hrs)

4.1 Elasticity, definition of stress and strain
4.2 Different types of modulus of elasticity
4.3 Pressure- its units, gauge pressure, absolute pressure, atmospheric pressure (Relation between them), Bourdon’s pressure gauge, Fortin’s barometer
4.4 Surface tension- its units, measurement of surface tension by capillary tube method, applications of surface tension, effect of temperature and impurity on surface tension.
4.5 Fluid motion, streamline and turbulent flow.
4.6 Viscosity and coefficient of viscosity, Effect of temperature on viscosity

5. Temperature and its measurement (8 hrs)

5.1 Difference between heat and temperature on the basis of K.E. of Molecules.
5.2 Principles of measurement of temperature and different scales of temperature.
5.3 Bimetallic and Platinum resistance thermometer: their merits and demerits
5.4 Pyrometers – Disappearing filament optical pyrometer

6. Transfer of Heat (8 hrs)

6.1 Modes of transfer of heat (conduction, convection and radiation with examples)
6.2 Coefficient of thermal conductivity
6.3 Properties of heat radiation. Prevost’s theory of heat exchange
6.4 Laws of black body radiations: Stefan’s law, Kirchhoff’s law, Wien’s law

LIST OF PRACTICALS

1. To find the thickness of wire using a screw gauge
2. To find volume of solid cylinder and hollow cylinder using a vernier caliper
3. To determine the thickness of glass strip and radius of curvature of a concave surface using a spherometer
4. To find the surface tension of a liquid by capillary rise method.
5. To determine the atmospheric pressure at a place using Fortin’s Barometer.
6. To determine the time period of simple pendulum and plot a graph between l & t
7. Verify parallelogram Law of forces.

RECOMMENDED BOOKS

1. Concept of Physics, Prof. H.C. Verma, Part-1 (Bharti Bhawan)
2. Concept of Physics, Prof. H.C. Verma, Part-2 (Bharti Bhawan)
3. A Text Book of Applied Physics : Egale Parkashan, Jullandhar
1.4 APPLIED CHEMISTRY-I

RATIONALE
The role of Chemistry and chemical products in every branch of engineering is expanding greatly. Now a days various products of chemical industries are playing important role in the field of engineering with increasing number of such products each successive years. The strength of materials, the chemical composition of substances, their behavior when subjected to different treatment and environment, and the laws of heat and dynamic energy have entered in almost every activity of modern life. Chemistry is considered as one of the core subjects for diploma students in engineering and technology for developing in them scientific temper and appreciation of chemical properties of materials, which they have to handle in their professional career. Effort should be made to teach this subject through demonstration and with the active involvement of students.

DETAILED CONTENTS
1. Language of Chemistry (6 hrs)
   1.1 Definition of symbol, formula, valency and chemical equation.
   1.2 Writing of the chemical formula of a simple chemical compound. Calculation of percentage composition of a chemical compound
   1.3 Essentials of a chemical equation, balancing of a chemical equation by Hit and Trial method

2. Atomic Structure (6 hrs)
Introduction to atom and its constituent particle, Dalton’s, Rutherford’s model.
Bohr’s model (postulates only), atomic number, mass number, isotopes, isobars, concept of atomic orbitals, shapes of S and P orbitals, quantum numbers, electronic configuration-Aufbau Principle, Hund’s rule and Pauli’s exclusion Principle, Hybridization (sp3, sp2 and sp).
3. Chemical Bonding (4 hrs)

3.1 Electronic concept of binding.

3.2 Elementary account of electrovalent, covalent and coordinate bond formation on the basis of the electronic concept of valency with the help of suitable examples to each.

3.3 Orbital concept of covalent bond, Sigma and Pi bond.

4. Water (10 hrs)

4.1 Hard and soft water, types of hardness and its causes, disadvantages of hardness of water (i) in industrial use (ii) in boilers for steam generation.

4.2 Methods to remove hardness of water (i) Soda Lime process (ii) Ion-Exchange process. Simple numerical problems related to soda lime process.

4.3 Definition of degree of hardness of water and the systems to express the degree of hardness of water, (Estimations method not included)

4.4 Qualities of water used for drinking purposes, treatment of river water to make it fit for town supply.

5. Solutions (8 hrs.)

5.1 Concept of homogeneous solution (i) Colloids (ii) Suspensions (iii) Brownian Movement (iv) Osmosis (v) Acidity (vi) Basicity (vii) Equivalent weight and gram equivalent weight with suitable examples (viii) Mole (ix) Avogadro number (x) pH (xi) Industrial application of pH

5.2 Strength of a solution (i) Normality (ii) Molarity (iii) Molality as applied in relation to a solution.

5.3 Simple numerical problems related to volumetric analysis.

6. Electrolysis (6 hrs)

6.1 Definition of the terms: Electrolytes, Non-electrolytes conductors and non-conductors with suitable examples

6.2 Faraday's Laws of Electrolysis

6.3 Simple numerical problems based upon the laws of electrolysis

6.4 Different industrial applications of 'Electrolysis'

6.5 Elementary account of (i) lead acid battery and (ii) Ni-Cd battery
LIST OF PRACTICALS
1. Volumetric analysis and study of apparatus used therein.
2. Preparation of standard solution of oxalic acid or potassium dichromate
3. Determine the strength of a given solution of sodium hydroxide with the help of a standard solution of oxalic acid
4. Determine the strength of solution of HCl with the help of a solution of NaOH and an intermediate solution of standard oxalic acid
5. Estimation of total alkalinity of water volumetrically
6. Determine, pH of water sample using pH meter

RECOMMENDED BOOKS
3. Engineering Chemistry by Dr. S. Rabindra and Prof. B.K. Mishra; Kumar and Kumar Publishers (P) Ltd. Bangalore-40

Other additional Books for Reading
1. Engineering Chemistry by Jain PC and Jain M
2. Chemistry of Engineering by Aggarwal CV
3. Chemistry for Environmental Engineers by Swayer and McCarty, McGraw Hill, Delhi
4. Progressive Applied Chemistry –I and II by Dr. G.H. Hugar; Eagle Prakashan, Jalandhar
1.5 BASICS OF INFORMATION TECHNOLOGY

RATIONALE
Information technology has great influence on all aspects of life. Almost all workplaces and living environments 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 concept of information technology and its scope; operating a computer; use of various tools of MS office; using internet etc. form the broad competency profile of diploma holders. This exposure will enable the students to enter their professions with confidence, live in a harmonious way and contribute to the productivity.

Note:

1. *Teaching of theory should be dovetailed with practical work*
2. *The following topics may be taught in the laboratory along with the practical exercises.*

DETAILED CONTENTS

1. Information Technology – its concept and scope
2. Computers for information storage, information seeking, information processing and information transmission
3. Elements of computer system, computer hardware and software; data – numeric data, alpha numeric data; contents of a program, processing
4. Computer organization, block diagram of a computer, CPU, memory
5. Input devices; keyboard, mouse etc; output devices; VDU and Printer, Scanner, Plotter
6. Electrical requirements, inter-connections between units, connectors and cables
7. Secondary storage; magnetic disks – tracks and sectors, optical disk (CD and DVD Memory), primary and secondary memory: RAM, ROM, PROM etc., Capacity; device controllers, serial port, parallel port, system bus
8. Exercises on file opening and closing; memory management; device management and input – output (I/O) management with respect of windows
9. Installation concept and precautions to be observed while installing the system and software
10. Introduction about Operating Systems such as MS-DOS and Windows
11. Special features, various commands of MS word and MS-Excel
12. About the internet – server types, connectivity (TCP/IP, shell); applications of internet like: e-mail and browsing
13. Various Browsers like WWW (World wide web); hyperlinks; HTTP (Hyper Text Transfer Protocol); FTP (File Transfer Protocol)

LIST OF PRACTICALS
1. Given a PC, name its various components and list their functions
2. Identification of various parts of a computer and peripherals
3. Practice in installing a computer system by giving connection and loading the system software and application software
4. Installation of DOS and simple exercises on TYPE, REN, DEL, CD, MD, COPY, TREE, BACKUP commands
5. Exercises on entering text and data (Typing Practice)
6. Installation of Windows 98 or 2000 etc.
   (1) Features of Windows as an operating system
      - Start
- Shutdown and restore
- Creating and operating on the icons
- Opening closing and sizing the windows
- Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file
- Creating and operating on a folder
- Changing setting like, date, time color (background and foreground)
- Using short cuts
- Using on line help

7. MS-WORD

- File Management:
  Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, Giving password protection for a file
- Page Set up:
  Setting margins, tab setting, ruler, indenting
- Editing a document:
  Entering text, Cut, copy, paste using tool- bars
- Formatting a document:
  Using different fonts, changing font size and colour, changing the appearance through bold/ italic/ underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
- Aligning of text in a document, justification of document, Inserting bullets and numbering
- Formatting paragraph, inserting page breaks and column breaks
- Use of headers, footers: Inserting footnote, end note, use of comments
- Inserting date, time, special symbols, importing graphic images, drawing tools
- Tables and Borders:
  Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
- Print preview, zoom, page set up, printing options
- Using Find, Replace options
- Using Tools like:
  Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelops and labels
- Using shapes and drawing toolbar,
- Working with more than one window in MS Word,
- How to change the version of the document from one window OS to another
- Conversion between different text editors, software and MS Word

8. MS-EXCEL
- Starting excel, open worksheet, enter, edit, data, formulas to calculate values, format data, create chart, printing chart, save worksheet, switching from another spreadsheet
- Menu commands:
  create, format charts, organise, manage data, solving problem by analyzing data, exchange with other applications. Programming with MS-Excel, getting information while working
- Workbooks:
  Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations, working with arrays
- Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells,
rows, columns, find and replace text, numbers of cells, formatting worksheet
- Creating a chart:
  Working with chart types, changing data in chart, formatting a chart, use chart to analyze data
- Using a list to organize data, sorting and filtering data in list
- Retrieve data with MS - query: Create a pivot table, customising a pivot table. Statistical analysis of data
- Customise MS-Excel:
  How to change view of worksheet, outlining a worksheet, customise workspace, using templates to create default workbooks, protecting workbook
- Exchange data with other application: linking and embedding, embedding objects, linking to other applications, import, export document.

9. Internet and its Applications
   a) Log-in to internet
   b) Navigation for information seeking on internet
   c) Browsing and downloading of information from internet
   d) Sending and receiving e-mail
      - Creating a message
      - Creating an address book
      - Attaching a file with e-mail message
      - Receiving a message
      - Deleting a message
RECOMMENDED BOOKS

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Computers Today by SK Basandara, Galgotia publication Pvt ltd. Daryaganj, New Delhi
4. Internet for Every One by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
7. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
1.6 ENGINEERING DRAWING – I

RATIONALE
Drawing is said to be the language of engineers and technicians. Reading and interpreting engineering drawing is their day-to-day responsibility. The course is aimed at developing basic graphic skills so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation.

Note:
1. First angle projection is to be followed
2. Minimum of 15 sheets to be prepared by each student
3. SP 46 – 1988 should be followed
4. Instruction relevant to various drawings may be given along appropriate demonstration, before assigning drawing practice
Students

DETAILLED CONTENTS

1. Drawing Office Practice
   1.1 Drawing instruments
   1.2 Sizes and layout of standard drawing sheets
   1.3 Sizes of drawing boards
   1.4 Drafting table/board

2. Different types of Lines and Free Hand Sketching (1 sheet)
   2.1 Different types of lines in engineering drawing as per BIS specifications
   2.2 Practice in free hand sketching of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, small and large circles, parabolas, curves and ellipses

3. Lettering Techniques and Practice (2 sheets)
   3.1 Instrumental single stroke (capital and inclined) lettering of 35 mm height in the ratios of 7:4
3.2 Instrumental double stroke lettering of 35 mm height in the ratio of 7:4, vertical

3.3 Free hand lettering (alphabet and numerals) lower case and upper case, single stroke vertical and inclined at 75 degree in different standard series of 2.5, 3, 5, 7, 10, and 15 mm heights in the ratio of 7:4

4. Dimensioning (1 sheet)
   4.1 Necessity of dimensioning, terms and notations – methods and principles, dimensioning small components as in 4.2 below (mainly theoretical instructions)
   4.2 Dimensioning of overall sizes, circles, thread holes, chamfered surfaces, angles, tapered surface holes equally spaced on PCD, counter sunk hole counter bored holes, cylindrical parts, narrow space and gaps, radii, curves and arches – chain and parallel dimensioning

5. Scale (3 sheets)
   5.1 Scales – their need and importance, Definition of representative fraction (RF); Find RF of a given scale
   5.2 Types of scales
   5.3 Construction of plain and diagonal scales

6. Principle of Projections (strictly in first angle projection) (8 sheets)
   6.1 Principle of orthographic projection
   6.2 Projection of points situated in different quadrants
   6.3 Projection of lines, Lines inclined to one plane and parallel to the other and vice versa
   6.4 Projection of Planes: Planes perpendicular and parallel to either of the planes; planes perpendicular to one plane and parallel to the other or vice versa
   6.5 Projection of solids, such as Prism, Cube, Cylinder and Cones with axis perpendicular to horizontal plane or parallel to horizontal plane/vertical plane or both
6.6 Drawing 3 orthographic views of given objects (at least five objects)
6.7 Drawing 6 views of given objects (non-symmetrical one or two objects may be selected for this exercise)
6.8 Identification of surfaces on drawn orthographic views from isometric object drawn
6.9 Exercises on missing lines, surfaces and views
6.10 Sketching practice of pictorial views from isometric objects

7. Sectional Views (2 sheets)
   Need for sectional views – cutting planes methods of representing sections, conventional sections of various material, classification of sections, conventions in sectioning
   Drawing of full section, half section, partial broken out sections, off-set sections, revolved sections and removed sections. Exercises on sectional views of different isometric views
   Drawing of different conventions for materials in section, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections

8. Isometric Views (2 sheets)
   8.1 Fundamentals of isometric projections (theoretical instructions)
   8.2 Isometric views from 2 or 3 given orthographic views

9. Introduction to Third angle projection (1 sheet)

Note: Minimum 15 drawing sheets will be prepared by the students

RECOMMENDED BOOKS
1. Elementary Engineering Drawing (in first angle projection) by ND Bhatt, Charotar Publishing House
2. A Text Book of Engineering Drawing by Surjit Singh published by Dhanpat Rai and Co., Delhi
3. Engineering Drawing by PS Gill published by SK Kataria and sons, Delhi
1.7 GENERAL WORKSHOP PRACTICE – I & II

RATIONAL
Manual abilities to handle engineering materials with hand tools need to be developed in the students. They will be using different types of tools/equipment in different shops for fabrication purposes. Besides developing the necessary skills, the students will appreciate the importance of quality and safety measures.

DETAILED CONTENTS
Note: 1. The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

2. The shops to be offered in I and II semester may be decided at polytechnic level

3. The students should be taken to various shops (not included in the curriculum) in the polytechnic in batches and should be given knowledge of the various machines/equipment. Such as machine shop, foundry shop, sheet metal shop, etc.

4. Students of Diploma in Chemical Engineering will undergo Shops 1 to 6 only

Following seven shops are being proposed:
1. Carpentry shop
2. Fitting and plumbing shop
3. Welding shop
4. Paint shop
5. Forging and sheet metal shop
6. Electric shop
7. Electronics Shop

1. Carpentry Shop
1.1 Introduction to various types of wood, carpentry tools - their identification with sketches. Different types of wood joints.
1.2 Simple operations viz. hand sawing, marking, planning
1.3 Introduction and sharpening of wood working tools and practice of proper adjustment of tools
1.4 Demonstration and use of wood working machines i.e. band saw, circular saw, rip saw, bow saw and trammels. Universal wood working machine and wood turning lathe
1.5 Making of various joints (Also draw the sketches of various wooden joints in the Practical Note Book)
   a) Cross lap joint
   b) T-lap joint
   c) Corner lap joint
   d) Mortise and tenon joint
   e) Dovetail joint
   f) Prepare a file handle or any utility items by wood turning lathe

2. Fitting and Plumbing Shop
2.1 Introduction to fitting shop, common materials used in fitting shop, description and demonstration of various types of work-holding devices and surface plate, V-block
2.2 Demonstration and use of simple operation of hack-sawing, demonstration of various types of blades and their uses
2.3 Demonstrate and use of all important fitting shop tools with the help of neat sketches (files, punch, hammer, scraper, taps and dyes etc.)

2.4 Introduction of chipping, demonstration on chipping and its applications.
Demonstration and function of chipping tools.

2.5 Description, demonstration and practice of simple operation of hack saw, straight and angular cutting.

2.6 Demonstrations, description and use of various types of blades - their uses and method of fitting the blade.

2.7 Introduction and use of measuring tools used in fitting shop like: Try square, Steel rule, Measuring Tape, Outside micrometer, Vernier Caliper and Vernier Height Gauge.

2.8 Description, demonstration and practice of thread cutting using taps and dies.

2.9 Plumbing: Descriptions and drawing of various plumbing shop tools, Safety precautions. Introduction and demonstration of pipe dies, Pipe holding devices, Demonstration and practice of Pipe Fittings such as Sockets, Elbow, Tee, Reducer, Nipple, Union coupling, plug, Bend, Float valves and Taps.

Job: Cutting and filing practice on a square of 45 x 45 mm² from MS flat.

Job: Angular cutting practice of 45° (on the above job).

Job: Preparation of stud (to cut external threads) with the help of dies (mm or BSW).

Job: Drilling, counter drilling and internal thread cutting with Taps.

Job: H-Fitting in Mild steel (ms) square.

Job: Pipe cutting practice and thread cutting on GI Pipe with pipe dies.

3. Welding Shop

3.1 Introduction to welding, type of welding, common materials that can be welded, introduction to gas welding equipment, types of flame, adjustment of flame, applications of gas welding. Welding tools and safety precautions.
3.2 Introduction to electric arc welding (AC and DC), practice in setting current and voltage for striking proper arc, precautions while using electric arc welding. Applications of arc welding, Introduction to polarity and their use

3.3 Introduction to brazing process, filler material and fluxes; applications of brazing. Use of solder. Introduction of soldering materials

3.4 Demonstrate and use of the different tools used in the welding shop with sketches. Hand shield, helmet, clipping hammer, gloves, welding lead, connectors, apron, goggles etc.

3.5 Demonstration of welding defects and Various types of joints and end preparation

Job: Preparation of cap joint by arc welding
Job: Preparation of Tee joint by arc welding
Job: Preparation of single V or double V butt joint by using Electric arc welding
Job: Brazing Practice. Use of Speltor (on MS sheet pieces) Job:
Gas welding practice on worn-out and broken parts

4. Paint Shop

Introduction of painting shop and necessity. Different types of paints. Introduction of powder coating plant and their uses.

Job: Preparation of surface before painting such as cleaning, sanding, putty, procedure and application of primer coat, and painting steel item.
Job: Painting practice by brush on MS sheet
Job: Practice of dip painting
Job: Practice of lettering: Name plates / Sign board
Job: Polishing and painting on wooden and metallic surfaces
Job: Practical demonstration of powder coating
5. **Forging and sheet metal shop**

Introduction to forging, forging tools, tongs, blowers/pressure blowers, hammers, chisels, punch, anvil, swag-block etc. Forging operations.

5.1 Forge a L hook or Ring from MS rod 6 mm φ

5.2 Forge a chisel and give an idea of hardening and tempering

5.3 Lap joint with forge welding

5.4 High Strength Steel (HSS) tools – forging of Lathe shaper tools like side-tools and V-shape tools

5.5 Making sheet metal joints

5.6 Making sheet metal trey or a funnel or a computer chassis

5.7 Preparation of sheet metal jobs involving rolling, shearing, creasing, bending and cornering

5.8 Prepare a lap riveting joint of sheet metal pieces

6. **Electric Shop**

6.1 Demonstration of tools commonly used in Electric Shop

6.2 Safety precautions, electric shock treatment

6.3 Demonstration of Common Electric material like: wires, fuses, ceiling roses, battens, cleats and allied items

6.4 Demonstration of Voltmeter, Ammeter, Multimeter and Energy meter

Job: Wiring practice in batten wiring, plastic casing-capping and conduit

Job: Control of one lamp by one switch

Job: Control of one lamp by two switches

Job: Control of one bell by one switch

Job: Assemble a Tube light

Job: Dismantle, study, find out fault, repair the fault, assemble and test domestic appliances like electric iron, electric mixer, ceiling and table fan, tube-light, water heater (geyser) and desert cooler

Job: Laying out of complete wiring of a house (Single-phase and Three-phase)

7. **Electronics Shop**
7.1 Identification, familiarization, demonstration and use of the following electronic instruments:
   a) Multi-meter digital
   b) Single beam simple CRO, function of every knob on the front panel
   c) Power supply, fixed voltage and variable voltage, single output as well as dual output.

7.2 Identification, familiarization and uses of commonly used tools; active and passive components; colour code and types of resistor and potentiometers

7.3 Cut, strip, join and insulate two lengths of wires/cables (repeat with different types of cables/wires)

7.4 Demonstrate and practice the skill to remove components/wires by unsoldering

7.5 Cut, bend, tin component, leads, inserts. Solder components e.g. resistor, capacitor, diodes, transistors on a PCB

7.6 Wiring of a small circuit on a PCB/tag strip involving laying, sleeving and use of identifier tags

7.7 Demonstrate the joining (or connecting) methods/mounting and dismantling method, as well as uses of the items mentioned below:
   a) Various types of plugs, sockets, connectors suitable for general-purpose audio video use. Some of such connectors e.g. 2 and 3 pin mains plug and sockets, Banana plugs, sockets and similar male and female connectors and terminal strips.
   b) 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.

7.8 Exposure to modern soldering and de-soldering processes (Field visits)

7.9 De-solder pump, remove and clean all the components and wires from a given equipment, a PCB or a tag strip.
2.1 COMMUNICATING EFFECTIVELY IN ENGLISH
II SEMESTER SYLLABUS

RATIONALE

Interpersonal communication is a natural and necessary part of organizational life. Yet communicating effectively can be challenging because of our inherent nature to assume, overreact to and misperceive what actually is happening. Poor or lack of communication is often cited as the cause of conflict and poor teamwork. In today’s team-oriented workplace, managing communication and developing strategies for creating shared meaning are crucial to achieving results and creating successful organizations. The goal of the Communicating Effectively in English course is to produce civic-minded, competent communicators. To that end, students must demonstrate oral as well as written communication proficiency. These include organizational and interpersonal communication, public address and performance.

II SEMESTER 48 hrs

1. LISTENING COMPREHENSION 4hrs
   1.1 Locating Main Ideas in a Listening Excerpt
   1.2 Note-taking

2. ORAL COMMUNICATION SKILLS 14 hrs
   2.1 Offering-Responding to Offers
   2.2 Requesting-Responding to Requests
   2.3 Congratulating
   2.4 Expressing Sympathy and Condolences
   2.5 Expressing Disappointments
   2.6 Asking Questions-Polite Responses
   2.7 Apologizing, Forging
   2.8 Complaining
   2.9 Persuading
   2.10 Warning
   2.11 Asking for and Giving Information
   2.12 Giving Instructions
   2.13 Getting and Giving Permission
   2.14 Asking For and Giving Opinions
3. GRAMMAR AND USAGE 10hrs
3.1 Prepositions
3.2 Pronouns
3.3 Determiners
3.4 Conjunctions
3.5 Question and Question Tag
3.6 Tenses (Simple Present, Simple Past)

*One chapter revising the topics discussed during the first semester. (Punctuation, Articles, Framing questions, Verbs, Word formation)

4. WRITING SKILLS 10hrs
4.1 Writing Notice
4.2 Writing Circular
4.3 Writing a Memo
4.4 Agenda for a Meeting
4.5 Minutes of the Meeting
4.6 Telephonic Messages

*Writing a paragraph will be a continuous exercise throughout the session. (Writing will be based on verbal stimuli, tables and graphs.)

5. READING SKILLS 10hrs
5.1 Vocabulary Enhancement
5.2 Techniques of reading: Skimming, Scanning, Intensive and Extensive Reading

NOTE: The Reading Skills of the learners (along with vocabulary enhancement) will be through reading thematic articles/essays and/or stories.
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2.2 APPLIED MATHEMATICS-II

RATIONALE

Applied Mathematics forms the backbone of engineering discipline. Basic elements of differential calculus, integral calculus, differential equations and coordinate geometry have been included in the curriculum as foundation course and to provide base for continuing education to the students.

DETAILED CONTENTS

1. Co-ordinate Geometry (18 hrs)
   1.1 Area of a triangle, centroid and incentre of a triangle (given the vertices of a triangle), Simple problems on locus
   1.2 Equation of straight line in various standard forms (without proof) with their transformation from one form to another, Angle between two lines and perpendicular distance formula (without proof)
   1.3 Circle: General equation and its characteristics given:
      \(\frac{1}{4}\) The center and radius
      \(\frac{1}{4}\) Three points on it
      \(\frac{1}{4}\) The co-ordinates of the end’s of the diameter
   1.4 Conics (parabola, ellipse and hyperbola), standard equation of conics (without proof), given the equation of conic to calculate foci, directrix, eccentricity, latus rectum, vertices and axis related to different conics

2. Differential Calculus (22 hrs)
   2.1 Concept of function, four standard limits
      \[
      \begin{align*}
      \lim_{x \to a} \frac{x^n - a^n}{x - a}, & \quad \lim_{x \to 0} \frac{\sin x}{x}, \quad \lim_{x \to \frac{1}{x}} \frac{(a^x - 1)}{x}, \quad \lim_{x \to 0} (1+x)^{1/x}
      \end{align*}
      \]
   2.2 Concepts of differentiation and its physical interpretation
      \(\frac{1}{4}\) Differentiation by first principle of \(x^n, (ax + b)^n, \sin x, \cos x, \tan x, \sec x, \cosec x \) and \(\cot x, e^x, a^x, \log x \). Differentiation of a function of a function and explicit and implicit functions
      \(\frac{1}{4}\) Differentiation of sum, product and quotient of different functions
      \(\frac{1}{4}\) Logarithmic differentiation. Successive differentiation excluding \(n^{th}\) order
   2.3 Application of derivatives for (a) rate measure (b) errors (c) real root by Newton’s method (d) equation of tangent and normal (c) finding the maxima and minima of a function (simple engineering problems)
3. Integral Calculus (16 hrs)

3.1 Integration as inverse operation of differentiation

3.2 Simple integration by substitution, by parts and by partial fractions

3.3 Evaluation of definite integrals (simple problems) by explaining the general properties of definite integrals

3.4 Applications of integration for
   ¾ Simple problem on evaluation of area under a curve where limits are prescribed
   ¾ Calculation of volume of a solid formed by revolution of an area about axis (simple problems) where limits are prescribed
   ¾ To calculate average and root mean square value of a function
   ¾ Area by Trapezoidal Rule and Simpson’s Rule

4. Differential Equations (8 hrs)

   Solution of first order and first degree differential equation by
   ¾ Variable separation
   ¾ Homogeneous differential equation and reducible homogeneous differential equations
   ¾ Linear differential equations and reducible linear differential equations

RECOMMENDED BOOKS

1. Higher Engineering Mathematics by BS Grewal
2. Engineering Mathematics by BS Grewal
4. Engineering Mathematics by Ishan Publication
5. Applied Mathematics Vol. II by SS Sabharwal and Others; Eagle Parkashan, Jalandhar
6. Engineering Mathematics by IB Prasad
7. Applied Mathematics Vol. II by Dr RD Sharma
2.3 APPLIED PHYSICS- II

RATIONALE

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

DETAILED CONTENTS

1. Waves and vibrations (8 hrs)
   1.1 Waves, Generation of waves by vibrating particles.
   1.2 Types of wave motion, transverse and longitudinal wave motion with examples
   1.3 Relation between velocity of wave, frequency and wave length of a wave \( v = \frac{\eta}{\lambda} \)
   1.4 Simple harmonic motion: definition, expression for displacement, velocity, acceleration, time period, frequency in S.H.M.
   1.5 Vibration of spring mass system, cantilever and determination of their time period.
   1.6 Free, forced and resonant vibrations with examples

2. Applications of sound waves (8 hrs)
   2.1 Acoustics of buildings-reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation
   2.2 Ultrasonics-Methods of production (magnetostriction and piezoelectric) and their engineering applications to cold welding, drilling, cleaning, flaw detection and SONAR

3. Principles of optics (8 hrs)
   3.1 Review of concept of mirrors, lenses, reflection & refraction of light, refractive index, lens formula (no derivation), real and virtual image, magnification.
   3.2 Power of lens
   3.3 Simple and compound microscope, astronomical telescope, magnifying power and its calculation (in each case)
   3.4 Total internal reflection, critical angle and conditions for total internal reflection.

4. Electrostatics (10 hrs)
   4.1 Coulomb’s law, unit charge
   4.2 Gauss’s Law
   4.3 Electric field intensity and electric potential
4.4 Electric field of point charge, charged sphere, straight charged conductor, plane charged sheet
4.5 Capacitance, types of capacitors, capacitance of parallel plate capacitor, series and parallel combination of capacitors
4.6 Dielectric and its effect on capacitors, dielectric constant and dielectric

5. Current Electricity  
5.1 Ohm’s law
5.2 Resistance of a conductor, specific resistance, series and parallel Combination of resistors, effect of temperature on resistance
5.3 Kirchhoff’s laws, Wheatstone bridge principle and its applications
5.4 Heating effect of current and concept of electric power

6. Semi conductor physics  
6.1 Energy bands, intrinsic and extrinsic semi conductor, p-n junction diode and its characteristics
6.2 Diode as rectifier-half wave and full wave rectifier, semi conductor transistor pnp and npn (concept only)

7. Modern Physics  
7.1 Lasers: concept of energy levels, ionizations and excitation potentials; spontaneous and stimulated emission; lasers and its characteristics, population inversion, types of lasers, ruby laser and applications
7.3 Fiber optics: Introduction and applications
7.4 Super conductivity: Phenomenon of super conductivity, Type I and Type II super conductor and its applications

LIST OF PRACTICALS
1. To determine and verify the time period of cantilever by drawing graph between load and depression
2. To determine the magnifying power of a compound microscope
3. To determine the magnifying power of an astronomical telescope
4. To verify Ohm’s law
5. To verify law of resistances in series
6. To verify law of resistances in parallel
7. To convert a galvanometer into an ammeter of given range
8. To convert a galvanometer into a voltmeter of a given range

RECOMMENDED BOOKS
1. Concept of Physics Prof. H.C. Verma, Part-1 (Bharti Bhawan)
2. Concept of Physics, Prof. H.C. Verma, Part-2 (Bharti Bhawan)
3. A Text Book of Applied Physics: Egale Parkashan, Jullandhar
RATIONALE

The role of Chemistry and chemical products in every branch of engineering is expanding greatly. Now a day's various products of chemical industries are playing important role in the field of engineering with increasing number of such products each successive years. The strength of materials, the chemical composition of substances, their behavior when subjected to different treatment and environment, and the laws of heat and dynamic energy have entered in almost every activity of modern life. Chemistry is considered as one of the core subjects for diploma students in engineering and technology for developing in them scientific temper appreciation of chemical properties of materials, which they have to handle in their professional career. Effort should be made to teach this subject through demonstration and with the active involvement of students.

DETAILED CONTENTS

1. Metallurgy (10 hrs)
   1.1 A brief introduction of the terms: Metallurgy (types), mineral, ore, gangue or matrix, flux, slag, concentration (methods of concentrating the ores), roasting calcination and refining as applied in relation to various metallurgical operations.
   1.2 Metallurgy of (i) Aluminium (ii) Iron (iii) copper with their physical and chemical Properties.
   1.3 Definition of an alloy, purposes of alloying, composition, properties and uses of alloys-brass, bronze, monel metal, magnalium, duralumin.

2. Fuels (10 hrs)
   2.1 Definition of a 'Fuel', characteristics of a good fuel and classification of fuels with suitable examples
   2.2 Definition of Calorific value of a fuel and determination of calorific value of a liquid fuel with the help of Bomb calorimeter. Simple numerical problems based upon Bomb-calorimeter method of finding the Calorific values
   2.3 Brief description of 'Proximate' and 'Ultimate' analysis of a fuel. Importance of conducting the proximate and ultimate analysis of a fuel
   2.4 Qualities of a good fuel and merits of gaseous fuels over those of other varieties of fuels
   2.5 Manufacture, composition, properties and uses of (i) Water gas (ii) Oil gas (iii) Biogas (iv) LPG (V) CNG
3 Corrosion (3 hrs)
3.1 Meaning of the term 'corrosion' and its definition
3.2 Theories of corrosion i.e. (i) direct chemical action theory and (ii) electro chemical theory
3.3 Prevention of corrosion by
  1. (a) Alloying
     (b) Providing metallic coatings
  2. Cathodic protections: (a) Sacrificial
     (b) Impressed voltage method

4 Lubricants (4 hrs)
4.1 Definition of (i) lubricant (ii) lubrication
4.2 Classification of lubricants
4.3 Principles of lubrication
   (i) fluid film lubrication
   (ii) boundary lubrication
   (iii) extreme pressure lubrication
4.4 Characteristics of a lubricant such as viscosity, viscosity index, volatility oiliness, acidity, emulsification, flash point and fire point and pour point.

5. Classification and Nomenclature of Organic Compounds (7 hrs)
5.1 Homologous series
5.2 IUPAC Nomenclature of Hydrocarbons, Alcohols, Aldehydes and Ketones & Carboxylic acids
5.3 Hydrocarbons (Alkanes, Alkenes and Alkynes)-general preparation, Chemical properties and uses.
5.4 Alcohols (Diols and Triols not included)-general preparation, Chemical properties and uses.
5.5 Aldehydes and Ketones preparation properties and uses.
5.6 Monocarboxlic acids-general preparation, chemical properties and uses

6 Rubber and Polymers (2 hrs)
6.1 Definition of Rubber and Polymers
6.2 Types of Rubber
6.3 Classification of Polymers
6.4 Composition and uses of Polythene, PVC, Teflon, Bakelite.

LIST OF PRACTICALS
1. Gravimetric analysis and study of apparatus used there in
2. To determine the percentage composition of a mixture consisting of a volatile and a non-volatile substances
3. Determine the viscosity of a given oil with the help of “Redwood viscometer”
4. Estimate the amount of ash in the given sample of coal
5. Determination of copper in the given brass solution, or sample of blue vitriol volumetrically
6. Electroplate the given strip of Cu with Ni
7. Detection of organic compounds (Aldehydes, Ketones, Carboxylic acid, and Amines)

RECOMMENDED BOOKS
1. “A Text Book of Applied Chemistry-I” by SS Kumar; Tata McGraw Hill, Delhi
3. Engineering Chemistry by Dr. S. Rabindra and Prof. B.K. Mishra ; Kumar and Kumar Publishers (P) Ltd. Bangalore-40

Other additional books for reading
1. Engineering Chemistry by Jain PC and Jain M
2. Chemistry of Engineering by Aggarwal CV
3. Chemistry for Environmental Engineers by Swayer and McCarty, McGraw Hill, Delhi
4. Progressive Applied Chemistry -I and II by Dr. G.H. Hugar; Eagle Prakashan, Jalandhar
2.5 GENERAL ENGINEERING

RATIONALE
An engineering diploma holder has to assist in activities of civil construction, installation, operation and maintenance etc of different machines and equipment. These activities are not branch specific and instead require him to know basics of civil, electrical and mechanical engineering. The subject of General Engineering has been included to impart basic knowledge of civil, electrical and mechanical engineering to the students.

Note:
1. The students of civil engineering will be studying only Part A (Mechanical Engineering) and Part B (Electrical Engineering)
2. The students of Electrical engineering, Electronics and Communication Engineering, Instrumentation and Control, Computer Engineering and Information Technology will be studying only Part A (Mechanical Engineering) and Part C (Civil Engineering)
3. The students of Mechanical Engineering will be studying only Part B (Electrical Engineering) and Part C (Civil Engineering)
4. The students of other branches of engineering and technology will be studying all the three Parts A (Mechanical Engineering), Part B (Electrical Engineering) and Part C (Civil Engineering), unless specified otherwise
5. A time of 2 hours per week has been allotted to Mechanical Engineering, 2 hours per week to Electrical Engineering and 1 hour per week to Civil Engineering in the lecture hours, for teaching theory and a lump-sum time of 2 hours week has been allotted for the Practicals.
DETAILED
CONTENTS PART -A
MECHANICAL ENGINEERING

Theory

1. Transmission of Power: (8 hrs)
   1.1 Transmission of power through belt, rope drives and pulleys, gears and chains
   1.2 Different type of pulleys and their application
   1.3 Chain drives and its comparison with belt drive
   1.1 Gear drives, types of gears, simple gear trains and velocity ratio

2. Internal combustion Engines: (14 hrs)
   2.1 Classification and application of IC Engines commonly used: spark ignition and compression ignition engines.
   2.2 Working principles of two stroke and four stroke petrol and diesel engines
   2.3 Ignition system in petrol engines i.e. spark ignition, magneto ignition
   2.4 Spark plug
   2.5 Carburetor
   2.6 Cooling system of IC Engines: Lubrication of IC Engines
   2.7 General maintenance of engines

3. Air Conditioning System: (8 hrs)
   3.1 Basic principle of refrigeration and air conditioning
   3.2 Working of centralized air conditioner
   3.3 Concept of split air conditioner and its applications

4. Pumps: Types and their uses (2 hrs)

PRACTICAL EXERCISES IN MECHANICAL ENGINEERING

1. Study of main parts of 4 stroke petrol and diesel engines by actually dismantling them (The idea is to acquaint the students with the most common troubles occurring in the engines)
2. Study of main parts of 2 stroke petrol engine by actually dismantling it. (The idea is to acquaint the students with the most common trouble occurring in the engines)
3. Study of ignition system of petrol engines
4. Study of fuel and air circuit of a petrol engine
5. Study of fuel injection system and air circuit of a diesel engine
6. Study of cooling system and lubricating (including greasing) of an IC Engine
7. Study of friction clutch
8. Study of hydraulic brake
9. Study of various drives for transmission of powers. Models of belts, pulleys, gears, chains and clutches
10. Study of air conditioning system in a building

NOTE: Study will include dismantling and reassembling of actual parts

PART B
ELECTRICAL ENGINEERING
Theory

5. Application and Advantages of Electricity: (3 hrs)
   5.1 Difference between AC and DC
   5.2 Various applications of electricity
   5.3 Advantages of electrical energy over other types of energy

6. Basic Quantities of Electricity: (4 hrs)
   6.1 Definition of voltage, current, power and energy with their units
   6.2 Name of the instruments used for measurement of quantities given in 5.1
   6.3 Connection of the instruments in 5.2 in electric circuit

7. Various Types of Power Plants: (4 hrs)
   7.1 Elementary block diagram of thermal, hydro and nuclear power stations
   7.2 Brief explanation of the principle of power generation in above power stations

8. Elements of Transmission Line: (4 hrs)
   8.1 Pictorial diagram of a three-phase transmission and distribution system showing transformers, supports, conductors, insulators and earth wire etc.
   8.2 Brief function of accessories of transmission lines
   8.3 Earthing of lines, substation and power station - need and practices adopted

9. Distribution System: (4 hrs)
9.1 Distinction between high and low voltage distribution system
9.2 Identification of three phase wires, neutral wires and the earth wire on a low voltage distribution system
9.3 Identification of the voltage between phases and between one phase and neutral
9.4 Distinction between three phase and single phase supply

10. Supply from the Poles to the Distribution Board: (3 hrs)

10.1 Arrangement of supply system from pole to the distribution board
10.2 Function of service line, energy meter, main switch, distribution board

11. Domestic Installation: (4 hrs)

11.1 Distinction between light and fan circuits and single phase power circuit, sub circuits
11.2 Various accessories and parts of installation, identification of wiring systems
11.3 Common safety measures and earthing
11.4 Introduction to BIS code of safety and wiring installation

12. Electric Motors and Pumps: (6 hrs)

12.1 Definition and various application of single phase and three phase motors
12.2 Connection and starting of three phase motors by star delta starter
12.3 Conversion of horse power in watts or kilowatts
12.4 Type of pumps and their applications

PRACTICAL EXERCISES IN ELECTRICAL ENGINEERING:

1. Use of Megger:
   **Objective:** To make the students familiar with different uses of megger

2. Connection of a three phase motor and starter including fuses and reversing of direction of rotation.
   **Objective:** Students may be made familiar with the equipment needed to control a three-phase motor
   The students must experience that by changing any two phases, the direction of rotation is reversed.

3. Connection of a lamp, ceiling fan, socket outlet, geyser, floor grinder,
voltage stablizer etc.

**Objective:** Students may be made familiar with the different types of equipment and circuits used in the domestic installations

4. **Trouble shooting in a three-phase motor**

**Note:** The teacher may create anyone of the following faults

(a) Loose connections  
(b) Blown fuse  
(c) Tripped overload protection  
(d) Incorrect direction of rotation  
(e) Single phasing  
(f) Burnt winding to be simulated by a loose connection behind a terminal box.

**Objective:** The students must be able to detect the most common faults, which may occur in a three-phase motor, using meggar wherever necessary

5. **Trouble shooting in a domestic wiring system.**

**Note:** The teacher may introduce a fault in the existing wiring system of a classroom or workshop like

(a) blown fuse  
(b) loose connection  
(c) faulty components/accessories etc.

**Objective:** Students must be able to detect common faults which may occur in a domestic wiring system

6. **Treatment of electric shock**

**Note:** The teacher may give a demonstration how an electric shock must be treated.

**Objective:** Students must be trained to treat the persons suffering from an electric shock

7. **Study of a distribution Board**

**Note:** Students may be asked to study the distribution board in the institution and note down all accessories.

**Objective:** Students must be made familiar with the distribution board

8. **Connections and reading down an energy meter**

**Objective:** Students may be asked to connect an energy meter to a load and calibrate reading

9. **Demonstration in electrical machine laboratory**

**Objective:** Students may be shown different types of electrical
machines and their starters and should be told that the three-phase induction motors are most commonly used.

10. Study of submersible motor pump set:
   **Objective:** To tell use of the set in water supply and irrigation works.

**PART C**

**CIVIL ENGINEERING**

**Theory**

13. Construction Materials (3 hrs)
   Basics of various construction materials such as stones, bricks, lime, cement and timber along with their properties, physical/field testing and uses, elements of brick masonry.

14. Foundations (6 hrs)
   i) Bearing capacity of soil and its importance
   ii) Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machines

15. Concrete (4 hrs)
   Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/field testing of concrete, mixing of concrete

16. RCC (3 hrs)
   Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building

**PRACTICAL EXERCISES IN CIVIL ENGINEERING**

1. Testing of bricks
   a) Shape and size
   b) Soundness test
   c) Water absorption
   d) Crushing strength

2. Testing of concrete
   a) Slump test
b) Compressive Strength of concrete cube

3. The students should be taken to different construction sites to show them various construction materials, concreting process and construction of RCC structural elements, foundations and other civil works

INSTRUCTIONAL STRATEGY

While imparting instructions, teachers are expected to lay more emphasis on concepts and principles. It will be better if the classes for general engineering are conducted in the laboratories and organized demonstrations for explaining various concepts and principles.

RECOMMENDED BOOKS Mechanical Engineering
1. General Mechanical Engineering by M. Adithan; TTTI, Chandigarh
2. Basic Civil and Mechanical Engineering by Jayagopal; Vikas Publications, New Delhi
3. IC Engines and Automobile Engineering by Dr.MP Poonia, Standard Publishers, New Delhi
4. Refrigeration and Air Conditioning by RK Rajput; SK Kataria and sons; Ludhiana
5. Theory of Machines by RS Khurmi and JK Gupta; S. Chand and Company Ltd., New Delhi

Electrical Engineering
1. Electrical Technology Part 1: Basic Electrical Engineering by Theraja, BL; S Chand and Company, New Delhi
3. Basic Electrical Engineering by Mehta VK; S Chand and Company, New Delhi
5. Basic Electrical and Electronics Engineering by SK Sahdev; Dhanpat Rai and sons, New
7. Basic Electricity by BR Sharma; Satya Parkashan, New Delhi

**Civil Engineering**

5. Building Construction by J Jha and Sinha; Khanna Publishers, Delhi
7. Civil Engineering Materials by SV Deodhar and Singhai; Khanna Publishers, Delhi
8. Soil Mechanics and foundation Engineering by SK Garg; Khanna Publishers, Delhi
2.6 ENGINEERING DRAWING – II

RATIONALE

Drawing is said to be the language of engineers and technicians. Reading and interpreting engineering drawing is their day-to-day responsibility. The course is aimed at developing basic graphic skills so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation.

Note: 1. First angle projection is to be followed
2. Minimum of 15 sheets to be prepared by each student
3. SP 46 – 1988 should be followed
4. Instructions relevant to various drawings may be given along with appropriate demonstration, before assigning drawing practice to the

DETAILED CONTENTS

1. Detail and Assembly Drawing (2 sheets)
   1.1 Principle and utility of detail and assembly drawings
   1.2 Wooden joints i.e. corner mortice and tenon joint, Tee halving joint, Mitre faced corner joint, Tee bridle joint, Crossed wooden joint, Cogged joint, Dovetail joint, Through Mortice and Tenon joint, Corner and Through halving joint, Closed Mortise and Tenon joint

2. Threads (3 sheets)
   2.1 Nomenclature of threads, types of threads (metric), single and multiple start threads
   2.2 Forms of various external thread sections such as V, square and acme threads, BA, BSW and Knuckle, Metric, Seller Thread, Buttress Threads
   2.3 Simplified conventions of left hand and right hand threads, both external and internal threads

3. Locking Devices (1 sheet)
   Lock nuts, castle nuts, split pin nuts, sawn nuts, slotted nut

4. Nuts and Bolts (3 sheets)
   Different views of hexagonal and square nuts; Different views of hexagonal
and square nuts; Assembly of hexagonal headed, square headed, square headed with square neck bolts with hexagonal and square nuts and washers. Foundations bolts – Rag bolt and Lewis bolt

5. Screws, Studs and Washers (1 sheet)
   5.1 Drawing various types of machine screws
   5.2 Drawing various types of studs and set screws

6. Keys and Cotters (3 sheets)
   6.1 Various types of keys and cotters and their practical application and preparation of drawing of various keys and cotters showing keys and cotters in position
   6.2 Cotter joints (i) sleeve and cotter joint (ii) gib and cotter joint (iii) knuckle joint (iv) Spigot and socket joint

7. Rivets and Riveted Joints (2 sheets)
   7.1 Types of structural and general purpose rivet heads
   7.2 Caulking and fullering of riveted joints
   7.3 Types of riveted joints – lap, butt (single riveted, double riveted lap joint, single cover plate and double cover plate), chain and zig – zag riveting

8. Welded Joints (1 sheet)
   8.1 Various conventions and symbols of welded joints (IS 696)
   8.2 Practical applications of welded joints say joints on steel frames, windows, doors and furniture

9. Couplings (2 sheets)
   9.1 Muff or Box coupling, half lap muff
9.2 Flange coupling (Protected and non-protected)

9.2 Flexible coupling

10. Symbols and Conventions (2 sheets)

10.1 Civil engineering sanitary fitting symbols

10.2 Electrical fitting symbols for domestic interior installations

10.3 Building plan drawing with electrical and civil engineering symbols

11. Development of Surfaces (3 sheets)

11.1 Construction of geometrical figures such as square, pentagon, hexagon

11.2 Development of surfaces of cylinder, square, pentagonal and hexagonal, Prism, Cone and Pyramid, Sequence pentagonal and hexa pyramid

12. Inter-penetration of (2 sheets)

12.1 Cylinder to cylinder

12.2 Cylinder to cone

13. AUTO CAD

13.1 Concept of AutoCAD, Tool bars in AutoCAD, coordinate system, snap, grid, and ortho mode

13.2 Drawing commands – point, line, arc, circle, ellipse

13.3 Editing commands – scale, erase, copy, stretch, lengthen and explode

13.4 Dimensioning and placing text in drawing area

13.5 Sectioning and hatching

13.6 Inquiry for different parameters of drawing entity
Note: A minimum of 15 sheets should be prepared by each student

RECOMMENDED BOOKS

1. Elementary Engineering Drawing (in first angle projection) by ND Bhatt, Charotar Publishing House
2. A Text Book of Engineering Drawing by Surjit Singh Published by Dhanpat Rai and Co. Delhi
3. Engineering Drawing by PS Gill; published by SK kataria and Sons, New Delhi
2.7 GENERAL WORKSHOP PRACTICE – I & II

RATIONAL

Manual abilities to handle engineering materials with hand tools need to be developed in the students. They will be using different types of tools/equipment in different shops for fabrication purposes. Besides developing the necessary skills, the students will appreciate the importance of quality and safety measures.

DETAILED CONTENTS

Note: 1. The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

2. The shops to be offered in I and II semester may be decided at polytechnic level

3. The students should be taken to various shops (not included in the curriculum) in the polytechnic in batches and should be given knowledge of the various machines/equipment. Such as machine shop, foundry shop, sheet metal shop, etc.

4. Students of Diploma in Chemical Engineering will undergo Shops 1 to 6 only

Following seven shops are being proposed:

1. Carpentry shop
2. Fitting and plumbing shop
3. Welding shop
4. Paint shop
5. Forging and sheet metal shop
6. Electric shop
7. Electronics Shop

1. Carpentry Shop

1.1 Introduction to various types of wood, carpentry tools - their identification with sketches. Different types of wood joints.

1.2 Simple operations viz. hand sawing, marking, planning
1.3 Introduction and sharpening of wood working tools and practice of proper adjustment of tools

1.4 Demonstration and use of wood working machines i.e. band saw, circular saw, rip saw, bow saw and trammels. Universal wood working machine and wood turning lathe

1.5 Making of various joints (Also draw the sketches of various wooden joints in the Practical Note Book)
   a) Cross lap joint
   b) T-lap joint
   c) Corner lap joint
   d) Mortise and tenon joint
   e) Dovetail joint
   f) Prepare a file handle or any utility items by wood turning lathe

2. **Fitting and Plumbing Shop**

2.1 Introduction to fitting shop, common materials used in fitting shop, description and demonstration of various types of work-holding devices and surface plate, V-block

2.2 Demonstration and use of simple operation of hack-sawing, demonstration of various types of blades and their uses

2.3 Demonstrate and use of all important fitting shop tools with the help of neat sketches (files, punch, hammer, scraper, taps and dyes etc.)

2.4 Introduction of chipping, demonstration on chipping and its applications.
   Demonstration and function of chipping tools.

2.5 Description, demonstration and practice of simple operation of hack saw, straight and angular cutting.

2.6 Demonstrations, description and use of various types of blades - their uses and method of fitting the blade.

2.7 Introduction and use of measuring tools used in fitting shop like: Try square, Steel rule, Measuring Tape, Outside micrometer, Vernier Caliper and Vernier Height Gauge
2.8 Description, demonstration and practice of thread cutting using taps and dies

2.9 Plumbing: Descriptions and drawing of various plumbing shop tools, Safety precautions. Introduction and demonstration of pipe dies, Pipe holding devices, Demonstration and practice of Pipe Fittings such as Sockets, Elbow, Tee, Reducer, Nipple, Union coupling, plug, Bend, Float valves and Taps

Job: Cutting and filing practice on a square of 45 X 45 mm² from MS flat
Job: Angular cutting practice of 45° (on the above job)
Job: Preparation of stud (to cut external threads) with the help of dies (mm or BSW)
Job: Drilling, counter drilling and internal thread cutting with Taps
Job: H-Fitting in Mild steel (ms) square
Job: Pipe cutting practice and thread cutting on GI Pipe with pipe dies

3. Welding Shop

3.1 Introduction to welding, type of welding, common materials that can be welded, introduction to gas welding equipment, types of flame, adjustment of flame, applications of gas welding. Welding tools and safety precautions

3.2 Introduction to electric arc welding (AC and DC), practice in setting current and voltage for striking proper arc, precautions while using electric arc welding. Applications of arc welding. Introduction to polarity and their use

3.3 Introduction to brazing process, filler material and fluxes; applications of brazing. Use of solder. Introduction of soldering materials

3.4 Demonstrate and use of the different tools used in the welding shop with sketches. Hand shield, helmet, clipping hammer, gloves, welding lead, connectors, apron, goggles etc.

3.5 Demonstration of welding defects and Various types of joints and end preparation

Job: Preparation of cap joint by arc welding
Job: Preparation of Tee joint by arc welding
Job: Preparation of single V or double V butt joint by using
Electric arc welding
Job: Brazing Practice. Use of Speltor (on MS sheet pieces) Job: Gas welding practice on worn-out and broken parts

4. **Paint Shop**
Introduction of painting shop and necessity. Different types of paints. Introduction of powder coating plant and their uses.

Job: Preparation of surface before painting such as cleaning, sanding, putty, procedure and application of primer coat, and painting steel item.
Job: Painting practice by brush on MS sheet
Job: Practice of dip painting
Job: Practice of lettering: Name plates / Sign board
Job: Polishing and painting on wooden and metallic surfaces
Job: Practical demonstration of powder coating

5. **Forging and sheet metal shop**
Introduction to forging, forging tools, tongs, blowers/pressure blowers, hammers, chisels, punch, anvil, swag-block etc. Forging operations.

5.1 Forge a L hook or Ring from MS rod 6 mm φ

5.2 Forge a chisel and give an idea of hardening and tempering

5.3 Lap joint with forge welding

5.4 High Strength Steel (HSS) tools – forging of Lathe shaper tools like side-tools and V-shape tools

5.5 Making sheet metal joints

5.6 Making sheet metal trey or a funnel or a computer chassis

5.7 Preparation of sheet metal jobs involving rolling, shearing, creasing, bending and cornering

5.8 Prepare a lap riveting joint of sheet metal pieces

6. **Electric Shop**

6.1 Demonstration of tools commonly used in Electric Shop
6.2 Safety precautions, electric shock treatment

6.3 Demonstration of Common Electric material like: wires, fuses, ceiling roses, battens, cleats and allied items

6.4 Demonstration of Voltmeter, Ammeter, Multimeter and Energy meter

Job: Wiring practice in batten wiring, plastic casing-capping and conduit
Job: Control of one lamp by one switch
Job: Control of one lamp by two switches
Job: Control of one bell by one switch
Job: Assemble a Tube light
Job: Dismantle, study, find out fault, repair the fault, assemble and test domestic appliances like electric iron, electric mixer, ceiling and table fan, tube-light, water heater (geyser) and desert cooler
Job: Laying out of complete wiring of a house (Single-phase and Three-phase)

7. Electronics Shop

7.1 Identification, familiarization, demonstration and use of the following electronic instruments:

a) Multi-meter digital
b) Single beam simple CRO, function of every knob on the front panel
c) Power supply, fixed voltage and variable voltage, single output as well as dual output.

7.2 Identification, familiarization and uses of commonly used tools; active and passive components; colour code and types of resistor and potentiometers

7.3 Cut, strip, join and insulate two lengths of wires/cables (repeat with different types of cables/wires)

7.4 Demonstrate and practice the skill to remove components/wires by unsoldering

7.5 Cut, bend, tin component, leads, inserts. Solder components e.g. resistor, capacitor, diodes, transistors on a PCB

7.6 Wiring of a small circuit on a PCB/tag strip involving laying, sleeving and use of identifier tags

7.7 Demonstrate the joining (or connecting) methods/mounting and
dismantling method, as well as uses of the items mentioned below:

a) Various types of plugs, sockets, connectors suitable for general-purpose audio video use. Some of such connectors e.g. 2 and 3 pin mains plug and sockets, Banana plugs, sockets and similar male and female connectors and terminal strips.

b) 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.

7.8 Exposure to modern soldering and de-soldering processes (Field visits)

7.9 De-solder pump, remove and clean all the components and wires from a given equipment, a PCB or a tag strip.
3.1 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

RATIONALE

A diploma holder in Electrical Engineering will be involved in maintenance, repair and production of electrical equipment and systems. In addition, he may be required to procure, inspect and test electrical and electronic engineering materials. Knowledge of various types of materials will be needed in order to execute the above mentioned functions. He may also have to decide for an alternative when a particular material is either not readily available in the market or its cost becomes prohibitive.

DETAILED CONTENTS

1. Classification: (3 Hrs)
   Classification of material into conducting, semi conducting and insulating materials through a brief reference to their atomic structures and energy bands

2. Conducting Materials (12 Hrs)
   2.1 Introduction
   2.2 Resistance and factors affecting it such as alloying and temperature etc
   2.3 Superconductor
   2.4 Classification of conducting material as low resistivity and high resistivity materials
      Low resistance materials
         2.4.1 Copper:
            Its general properties as conductor, resistivity, temperature coefficient, density, mechanical properties of hard-drawn and annealed copper, corrosion, contact resistance. Application in the field of electrical engineering.
         2.4.2 Aluminium:
            General properties at conductor, resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solderability, contact resistance. Applications in the field of electrical engineering.
         2.4.3 Steel:
            General properties at conductor, resistivity, corrosion, temperature coefficient, density, mechanical properties, solderability, Applications in the field of electrical engineering.
         2.4.4 Introduction to handle conductors and its applications.
2.4.5 Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), their practical applications with reasons for the same

2.5 Applications of special metals e.g. Silver, Gold, Platinum etc.
2.6 High resistivity materials and their applications e.g., manganin, constantin, Nichrome, mercury, platinum, carbon and tungsten
2.7 Superconductors and their applications

3. Semi-conducting Materials (8 Hrs)

3.1 Introduction
3.2 Semi-conductors and their properties
3.3 Different semi-conducting materials (silicon and germanium) used in manufacture of various semiconductor devices (i.e p-type and n-type semiconductors)
3.4 Materials used for electronic components like resistors, capacitors, diodes, transistors and inductors etc.

4. Insulating materials; General Properties: (12 Hrs)

4.1 Electrical Properties:
Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant
4.2 Physical Properties:
Hygroscopicity, tensile and compressive strength, abrasive resistance, brittleness
4.3 Thermal Properties:
Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro-thermal breakdown in solid dielectrics
4.4 Chemical Properties:
Solubility, chemical resistance, weather ability
4.5 Mechnical properties, mechanical structure, tensile structure

5. Insulating Materials and their applications: (12 Hrs)

5.1 Plastics
5.1.1 Definition and classification
5.1.2 Thermosetting materials:
Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and Malamine-formaldehyde), epoxy resins - their important properties and applications
5.1.3 Thermo-plastic materials:
Polyvinyl chloride (PVC), polyethlene, silicons, their important properties and applications
5.2 Natural insulating materials, properties and their applications
   - Mica and Mica products
   - Asbestos and asbestos products
   - Ceramic materials (porcelain and steatite)
   - Glass and glass products
   - Cotton
   - Silk
   - Jute
   - Paper (dry and impregnated)
   - Rubber, Bitumen
   - Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
   - Enamels for winding wires
   - Glass fibre sleeves

5.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF₆ their properties and applications

6. Magnetic Materials: (9 Hrs)

6.1 Introduction - ferromagnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop (including) coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magnetostriction effect.

6.2 Soft Magnetic Materials:

   6.2.1 Alloyed steels with silicon, high silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines
   6.2.2 Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine
   6.2.3 Nickel-iron alloys
   6.2.4 Soft Ferrites

6.3 Hard magnetic materials
   Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications

7. Special Materials (4 hrs)
   Thermocouple, bimetals, lead soldering and fuse material, mention their applications

8. Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc (4 hrs)
RECOMMENDED BOOKS

2. Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi
7. Electrical & Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi
3.2 FUNDAMENTALS OF ELECTRICAL ENGINEERING

RATIONALE

For a diploma holder in electrical engineering, it becomes imperative to know the fundamentals of the subject in order to grasp the knowledge of the field. This subject will provide knowledge of fundamental concepts of electricity, magnetism and various principles related to it.

DETAILED CONTENTS

1. Applications and Advantages of Electrical Energy (03 hrs)
   1.1 Different forms of energy
   1.2 Advantages of electrical energy
   1.3 Difference between AC and DC
   1.4 Uses of electrical energy

2. Basic Electrical Quantities (03 hrs)
   2.1 Basic concept of charge, current, voltage, resistance, power, energy and their units
   2.2 Conversion of units of work, power and energy from one form to another

3. Batteries (10 Hrs)
   3.1 Basic idea about primary and secondary cells
   3.2 Working principle, construction and applications of Lead acid battery and Nickel Cadmium cells, Silver Oxide Cells
   3.3 Charging methods used for lead acid accumulator
   3.4 Care and maintenance of lead acid battery
   3.5 Grouping of cells in series and parallel (simple numerical problems).

4. DC Circuits (6 Hrs)
   4.1 Ohm’s law, resistances in series and parallel
   4.2 Kirchhoff laws and their applications in solving electrical network problems
   4.3 Network theorems such as theorem and Newton theorem
   4.4 Star-delta transformation

5. Magnetism and Electromagnetism: (6 Hrs)
   5.1 Introduction to electromagnetism, Magnetic field around a straight current carrying conductor and a solenoid and methods to find its direction, force between two parallel current carrying conductors.
   5.2 Force on a conductor placed in the magnetic field
5.3 Series magnetic circuits, simple problems
5.4 Concept of hysteresis, hysteresis loop and hysteresis loss.

6. Electromagnetic Induction: (8 Hrs)

6.1 Faraday's Laws of electromagnetic induction
6.2 Lenz's law
6.3 Fleming's Right and Left Hand Rule
5.3 Principle of self and mutual induction
5.4 Principle of self and mutually induced e.m.f. and simple problems
5.5 Inductances in series and parallel
5.6 Energy stand in a magnetic field
5.7 Concept of eddy currents, eddy current loss

7. AC Fundamentals (18 Hrs)

7.1 Concept of alternating current and voltage, equation of instantaneous values
7.2 Representation of alternating sinusoidal quantities by vectors
7.3 Phasor algebra (addition, subtraction, multiplication and division of complex quantities)
7.4 AC through pure resistance, inductance and capacitance
7.5 Concept of susceptance, conductance and admittance
7.6 Alternating voltage applied to RL, RC and RLC series and parallel circuits (impedance triangle, phasor diagram and their solutions)
7.7 Power in pure resistance, inductance, capacitance, RL, RC, RLC circuits
7.8 Active and reactive components of current and their significance
7.9 Power factor and its practical significance
7.10 Resonance in series and parallel circuits
7.11 J-notation and its application in solving problems in ac circuits

8. Polyphase systems

8.1 Advantages of 3 phase over single phase system
8.2 Star and delta connections (relationship between phase and line voltages, phase and line currents
8.3 Power in 3 phase circuits
8.4 Measurement of power and power factor of a 3 phase load by two wattmeter method

LIST OF PRACTICALS

1. To verify Ohm's law
2. To verify that \( R_t = R_1 + R_2 + \ldots \) where \( R_1, R_2 \) etc. are resistances connected in series
3. To verify \( R_t = \frac{R_1 R_2 R_3}{R_1 + R_2 + R_3} \) Where \( R_1, R_2 \) etc. are resistances connected in parallel
4. Verification of Kirchhoff’s laws applied to DC circuits
   a) to construct a circuit arrangement consisting of resistances in series, parallel combination
   b) identification of mesh points in the circuit
   c) to see that algebraic sum of currents at mesh point is zero
   d) to see that algebraic sum of e.m.f.s. and voltage drops in a closed loop is zero

5. Filament lamp
   a) measure the resistance of a cold lamp filament with the help of multimeter
   b) measure the current drawn by the lamp at different voltages from zero to 220 volts and the resistance of lamp at different voltages, plot a graph between resistance and voltage

6. To find ratio of inductance values of a coil having air/iron core respectively and to see the effect of introduction of a magnetic core on coil inductance

7. To construct an R-L series circuit and to measure:
   (a) impedance (Z) of the circuit
   (b) Inductive reactance (X_L) of the circuit by measuring voltage drop across the inductance dividing it by the current through the circuit
   c) to verify impedance \( Z = \sqrt{(R^2 + X_L^2)} \)
   d) to determine phase angle between voltage and current and its power factor
   e) construct its impedance triangle

8. To construct an RLC series circuit and to measure
   a) its impedance
   b) inductive (X_L) and capacitive reactance (X_C)
   c) verify \( z = \sqrt{R^2 + (X_L - X_C)^2} \)
   d) measure phase angle between voltage and current
   e) construct impedance triangle

9. Measurement of power and power factor of a single phase RC, RL and RLC circuit. To calculate KVA and KVAR

10. Measurement of power and power factor of a 3 phase circuit by using 2 wattmeter and 3 wattmeter method. To calculate KVA and KVAR

12. Testing a battery for its changed condition and to charge it

Note: The result should be verified analytically also.
RECOMMENDED BOOKS

1. Electrical Science by VK Mehta, S Chand & Co., New Delhi
2. Electrical Science by Sahdev, Unique International Publication, Jalandhar
3. Electrical Engineering by DR Arora, Ishan Publications, Ambala
4. Electrical Science by JB Gupta, SK Kataria & Sons, New Delhi
5. Electrical Technology by BL Theraja, S Chand & Co., New Delhi
6. Electrical Science by Trilok Singh, SK Kataria, New Delhi
3.3 BASIC ELECTRONICS

RATIONALE

At present electronics gadgets are being extensively used in manufacturing process in industries, power system operations, communication systems, computers etc. Even for an electrical diploma holder, it is absolutely necessary to take a basic understanding of electronics components, their function and applications. This understanding should facilitate in operation and maintenance equipments which are electronically controlled.

In this course, topics like electronics components, semi-conductor physics, rectifiers, and amplifiers have been included. The remaining topics are included in electronic devices and circuits.

DETAILED CONTENTS

1. Introduction (5 hrs)
   1.1 Brief history of development of electronics
   1.2 Active and passive components
   1.3 Concept of current and voltage sources, constant voltage and current sources, their graphical representation. Conversion of voltage source into current source and vice-versa
   1.4 Difference between actual voltage source and constant voltage source

2. Semi-conductor Theory (10 hrs)
   2.1 Atomic structure, crystalline structure
   2.2 Energy band theory of crystals, energy band structure of insulator, semiconductor and conductor, generation and recombination. Energy band structure of Silicon and Germanium
   2.3 Silicon versus Germanium for mobility and conductivity
   2.4 Concept of intrinsic and extrinsic semiconductors
   2.5 Effect of temperature on intrinsic and extrinsic semiconductors

3. Semiconductor Diodes (10 hrs)
   3.1 PN Junction, mechanism of current flow in PN junction, drift and diffusion currents, depletion layer, potential barrier, effect of forward and reverse biasing and a PN junction. Concept of junction capacitance in forward and reverse biased conditions. Breakdown mechanism
   3.2 Ideal diode, Semiconductor diode characteristics, static and dynamic resistance
   3.3 Use of diode as half wave and full wave rectifiers (centre tapped and bridge type), relation between DC output and AC input voltage, rectifier efficiency
3.4 Concept of ripples, filter circuits – shunt capacitor, series inductor, and π filters and their applications
3.5 Diode ratings/specifications
3.6 Various types of diodes such as zener diode, varactor diode, schottky diode, light emitting diode, tunnel diode, photo diode; their working characteristics and applications
3.7 Zener diode and its characteristics
3.8 Use of zener diode for voltage stabilization

4. Bi-polar Transistors (7 hrs)
4.1 Concept of junction transistor, PNP and NPN transistors, their symbols and mechanism of current flow
4.2 Transistor configurations: common base (CB), Common emitter (CE) and common collection (CC), current relation and their input/output characteristics; comparison of the three configurations

5. Transistor Biasing and Stabilization (10 hrs)
5.1 Transistor biasing, its need, operating point and need of stabilization of operating point.
5.2 Difference between circuits, limitations, simple problems to calculate operating point in different biasing circuits. Use of thevenin theorem to determine operating point
5.3 Effect of temperature on the operating point of a transistor
5.4 Concept of h-parameters of a transistor
5.5 Use of data book to know the parameters of a given transistor

6. Single-Stage Transistor Amplifiers (10 hrs)
6.1 Single stage transistor amplifier circuit in CE configuration, function of each component
6.2 Working of single stage transistor amplifier, physical and graphical explanation, phase reversal
6.3 Concept of DC and AC load line
6.4 Voltage gain of single stage transistor amplifier using characteristics of the device
6.5 Concept of input and output impedance
6.6 AC equivalent circuit of single stage transistor amplifiers
6.7 Calculation of voltage gain using AC equivalent circuit
6.8 Frequency response of a single stage transistor amplifier

7. Multi-Stage Transistor Amplifiers (7 hrs)
7.1 Need of multi-stage transistor amplifiers – different types of couplings, their purpose and applications.
7.2 Knowledge of various terms such as voltage gain, current gain, power gain, frequency response, decibel gain and band width
7.3 RC coupled two-stage amplifiers, circuit details, working, frequency response, applications
7.4 Loading effect in multistage amplifiers
7.5 Elementary idea about direct coupled amplifier, its limitations and applications
7.6 Transformer coupled amplifiers, its frequency response. Effect of co-efficient of coupling on frequency response. Applications of transformer coupled amplifiers

8. Field Effect Transistor (FET)
   (05 hrs)

8.1 Construction, operation, characteristics and applications of a N channel JFET and P channel JFET
8.2 JFET as an amplifier
8.3 Construction, operation, characteristics and applications of a MOSFET in depletion enhancement mode
8.4 Comparison between BJT, JFET and MOSFET

LIST OF PRACTICALS

1. a) Identification and testing of electronic components such as resistor, inductor, capacitor, diode, transistor
   b) Measurement of resistances using multimeter and their comparison with colour code values

2. V-I characteristics of a Semiconductor diode and to calculate its static and dynamic resistance

3. a) V-I characteristics of a zenor diode and finding its reverse breakdown voltage
   b) Fabrication of a zenor diode voltage stabilizer circuit using PCB

4. Observation of input and output wave shapes of a half-wave rectifier and verification of relationship between dc output and ac input voltage

5. Observation of input and output wave shapes of a full wave rectifier and verification and relationship between dc and ac input voltage

6. Observation of input wave shape of a full wave rectifier with (i) shunt capacitor) (ii) series induction (iii) Π filter circuits

7. Plotting input and output characteristics of a transistor in CB configuration

8. Plotting input and output characteristics of a transistor in CE configuration

9. Measurement of operating point in case of (i) fixed biased circuit (ii) potential divider biasing circuit and to observe the effect of temperature variation on the operating point.
10. To measure the voltage gain of a single stage amplifier using CE configuration at different loads

11. To plot frequency response curve of a single stage transistor amplifier using semilog sheet and to measure its band width

12. To measure the voltage gain of a two-stage RC coupled amplifier (a) as individual stages (b) after coupling as multi-stage amplifier (c) to study effect of coupling capacitor on frequency response

13. To plot frequency response curve of a two stage RC coupled amplifier using semi-log sheet and measure the band width

14. To plot V-I characteristics of a FET

RECOMMENDED BOOKS

1. Basic Electronics and Linear Circuits by NN Bhargava, Tata McGraw Hill, New Delhi
2. Analog Electronics by BP Arora, Ishan Publications, Ambala
4. Electronic Devices and Circuits by R Boylestead
5. Electronic Devices and Circuits by Ravi Raj Dubey
6. Analog Electronics by JC Karhara, King India Publication, New Delhi
8. Principles of Electronics by SK Bhattacharya and Renu Vig, SK Kataria and Sons, Delhi
3.4 ELECTRICAL ENGINEERING DESIGN AND DRAWING - I

L T P
2 - 6

RATIONALE

A polytechnic pass-out in electrical engineering is supposed to have ability to:

i) Read, understand and interpret engineering drawings

ii) Communicate and correlate through sketches and drawings

iii) Prepare working drawings of alternative panels, transmission and distribution

The contents of this subject has been designed to develop requisite knowledge and skills of electrical drawings in the students of diploma in electrical engineering.

DETAILED CONTENTS

1. Simple light and Alarm Circuits (10 hrs)
   2.1 One lamp controlled by two switches (staircase circuit)
   2.2 Two lamps controlled by three switches (double staircase circuit)
   2.3 Circuit using master switch
   2.4 Fluorescent tube controlled from one switch
   2.5 One bell controlled by one push button
   2.6 Two ordinary bells (for day and night) used at a distant residence
   2.7 Nos. of bells controlled by separate switches
   2.8 Bell response circuit using one bell and one relay
   2.9 Bell response circuit of an office (for three rooms)
   2.10 Traffic light control system for two road crossing

2. Design and draw wiring circuit of a two room set for light and fan circuit (14 hrs)
   3.1 To draw Installation plan and wiring diagram of two room house
   3.2 Conductor size calculation
   3.3 List of material required with cost by doing market survey
   3.4 Description of various tests to test the wiring installation before commissioning

4. Orthographic Projection of Simple Electrical parts (8 hrs)
   4.1 Kit kat fuse base
   4.2 Kit kat fuse carrier
   4.3 Bus bar post
   4.4 Pin type and shackle type insulator
   4.5 Engineering translator
   4.6 Stay insulators
4.7 M.C.B.
4.8 E.L.C.B.
4.9 Bobbin of a small transformer/choke

RECOMMENDED BOOKS

1. Electrical Engineering Design and Drawings by Surjit Singh, Khanna Publishers, New Delhi
2. Electrical Engineering Design and Drawings by SK Bhattacharya, SK Kataria and Sons, New Delhi
3. Electrical Engineering Design and Drawings by Ubhi & Marwaha, IPH, New Delhi
4. Electrical Design and Drawing by SK Sahdev, Unique International Publications, Jalandhar
3.5 COMPUTER PROGRAMMING AND APPLICATIONS  
(For Electrical Engineering)

RATIONALE

Computers play a very vital role in present day life, more so, in the professional life of diploma engineers. With the extensive use of Information Technology in large number of areas, the diploma engineers should be well conversed with these environments. In order to enable the students to use the computers effectively in problem solving, this course offers the modern programming languages like C along with exposition to various engineering applications of computers.

DETAILED CONTENTS

1. Information Storage and Retrieval
   1.1 Need for information storage and retrieval
   1.2 Creating database file
   1.3 Querying database file on single and multiple keys
   1.4 Ordering the data on a selected key
   1.5 Programming a very simple application

2. Programming in C
   2.1 Basic structure of C programs
   2.2 Executing a C program
   2.3 Constants, variables, and data types
   2.4 Operators and expressions
   2.5 Managing Input-Output operations like reading a character, writing a character, formatted input, formatted output through print, scan, getch, putch statements etc.
   2.6 Decision making and branching using IF ..... else, switch, go to statements
   2.7 Decision making and looping using do-while, and for statements
   2.8 Arrays - one dimensional and two dimensional
   2.9 File
3. Computers Application Overview

3.1 Commercial and business data processing application

3.2 Engineering computation

3.3 CAD, CAM, CAE, CAI

4. Typical Applications:

Students will be required to make a small programme for analysis of circuits design in Electrical Engineering components or any other area.

Use of various software available in the field of electrical engineering

LIST OF PRACTICALS

2. Querying the database.
4. Programming in dbase
5. Use of spread sheets/Matlan/Mathematica/Eureka (or any other package) for engineering computers.
6. Use of design packages (appropriate design packages may be selected depending upon the availability) on Estimating and Costing, Analysis of rates and other areas
7. Use of and electrical engineering related CAI packages.
8. Programming for DAS and control.
9. Exercises on data acquisition.
10. Exercises on control - on/off switch, and proportional control.
11. Programming exercise on executing C program
12. Programming exercise on editing C program
13. Programming exercise on defining variables and assigning values to variables.
15. Programming exercise on arithmetic expressions and their evaluation.
17. Programming exercise on writing a character.
20. Programming exercise on simple if statement.
23. Programming exercise on go to statement.
26. Programming exercise on one-dimensional arrays.
27. Programming exercise on two-dimensional arrays.
28. Exercises on
   - Internet use/application
   - Typical application on Electrical Engineering

RECOMMENDED BOOKS

3. Programming in C by Kerning Lan and Riechie Prentice Hall of India, New Delhi
6. Vijay Mukhi Series for C and C++
3.6 ELECTRICAL WORKSHOP PRACTICE-I

RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers working under him. In addition, 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, fault finding, wiring in electrical appliances and installations.

DETAILED CONTENTS

1. Study of electrical safety measures and shock treatment

2. Wire jointing
   2.1 Straight married joint
   2.2 Technology-joint
   2.3 Western union joint
   2.4 Britania joint
   2.5 Twist sleeve joint
   2.6 Bolted type joint

3. Filling of thimbles and crimping of thimbles (using hydraulic and hand crimp)

4. Types of wiring and to make different light control circuits in the following types of wiring
   4.1 Casing caping (PVC) wiring
   4.2 Conduit wiring (surface/concealed)

5. Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and fuses (only internal connection)

6. Construction of an extension board with two 5A sockets, one 15A socket controlled by their respective switches, a fuse and indicator

7. Wiring of a switch board containing at least two switches, one fan regulator and one 5A socket controlled by their respective switches using (i) tumbler switches (ii) flush type switches

11. Wiring of a series test lamp board and to use it for finding out simple faults

12. Testing of domestic wiring installation using meggar
13. Fault finding and repair of a tube light circuit

14. Wiring and testing of alarm and indicating circuits using relay, push buttons and bells (simple single phase circuits)

15. Assembly of a 4-way distribution board using MCB, main switch and ELCB

16. Repair and maintenance of domestic electric appliances, i.e. electric iron, geyser, fan, heat converter, washing machine, desert room cooler, room heater, electric kettle, electric oven, electric furnace etc.
RATIONAL

Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications

DETAILED CONTENTS

1. Introduction to Electrical Machines (6 hrs)
   1.1 Definition of motor and generator
   1.2 Torque development due to alignment of two fields and the concept of torque angle
   1.3 Electro-magnetically induced emf
   1.4 Elementary concept of an electrical machine
   1.5 Comparison of generator and motor
   1.6 Generalised theory of electrical machines

2. DC Machines (24 hrs)
   2.1 Main constructional features, Types of armature winding
   2.2 Function of the commutator for motoring and generation action
   2.3 Factors determining induced emf equation
   2.4 Factors determining the electromagnetic torque
   2.5 Significance of types of machines
   2.6 Significance of back e.m.f., the relation between back emf and Terminal voltage
   2.7 Performance and characteristics of different types of DC motors
   2.8 Speed control of dc shunt/series motors
   2.9 Need of starter, three point dc shunt motor starter and 4 point starter
   2.10 Applications of DC motors
   2.11 Faults in dc machines and their retrospective
   2.12 Losses in a DC machine
   2.13 Determine of loses by Swimburn test

3. Transformers (single phase) (24 hrs)
   3.1 Introduction
   3.2 Constructional features of a transformer and parts of transformer
   3.3 Working principle of a transformer
   3.4 EMF equation
3.5 Transformer on no-load and its phasor diagram
3.6 Transformer on load (including voltage drops and its phasor diagram)
3.7 Transformer – neglecting voltage drop in the windings – Ampere turn balance – its phasor diagram
3.8 Mutual and leakage fluxes, leakage reactance
3.9 Equivalent circuit
3.10 Relation between induced emf and terminal voltage, regulation of a transformer—mathematical relation
3.11 Losses in a transformer
3.12 Open circuit and short circuit test. Calculation for efficiency, condition for maximum efficiency
3.13 Cooling of transformer, conservator
3.14 Auto transformer construction, working and applications
3.15 Different types of transformers

4. Three phase Transformers (10 hrs)
4.1 Construction of three phase transformer
4.2 Types of three phase transformer i.e. delta-delta, delta-star, star-delta and star-star
4.3 Conditions for parallel operation (only conditions are to be studied)
4.4 On load tap changer, ON/OFF load tap changer
4.5 Difference between power and distribution transformer
4.6 Cooling of transformer

LIST OF PRACTICALS

1. Introduction to electrical machines

   Measurement of the angular displacement of rotor of the three phase synchronous machine with respect to the stator on application of DC to the field winding and simultaneously to each phase-winding in sequence

   OR

   Measurement of the angular displacement of the rotor of a slip-ring induction motor on application of DC to stator of motor winding in sequence and simultaneously to each phase of rotor winding

2. DC machines

   2.1 Speed control of dc shunt motor (i) Armature control method (ii) Field control method
   2.2 Study of dc series motor with starter (to operate the motor on no load for a moment)
   2.3 Determination of efficiency of DC motor by swibuns test at (i) rated capacity (ii) half full load
3. Transformers (single phase)

3.1 To perform open circuit and short circuit test for determining equivalent circuit parameter of a transformer

3.2 To determine the regulation and efficiency from the data obtained from open circuit and short circuit test at full load

4. Three-phase transformers

4.1 Checking the polarity of the windings of a three phase transformer and connecting the windings in various configurations

4.2 Finding the voltage and current relationships of primary and secondary of a three phase transformer under balanced load in various configurations conditions

RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, New Delhi
2. Electrical Machines by SK Sahdev, Unique International Publications, Jalandhar
3. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi
4. Electrical Machines by SB Gupta, SK Kataria and Sons, New Delhi
## 4.2 ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS

### RATIONALE

Diploma holders in Electrical Engineering has to work on various jobs in the field as well as in testing laboratories and on control panels, where he performs the duties of installation, operation, maintenance and testing of measuring instruments. Persons working on control panels in power plants, substations and in industries, will come across use of various types of instruments and has to take measurements.

Instruments used to read and observe the general electrical quantities like current, voltage, power, energy, frequency, resistance etc and their wave shapes, have been incorporated in this subject. So the technician will know the construction and use of various types of instruments.

### DETAILED CONTENTS

1. **Introduction to Electrical Measuring Instruments:** (6 hrs)
   - 1.1 Concept of measurement and instruments
   - 1.2 Electrical quantities and instruments for their measurements
   - 1.3 Types of electrical measuring instruments – indicating, integrating and recording instrument
   - 1.4 Essentials of indicating instruments – deflecting, controlling and damping torque

2. **Ammeters and Voltmeters (Moving coil and moving iron type):** (6 hrs)
   - 2.1 Concept of ammeters and voltmeters and difference between them
   - 2.2 Construction and working principles of moving Iron and moving coil instruments
   - 2.3 Merits and demerits, sources of error and application of these instruments

3. **Wattmeters (Dynamometer Type)**
   - Construction, working principle, merits and demerits of dynamometer type wattmeter, sources of error
   - (4 hrs)

4. **Energymeter (Induction type):** (6 hrs)
   - Construction, working principle, merits and demerits of single-phase and three-phase energy meters
   - 4.1 Errors and compensation
   - 4.2 Simple problems
   - 4.3 Construction and working principle of maximum demand indicators
5 Miscellaneous Measuring Instruments: (10 hrs)

5.1 Construction, working principle and application of Meggar, Earth tester, Multimeter, Frequency meter (dynamometer type) single phase power factor meter (Electrodynamometer type). Working principle of synchroscope and phase sequence indicator, tong tester (Clamp-on meter)

5.2 Instrument Transformers: Construction, working and applications
   a) CT
   b) PT and their ratio and phase angle error

6. Electronics Instruments: (5 hrs)

6.1 Cathode Ray Oscilloscope: Block diagram, working of CRO and its various controls. Applications of CRO.
6.2 Digital multi-meter (only block diagram)

7. LRC meters. (3 hrs)

8. Power Measurements in 3-phase circuits: (2 hrs)

8.1 Three wattmeter method
8.2 Two watt meter method

9. Measurement of Non-electrical Quantities (Introduction only) (3 hrs)

9.1 Basic concept Pressure measurement, flow measurement, level measurement, displacement measurement

10. Measurement of Temperature (3 hrs)

Different types of thermometers, thermocouple, resistance temperature detector

LIST OF PRACTICALS

1. Use of multimeter for measuring voltage, current and resistance
2. To calibrate 1-phase energy meter by direct loading method.
3. To measure the value of earth resistance.
4. To measure power, power factor in a 1-phase circuit, using wattmeter and power factor meter and verify results with calculations.
5. Measurement of power and power factor of a three-phase balanced load by two wattmeter method.
6. Measurement of voltage, frequency of a Sinusoidal signal with CRO.
7. Measurement of power in a 3 phase circuit using CT, PT and 3-phase energy meter.
8. Connecting appropriate instruments at the supply of an installation to measure supply voltage, frequency, power, maximum demand, Phase sequence, energy consumed (Instruments to be used are CRO, VTVM, Maximum demand Indicator, phase sequence indicator, Energy meter and power factor meter)
9. Use of LCR meter for measuring inductance, capacitance and resistance.
RECOMMENDED BOOKS

1. Electrical Measurements and Measuring Instruments by Golding and Widdis; Wheeler Publishing House, New Delhi

2. Electrical Measurements and Measuring Instruments by SK Sahdev, Unique International Publications, Jalandhar

3. A Course in Electrical Measurement and Measuring Instruments by AK Sawhney and PL Bhatia; Dhanpat Rai and Sons, New Delhi

4. Electric Instruments by D. Cooper

5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi

6. Electronics Instrumentation by Umesh Sinha

7. Basic Electrical Measurements by Melville B. Staut.
4.3 ELECTRONIC DEVICES AND CIRCUITS

RATIONALE

The purpose of the introduction of electronics in the electrical engineering diploma course has been already explained in the rationale of the subject Basic Electronics in this course topic like Amplifiers, Oscillators and Wave Shape Circuits have been dealt with.

DETAILED CONTENTS

1. Transistor Audio Power Amplifier (10 hrs)
   1.1 Difference between voltage and power amplifier
   1.2 Important terms in Power Amplifier collector efficiency, distortion and dissipation capability
   1.3 Classification of power amplifier class A, B and C
   1.4 Class A single-ended power amplifier, its working and collector efficiency
   1.5 Impedance matching in a power amplifier using transformer
   1.6 Heat sinks in power amplifiers
   1.7 Push-pull amplifier circuit details, working and advantages (no mathematical derivations)
   1.8 Principles of the working of complementary symmetry push-pull amplifier

2. Tuned Voltage Amplifier (7 hrs)
   2.1 Introduction
   2.2 Series and paralleled resonance
   2.3 Single and double tuned voltage amplifiers
   2.4 Frequency response of tuned voltage amplifiers
   2.5 Applications of tuned voltage amplifiers

3. Feedback in Amplifiers (7 hrs)
   3.1 Feedback and its importance, positive and negative feedback and their need
   3.2 Voltage gain of an amplifier with negative feedback \( A = \frac{1}{1+AB} \)
   3.3 Effect of negative feedback on voltage gain, stability, distortion, band width, output and input impedance of an amplifier (No mathematical derivation)
   3.4 Typical feedback circuits
   3.5 Effect of removing the emitter by-pass capacitor on an ordinary CE transistor amplifier
   3.6 Emitter follower and its applications
4. **Sinusoidal Oscillators**

4.1. Sinusoidal Oscillators – positive feedback in amplifiers
4.2. Difference between an oscillator and an alternator
4.3. Essentials of an oscillator
4.4. Circuit details and working of LC oscillators viz. Tuned Collector, Hartley and Colpitt’s oscillators
4.5. R-C oscillator circuits, phase shift and Wein bridge oscillator circuits
4.6. Introduction to piezoelectric crystal and crystal oscillator circuit

5. **Wave-Shaping and Switching Circuits** (15 hrs)

5.1. Concept of Wave-shaping
5.2. Wave-shaping circuits
   5.2.1 R-C differentiating and integrating circuits
   5.2.2 Diode clipping circuits
   5.2.3 Diode clamping circuits
   5.2.4 Application of wave-shaping circuits
5.3. Transistor as a switch (explanation using CE transistor characteristics)
5.4. Collector coupled astable, monostable, bistable multivibrator circuits (explanation using wave shapes). Brief mention of uses of multivibrators
5.5. Working and applications of transistor inverter circuit using power transistors

8. **Working Principles of different types of power suppliers viz. CVTs, UPS, Stabilizers, SMPS, IC voltage regulator etc.** (5 hrs)

9. **Operational Amplifier**

7.1. The basic operational amplifier. The differential amplifier. The emitter coupled differential amplifier. Offset even voltages and currents
7.2. Basic operational amplifier applications, analog integrator and differentiator
7.3. Familiarisation with specifications and pin configuration of IC 741
7.4. Block diagram and operation of 555 IC timer

**LIST OF PRACTICALS**

1. To measure (a) optimum load (b) output power in Class A single-ended transistor amplifier
2. To measure (a) optimum load (b) output power (c) signal handling capacity in a push-pull amplifier
3. To measure voltage gain and plot the frequency response curve of single-stage feedback
4. To measure (a) voltage gain (b) input and output impedance for an emitter follower circuit
5. To measure frequency generation in (a) Hartley (b) Colpitt and (c) Wein bridge oscillators (d) phasing oscillator
6. To observe the differentiated and integrated square wave on a CRO for different values of R-C time constant
7. (i) Clipping of one portion of sine-wave using diode
8. Clipping of both portion of sine-wave using:
   a) diode and dc source
   b) zener diodes
   (ii) Clamping a sine-wave to:
      a) Negative dc voltage
      b) Positive dc voltage

9. To generate square-wave using an astable multivibrator and to observe the wave form on a CRO

10. To observe Triggering and working of a bistable multivibrator circuit and observe its output wave form on a CRO

11. To use the op-Amp (IC 741) as inverting one) and non-inverting amplifiers, adder, comparator, integrator and differentiator

12. To study the pin configuration and working of IC 555 and its use as nonostable and astable multivibrator

13. To realize the regulated power supply by using three terminal voltage regulator ICs such as 7805, 7905, 7915 etc.

RECOMMENDED BOOKS


2. Electronics Principles by SK Sahdev, Dhanpat Rai and Co., New Delhi


4. Operational Amplifiers and Linear Circuits by Rama Kant and A. Gaykwad, Prentice Hall of India, New Delhi


7. Analog Electronics – II by DR Arora, Ishan Publication, Ambala

8. Electronic Devices and Circuits by JC Karhara, King India Publication, New Delhi

9. Electronic Devices and Circuits-I, Eagle Prakashan, Jalandhar
4.4 ELECTRICAL ENGINEERING DESIGN AND DRAWING - II

RATIONALITY

A polytechnic pass-out in electrical engineering is supposed to have ability to:

i) Read, understand and interpret engineering drawings
ii) Communicate and correlate through sketches and drawings
iii) Prepare working drawings of alternative panels, transmission and distribution

The contents of this subject has been designed to develop requisite knowledge and skills of electrical drawings in the students of diploma in electrical engineering.

DETAILED CONTENTS

1 Contractor Control Circuits (70 hrs)

Design of Circuit Drawing of schematic diagram and power wiring diagram of following circuits, specification of contactors

1.1 DOL starting of 3-phase induction motor
1.2 Remote Control of 3-phase induction motor
1.3 3-phase induction motor getting supply from selected feeder
1.4 Forwarding/reversing of a 3-phase induction motor
1.5 Two speed control of 3-phase induction motor
1.6 Limit switch control of a 3-phase induction motor
1.7 Sequential operating of two motors using time delay relay
1.8 Automatic star delta starter for 3-phase Induction Motor

2. Earthing (30 hrs)

2.1 Purpose of earthing
2.2 Different types of earthing, drawings of plate and pipe earthing
2.3 Procedure of earthing, test of materials required and costing

2.4 Method of reducing earth resistance

2.5 Relevant IS specifications of earth electrode for earthing a transformer, a high building

2.6 Earthing layout of distribution transformer

2.7 Substation earthing layout and earthing materials

2.8 Key diagram of 11KV, 33KV, 66KV, 132 KV sub-stations

3. Drawings of Machine Parts (28 hrs)

3.1 End cover of induction motor

3.2 Rotor of a squirrel cage induction motor

3.3 Field coil of a DC motor

3.4 Terminal plate of an induction motor

3.5 Motor body (induction motor) as per IS specifications

3.6 Sliprings of 3-phase induction motor

RECOMMENDED BOOKS

1. Electrical Design and Drawings by Raina & Bhattacharya

2. Electrical Design & Drawings by Sarabjeet Singh


5. Electrical Controls in Industry by Charles Siskind

6. BIS for Electrical Earthing
4.5 ELECTRICAL WORKSHOP PRACTICE - II

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, fault finding, wiring in electrical appliances and installations.

DETAILED CONTENTS

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

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

3. Wiring, testing and fault finding of the following contactor control circuits operating on 3-phase supply:
   - c) Remote control circuits
   - d) Time delay circuits
   - e) Inter locking circuits
   - f) Sequential operation control circuits

7. Winding/re-winding of a fan (ceiling and table) and choke

8. Soldering and de-soldering practice (soldering and de-soldering of electronic components on PCB)

9. Power cable jointing using epoxy based jointing

10. Demonstration of laying of underground cables at worksite

11. Dismantling/assembly of star-delta/DOL starter and slipring induction motor starter

12. Dismantling and assembly of voltage stabilizers
4.6 ESTIMATING AND COSTING IN ELECTRICAL ENGINEERING

RATIONALE

A diploma holder in electrical engineering should be familiar to Indian Standards and relevant Electricity Rules. Preparation of good estimates is a professional job, which requires knowledge of materials and methods and the principles of economics. The contents of this subject has been designed keeping in view developing requisite knowledge and skills of estimation and costing in students of diploma in electrical engineering.

DETAILED CONTENTS

1. Introduction

Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule costing, price list, tender document net price list, market survey, overhead charges, labour charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements, orders for supply, payment of bills. Tenders – its constituents, finalization specimen tender.

2. Types of wiring

Electrical, batten, casing-casing and conduit wiring, comparison of different wiring, selection and design of wiring schemes for particular situation (domestic and Industrial). Selection of wires and cables, wiring accessories and use of protective devices i.e. MCB, ELCB etc. Use of wire-gauge and tables.

3. Estimating and Costing:

3.2 Domestic installations; standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate (single storey and multi-storey buildings)

3.2 Industrial installations; relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, sizing of diagram, starters, preparation of materials lists, estimating and costing exercises on workshop with single-phase, 3-phase motor load and the light load (3-phase supply system)

3.3 Service line connection estimate for domestic and Industrial loads (over-head and under ground connections) from pole to energy meter. Electrical forms: different types of fans and their sizes, air-conditioners, exhaust fans, determination of size and number of fans for a given situation.
4. a) Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations

b) Substation: Types of substations, substation schemes and components, estimate of 11/0.4 KV pole mounted substation up to 200 KVA rating.

RECOMMENDED BOOKS

4. Estimating and Costing by Qurashi
ENTREPRENEURIAL AWARENESS CAMP

This is to be organized at a stretch for two to three days during second year. Lectures will be delivered on the following broad topics. There will be no examination for this subject

1. Who is an entrepreneur?
2. Need for entrepreneurship, entrepreneurial career and wage employment
3. Scenario of development of small scale industries in India
4. Entrepreneurial history in India, Indian values and entrepreneurship
5. Assistance from District Industries Centres, Commercial Banks, State Financial Corporations, Small industries Service Institutes, Research and Development Laboratories and other financial and development corporations
6. Considerations for product selection
7. Opportunities for business, service and industrial ventures
8. Learning from Indian experiences in entrepreneurship (Interaction with successful entrepreneurs)
9. Legal aspects of small business
10. Managerial aspects of small business
5.1 ELECTRICAL MACHINES-II

L.T.P
4 1 3

RATIONALE

Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

DETAILED CONTENTS

1. Synchronous Machines (24 hrs)
   1.1 Main constructional features of commutator and brushless excitation system
   1.2 Generation of three phase emf
   1.3 Production of rotating magnetic field in a three phase winding
   1.4 Concept of distribution factor and coil span factor and emf equation
   1.5 Operation of single synchronous machine independently supplying a load - Voltage regulation by synch-impedance method
   1.6 Need and necessary conditions of parallel operation of alternators
   1.7 Operation of synchronous machine as a motor – its starting methods
   1.8 Effect of change in excitation of a synchronous motor
   1.9 Cause of hunting and prevention
   1.10 Rating and cooling of synchronous machines
   1.11 Applications of synchronous machines (as an alternator, as a synchronous condenser)

2. Induction Motors (16 hrs)
   2.1 Salient constructional features of squirrel cage and slip ring 3-phase induction motors
   2.2 Principle of operation, slip and its significance and connection of submersible motor (monoblock)
   2.3 Locking of rotor and stator fields
   2.4 Rotor resistance, inductance, emf and current
   2.5 Relationship between copper loss and the motor slip
   2.6 Power flow diagram of an induction motor
   2.7 Factors determining the torque
   2.8 Torque-slip curve, stable and unstable zones
   2.9 Effect of rotor resistance upon the torque slip relationship
   2.10 Double cage rotor motor and its applications
2.11 Starting of 3-phase induction motors, DOL, star-delta, auto transformer
2.12 Causes of low power factor of induction motors
2.13 Testing of 3-phase motor on no load rotor test and find efficiency
2.14 Speed control of induction motor, conventional and thyristorized

3. Fractional Kilo Watt (FKW) Motors (18 hrs)

3.1 Single phase induction motors; Construction characteristics and applications
3.2 Nature of field produced in single phase induction motor
3.3 Split phase induction motor
   3.3.1 Capacitors start and run motor
   3.3.2 Shaded pole motor
   3.3.3 Reluctance start motor
3.4 Alternating current series motor and universal motors
3.5 Single phase synchronous motor
   3.5.1 Reluctance motor
   3.5.2 Hysteresis motor

4. Special Purpose Machines (8 hrs)

Construction and working principle, linear induction motor, stepper motor, schrage motor.

LIST OF PRACTICALS

1. Synchronous machines:
   1.1 Demonstration of revolving field set up by a 3-phase wound stator
   1.2 Determination of excitation
   1.3 Determination of the relationship between the voltage and load current of an alternator, keeping excitation and speed constant
   1.4 Determination of the regulation and efficiency of alternator from the open circuit and short circuit test
   1.4 Parallel operation of polyphase alternators and load sharing
   1.5 Determination of the effect of variation of excitation on performance of a synchronous motor

1. Induction Machines:
   1.1 Determination of efficiency by (a) no load test and blocked rotor test on an induction motor (b) direct loading of an induction motor (refer ISI Code/BIS code)
   1.2 Determination of effect of rotor resistance on torque speed curve of an induction motor

2. FKW Motors:
   2.1 To tell the effect of a capacitor on the starting and running of a single-phase induction motor.
   2.2 Reversing the direction of rotation of ceiling fan
RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, New Delhi
2. Electrical Machines by SK Sahdev, Unique International Publications, Jalandhar
3. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi
4. Electrical Engineering by JB Gupta, SK Kataria & sons, New Delhi
5.2 POWER – 1 (Generation, Transmission and Distribution of Electrical Power)

RATIONALE

The majority of the polytechnic passouts have to perform various activities in the State Electricity Boards in the field of Generation, Transmission and Distribution of Electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in power stations, transmission and distribution networks in addition to administrative jobs to public relations.

They should also be made aware of recent developments, current practices in the electricity departments, corporations and boards to keep them abreast with modern techniques in Generation, Transmission and Distribution of Electrical Power.

DETAILED CONTENTS

1. Power Generation (10 hrs)
   1.1 Main resources of energy, conventional and non-conventional
   1.2 Different types of power stations, thermal, hydro, gas, diesel and nuclear power stations. Flow diagrams and brief details of their operation, comparison of the generating stations on the basis of running cost, site, starting, maintenance etc.
   1.3 Importance of non-conventional sources of energy in the present scenario. Brief details of solar energy, bio-energy, wind energy

2. Transmission Systems (24 hrs)
   2.1 Layout of transmission system, selection of voltage for H.T and L.T lines, advantages of high voltage for Transmission both AC and DC
   2.2 Comparison of different system: AC versus DC for power transmission, conductor material and sizes from table
   2.3 Constructional features of transmission lines: Types of supports, types of insulators, Selection of insulators, conductors, earth wire and their accessories, Transposition and strig efficiency of lines
   2.4 Mechanical features of line: Importance of sag, calculation of sag, effects of wind and ice and related problems; Indian electricity rules pertaining to clearance
   2.5 Electrical features of line: Calculation of resistance, inductance and capacitance without derivation in a.c. transmission line, voltage regulation concept of corona. Effects of corona and remedial measures

3. Distribution System (10 hrs)
   3.1 Lay out of HT and LT distribution system, constructional feature of distribution lines and their erection. LT feeders and service mains; Simple problems on AC radial distribution system, determination of size of conductor
   3.2 Construction of LT and HT power cables advantages/disadvantages
3.3 Preparation of estimates for LT and HT overhead distribution lines.
3.4 Calculation of line losses in distribution system

4. Substations: (8 hrs)
4.1 Brief idea about substations; outdoor grid sub-station 220/132 KV, 66/33 KV outdoor substations, pole mounted substations and indoor substation
4.2 Layout of 33/11 KV distribution substation and various auxiliaries and equipment associated with it
4.3 Preparation of estimates for 11 KV/0.4 KV substations (pole mounted)

5. Faults: (4 hrs)
5.1 Common type of faults in both overhead and underground systems

6. Power Factor: (4 hrs)
6.1 Concept of power factor
6.2 Reasons and disadvantages of low power factor
6.3 Methods for improvement of power factor using capacitor banks

7. Various Types of Tariffs: (3 hrs)
7.1 Tariffs
7.2 Block rate, flat rate, maximum demand and two part tariffs
7.3 Simple problems

8. Field Visits

RECOMMENDED BOOKS

2. Substation Design and Equipment by Satnam and PV Gupta, Dhanpat Rai & Sons, New Delhi
4. Electrical Power System by VK Mehta, S Chand & CO., New Delhi
5. Electrical Power System by JB Gupta, Kataria and Sons, New Delhi
6. Sub-Station Design by Satnam, Dhanpat Rai and Co., New Delhi
5.3 INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES

RATIONALE

Industrial electronics plays a very vital role in the field of control engineering specifically in the modern industries as they mostly use electronic controls which are more efficient, effective and precise as compare to the conventional method. The old magnetic and electrical control schemes have all become obsolete. Electrical diploma holder many times has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control electronics is must for them in order to supervise the work efficiently and effectively. Looking in to usefulness and importance to the subject this has been incorporated in the curriculum.

DETAILED CONTENTS

1. Introduction to SCR  (15 hrs)
   1.1. Construction and working principles of an SCR, two transistor analogy circuit and characteristics of SCR
   1.2. SCR specifications and rating
   1.3. Construction, working principles and V-I characteristics of DIAC and TRIAC
   1.4. Basic idea about the selection of heat sinks for SCR and TRIACS
   1.5. Methods of triggering a Thyristor. Study of triggering circuits
   1.6. UJT, its Construction, working principles and VI characteristics, UJT relaxation oscillator
   1.7. Commutation of Thyristors
   1.8. Series and parallel operation of Thyristor
   1.9. Applications of SCR and TRIACS such as light intensity control control of DC and universal motor, fan regulator, battery charger etc.

2. Controlled Reactifiers  (10 hrs)
   2.1. Single phase half wave controlled rectifier with resistive load and inductive load
   2.2. Single phase half controlled full wave rectifier
   2.3. Fully controlled full wave rectifier bridge
   2.4. Single phase full wave centre tap rectifier
   2.5. Three phase full wave half controlled bridge rectifier
   2.6. Three phase full wave fully controlled bridge rectifier

3. Inverters, choppers, dual converters and cycloconvertors  (18 hrs)
   3.1. Inverter-introduction, working principles, voltage and current driven in series and parallel invertors and applications
   3.2. Choppers introduction, types of choppers and their working principles and applications
3.3 Dual Convertors-introduction, types of cyclo-convertors, working principles and applications
3.4 Cyclo-convertors-introduction, types, working principles and applications

4. Thyristor control of electric drives  
4.1 DC drives control
4.2 Half wave drives
4.3 Full wave drives
4.4 Chopper drives
4.5 AC drives control
4.6 Phase control
4.7 Variable frequency a.c. drives
4.8 Constant V/F appreciation
4.9 Voltage controlled inverter drives
4.10 Constant current inverter drives
4.11 Cyclo convertors controlled AC drives
4.12 Slip control AC drives

5 Uninterrupted power supplies  
5.1 UPS, online, stand by, Redundant UPS, DC UPS
5.2 Storage devices, battery charger with UPS

6. Static Control of Machines  
Advantages and disadvantages of static control compared to magnetic control. Development of simple control circuits using logic gates, off-return and retentive memory elements. Input and output devices for solid state logic circuits. Study of some industrial control circuits like product dispersion, product inspection conveyor system etc. using shift registers, counters, decoder, mono shot, clock, down counter and encoder.

7. Programmable Logic Controllers  
Parts of a programmable controller, inputs/output section, central processing unit, input image table, output image table, user program memory, variable data memory, complete scan cycle, the programming terminals, programming basics, relay, timer, Counter and Sequencer type instructions, analog operation.

LIST OF PRACTICALS

1. To draw firing characteristics of an SCR
2. To draw firing characteristics of a TRIAC
3. To draw firing characteristics of a DIAC
4. To draw unijunction transistor characteristics
5. Observe the output wave of an UJT relexation oscillator
6. Observe the wave shape across SCR and load of an illumination control circuit
7. Fan speed regulator using TRIAC (fabrication of this circuit)
8. Speed-control of a DC suit motor or universal motor
9. Single phase 1 halt controlled full wave rectifier
10. Single phase controlled rectifier
11. Three phase controlled rectifier
12. Single phase inverter circuit (fabrication of this circuit)
13. Learning programme entry and editing of PLC using Hand held programmer.
14. Learning programme entry and editing on PLC through personal computer which is interfaced to PLC through a software package.
15. Writing, testing and debugging of simple programmes to control the working of different components like motors, solenoid operated cylinder pistons, relays, flashers etc. using sensors on a PLC trainer.
16. Wiring of different types of starters for three phase wound and squirrel cage induction motor.
17. Study of some actual control drawings from industry.
18. Design and modification of control circuit as per required control requirements.

BOOKS RECOMMENDED

4. Power Electronics, Circuits Devices and Applications by Mohammad H. Rashid
5. Power Electronics by PC Sen
6. Power Electronics by Dr. PS Bhimbra, Khanna Publishers, New Delhi
7. Industrial Electronics & Control by SK Bhattacharya & S Chatterji, New Age international Publications(P) Ltd, New Delhi
8. Power Electronics by SK Sahdev, Unique International Publication, Jalandhar
9. Power Electronics by JC Karhava, King India Publication,
11. Power Electronics and Controls by Samir K Datta, Prentice Hall of India, New Delhi
RATIONALE

This subject deals with the various instruments, their construction and working which control the various parameters and operations in any industry. Electrical supervisor employed in maintenance of electrical equipment, machinery is required to diagnose faults, rectify them and test the total system for good performance. Thus there is a need of introducing diploma holders to the basics of Instrumentation.

DETAILED CONTENTS

1. Measurements: (4 hrs)
   Importance of measurement, Basic measuring systems, advantages and limitations of each measuring systems, generalized measurement system, signal conditioning and display devices

2. Transducers: (8 hrs)
   Theory, construction and use of various transducers (resistance, inductance, capacitance, electromagnetic, piezo electric type)

3. Measurement of Displacement and Strain: (10 hrs)
   Displacement Measuring Devices: wire wound potentiometer, LVDT, strain gauges, different strain gauges such as inductance type, resistive type, wire and foil etc. Gauge factor, gauge materials, and their selections, sources of errors and its compensations. Use of electrical strain gauges, strain gauge bridges and amplifiers.

4. Force and Torque Measurement: (10 hrs)
   Different types of force measuring devices and their principles, load measurements by using elastic Transducers and electrical strain gauges. Load cells, proving rings. Measurements of torque by brake, dynamometer, electrical strain gauges, speed measurements; different methods, devices.

5. Pressure Measurement: (8 hrs)
   Bourdon pressure gauges, electrical pressure pick ups and their principle, construction application and use of pressure cells.

6. Flow Measurement: (6 hrs)
   Basic principles of magnetic and ultrasonic flow meters
6. Measurement of Temperature: (10 hrs)

Bimetallic thermometer, pressure thermometers, thermoelectric thermometers, resistance thermometer, thermocouple, thermisters and pyrometer, errors in temperature measurements in rapidly moving fluids. Temperature recorders

8. Measurement of other non electrical quantities such as humidity, pH, level, (8 hrs)

RECOMMENDED BOOKS

1. Electronic Measurement and Instrumentation by Dr Rajendra Prasad

2. Electrical and Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Co., New Delhi

3. Electronic Instrumentation and Measurement Techniques by WD Cooper, AD Helfrick Prentice Hall of India Pvt. Ltd. New Delhi
5.4(b) Elective-II  
NON CONVENTIONAL ENERGY SOURCES  
L T P  
4 - - 

RATIONALE

Energy is a crucial input in the process of economic, social and industrial development. High energy consumption has traditionally been associated with higher quality of life, which in turn is related to Gross National Project (GNP). Since the conventional energy resources are under depletion, it is high time to tap the non conventional energy sources. The electrical diploma holder will have to face this challenges in future life. Therefore this subject is offered in diploma programme for future benefit.

DETAILED CONTENTS

1. Introduction:  
   Importance of Non conventional sources of energy, Present Scenario, Future Prospects,  
   Economic Criteria  
   (6 hrs)

2. Solar Energy:  
   Physical Principal of the conversion of Solar radiation into heat, Photo-voltaic cell,  
   Electricity generation, Solar water heaters, Solar Furnaces, Solar cookers, Solar Stills solar  
   pumping  
   (10 hrs)

3. Hydro Energy:  
   Hydro-electric Power Plants, Mini and Micro hydro-electric power generation. Magneto  
   Hydro Dynamic (MHD) Power Generation  
   (8 hrs)

4. Bio-energy:  
   Bio-mass Conversion Technologies- wet and dry processes. Methods for obtaining energy  
   from Biomass. Power Generation by using gassifiers  
   (8 hrs)

5. Wind Energy:  
   Wind Energy Conversion, Wind mills, Electricity generation from wind- Types of wind mills,  
   local control, energy storage  
   (6 hrs)

6. Geo-thermal and Tidal Energy:  
   Geo-thermal sources, Ocean thermal electric conversion, open and closed cycles, hybrid  
   cycles. Prime movers for geo-thermal energy conversion. Steam Generation and  
   electricity generation  
   (10 hrs)

7. Chemical Energy Sources:  
   Design and operating principles of a fuel cell, conversion efficiency, work output and emf of  
   fuel cells, applications storage battery characteristics, types, applications, maintenance of  
   batteries  
   (10 hrs)
8. **Thermo Electric Power:**

   Basic principle, performance analysis of thermo electric power generation, thermoelectric materials and their application.

**RECOMMENDED BOOKS:**

5. *Energy Today and Tomorrow*; Maheshwar Dayal; Publications Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi.
RATIONAL

The PC is the tool that defines today current age and culture. A right understanding about any tool is required to use it effectively. There has been a complete revolution in this area because of rapid advancement in the field of electronics. The PC is the most logical and modern machine and is no more difficult to understand its function. It is very important to learn the various components of PC and how these parts work together. All technically trained individuals must understand the general nature of PC operation of memory, I/O techniques, interfacing applications etc. Looking at the importance and usefulness, this subject has been included in the curriculum.

DETAILED CONTENTS

1. Introduction (04 hrs)
   1.1 Origin of PC
   1.2 Hardware and software
   1.3 Operating system
   1.4 Programming language

2. Hardware Components (16 hrs)
   2.1 Motherboard
   2.2 Microprocessors and Co-processors
   2.3 Memory – ROM, RAM
   2.4 Chipsets and support circuits, its function, system control, peripheral control and memory control
   2.5 Bus-architecture, function and various buses i.e. ISA, EISA, VESA, PCI
   2.6 Moist storage device i.e. hard disk, floppy disk, compact disk
   2.7 Input/output devices i.e. keyboard, mouse, display system. Video adopter, audio printers, modems, serial and parallel ports, IEEE 1284, RS-232-C
   2.8 General information about computer virus and anti-virus

3. Interfacing Components and Techniques (02 hrs)
   3.1 Interface systems and standards
   3.2 Programmable peripherals interface (PPI) Chip-8255, 8155
   3.3 Pin diagrams and programming

4. Networking Topologies Standards, Cabling and Configuration, IEEE Standards for LANS (02 hrs)
5. Concept of Internet

5.1 Internet Protocols H.T.T.P.
5.2 Simple Networking Management Protocol (SNMP)
5.3 Domain Name Systems (DNS)
5.4 Security
5.5 Electronic Mail
5.6 World Wide Web
5.7 Concept of ATM Networks

RECOMMENDED BOOKS

1. Hardware Bible ; Winn. L. Rosch, Techmedia
2. The complete PC upgrade and maintenance guide, Mark Minasi, BPB Publications
3. Computer Networks, A. Tanenbaum, PHI Ltd., New Delhi
5.5 DIGITAL ELECTRONICS AND MICROPROCESSORS

RATIONALE

Digital electronics has made extremely rapid advances in the last five decades. It has important applications in communication entertainment, instrumentation, control, automation etc. Thus it appears that there is no end to its usefulness in the light and the new world belongs to it. So it is necessary to give the knowledge of digital electronics to the students. Microprocessor is one of the most exciting technological among the semiconductor devices in recent times. It has a tremendous impact on the Industrial processes due to its high reliability and flexibility both at the design and the Implementation stages. The decreasing cost of with increasing facilities act as catalysts in widening their scope of applications.

DETAILED CONTENTS

(Part-A)

1. Number Systems (4 hrs)
   1.1 Decimal, binary, octal and hexa-decimal number systems and their inter-conversion
   1.2 Binary addition, substraction and multiplication
   1.3 1’s and 2’s complement methods of addition/substraction

2. Gates (3 hrs)
   Definition, symbol and truth tables for inverter, OR, AND, NAND, NOR and X-OR gates

3. Boolean Algebra (5 hrs)
   3.1 Boolean Relations
   3.2 DeMorgan’s Law
   3.3 K-Map upto four variables

4. Combinational Circuits (8 hrs)
   4.1 Half adder, Full adder
   4.2 Encoder, Decoder
   4.3 Multiplexer/Demultiplexer
   4.4 Display Devices (LED, LCD and 7-segment display)

5. Flip-Flops (6 hrs)
   5.1 J-K Flip-Flop
   5.2 R-S Flip-Flop
   5.3 D-Type Flip-Flop
   5.4 T-Type Flip-Flop
   5.5 Applications of Flip-Flops
6. A/D and D/A Converters (4 hrs)
   6.1 D/A converters (Binary weighted, R-2R D/A Converter)
   6.2 A/D converter (Counter ramp, successive approximation method of A/D Conversion)

7. Semi-conductor Memories (2 hrs)

(PART-B)

1. Microprocessor (20 hrs)
   1.1 Study 8085 microprocessor architecture, pin configuration, bus organisation, registers flags, interrupts
   1.2 Instruction set of 8085 microprocessor, addressing modes, instruction format. Writing some simple assembly language programmes. Use of stacks and sub-routines in programming
   1.3 Interfacing and data transfer between peripheral, I/O and microprocessor
   1.4 Study of peripheral chips – 8255, 8253, 9155
   1.5 Introduction of 16-bit, 32-bit microprocessor, their advantages over 8-bit microprocessor
   1.6 Concept of 8086 and 68000 microprocessors

2. Introduction to Microcontrollers (5 hrs)
   2.1 Different between microprocessor and microcontroller
   2.2 Architecture of 8031 and 8051 varieties of microprocessor

3. Programmable Logic Controller (PLC) (6 hrs)
   3.1 Introduction to PLC
   3.2 Basic configuration of PLC
   3.3 Comparison of logic controller

LIST OF PRACTICALS

1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, X-OR gates
2. Construction of Half Adder using gates
3. Construction of Full Adder using gates
4. Verification of operation of a 8-bit D/A Converter
5. Writing assembly language programme using numemoanics and test them on µP Kit (any three)
   i) Addition of two 8-bit numbers
   ii) Subtraction of two 8-bit numbers
   iii) Multiplication of two 8-bit numbers
iv) Division of two 8-bit numbers
v) Finding average of N given integer
vi) Finding maximum number out of three given numeric

6. Assembly language programming for different applications on 8051 microprocessor

7. Dadder diagram programming on PLC (any available version of PLC)

RECOMMENDED BOOKS

1. Modern Digital Electronics by RP Jain
2. Digital Principles and Electronics by Malvino & Leach
3. Digital Electronics by RL Rokheine
4. Digital Electronics by SN Ali
5. Microprocessor by Goanker, Wiley Eastern Ltd. New Delhi
6. Digital Electronics by T.L. Foyal
7. Digital Electronics by Jamwal

Note: Question paper will be set 50% from Part-A and 50% from Part-B.
### 5.6 MINOR PROJECT WORK

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Minor project work aims at exposing the students to industrial/field practices so as to have an appreciation of size, scale and type of operations; and work culture in the industries. Also the students will be able to comprehend concepts, principles and practices taught in the classroom and their application in solving field/industrial problems.

Depending upon the interests of the students, location of the organization the student may be sent to:

- a) Study various operations
- b) Study various types of materials being used
- c) Learn about various operations/processes
- d) Know about various measuring instruments and test equipment
- e) Study the plant layout and material handling in an industry
- f) Have knowledge about production planning and control in an industry
- g) Know about various quality control techniques and safety measures adopted
- h) Prepare specifications and
- i) Disassembly and assembly of motors, transformers available in the laboratory
- j) Checking of wiring in the control panels

For effective planning and implementation of this practical training, it is suggested that polytechnic should:

- a) Identify adequate number of industrial/field organizations where students will be sent for visits.
- b) Prepare a workbook (which can be used by students) for guiding students to perform definite task during the practical training.
- c) Identify teachers who would supervise the students and provide guidance during practical training.

This practical training of 3-4 weeks duration will carry 100 marks. 50 marks will be given by industrial/field supervisors and 50 marks by the teacher supervising this training. The components of evaluation will include the following:

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6.1 UTILIZATION OF ELECTRICAL ENERGY (UEE)

RATIONALE

This subject assumes importance in view of the fact that a technician has to work in a wide spectrum of activities wherein he has to make collections from alternative schemes from technical and economical considerations; i.e. to plan and design using basic principles and handbooks, to select equipment, processes and components in different situations.

The curriculum has been designed keeping the above objectives in view. Besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas.

DETAILED CONTENTS

1. Electric Drives: (8 hrs)

1.1 Advantages of electric drives

1.2 Characteristics of different mechanical loads

1.3 Types of motors used in electric drive

1.4 Electric braking
   1.4.1 Plugging
   1.4.2 Rheostat braking
   1.4.3 Regenerative braking

1.5 Methods of power transfer by direct coupling by using devices like belt drive, gears, pulley drives etc.

1.6 Examples of selection of motors for different types of domestic loads

1.7 Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.

1.8 Specifications of commonly used motors e.g. squirrel cage, slip ring induction motors, AC series motors, FKW motors
2. Illumination: (8 hrs)

2.1 Nature of light, visibility spectrum curve of relative sensitivity of human eye and wavelength of light

2.2 Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux.

2.3 Laws of illumination - simplenumericals

2.4 Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for filament lamp, mercury vapour lamp, fluorescent lamp, metal halide lamp, neon lamp.

2.5 Calculation of number of light points for interior illumination, calculation of illumination at different points, considerations involved in simple design problems. Illumination schemes; indoor and outdoor. Illumination levels

2.6 Main requirements of proper lighting; absence of glare, contrast and shadow

2.7 General ideas bout street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc.

3. Electric Heating (6 hrs)

3.1 Advantages of electrical heating

3.2 Heating methods:

3.2.1 Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances and thermostat control circuit

3.2.2 Induction heating; principle of core type and coreless induction furnace

3.2.3 Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace

3.2.4 Dielectric heating, applications in various industrial fields

3.2.5 Infra-red heating and its applications

3.2.6 Microwave heating

3.3 Simple design problems of resistance heating element

4. Electric Welding: (6 hrs)

4.1 Advantages of electric welding

4.2 Welding method
4.2.1 Principles of resistance welding, types – spot, projection seam and butt welding and welding equipments used

4.2.2 Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method of and their applications. Power supply required. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper

4.3 Introduction to TIG, MIG Welding

5. Electrolytic Processes: (6 hrs)

5.1 Need of electro-deposition
5.2 Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing
5.3 Equipment and accessories for electroplating
5.4 Factors affecting electro-deposition
5.5 Principle of galvanizing and its applications
5.6 Principles of anodising and its applications
5.7 Electroplating on non-conducting materials
5.8 Manufacture of chemicals by electrolytic process
5.9 Manufacturing of chemicals by electrolysis process

6. Electrical Circuits used in Refrigeration and Air Conditioning and Water Coolers: (6 hrs)

6.1 Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants
6.2 Description of Electrical circuit used in
   a) refrigerator,
   b) air-conditioner, and
   c) water cooler

7. Electric Traction: (6 hrs)

7.1 Advantages of electric traction
7.2 Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main lines and their speed-time curves
7.3 Different accessories for track electrification; such as overhead capacitor wire, conductor rail system, current collector-pentagraph
7.4 Factors affecting scheduled speed
7.5 Electrical block diagram of an electric locomotive with description of various equipment and accessories
7.6 Types of motors used for electric traction
7.7 Starting and braking of traction motors
7.8 Introduction to EMU and metro railways

Note: Students should be taken for visits to the way track to study the electric traction system.
LIST OF PRACTICALS

1. Study of different types of sources of light and make connections, and to measure intensity of light with lux-meter:
   1.1 Fluorescent lamp
   1.2 HP mercury vapour lamp
   1.3 HP sodium vapour lamp
   1.4 Compact Fluorescent lamp (CFL)

2. Study of induction furnace by visiting a factory and to prepare a report

3. Study of welding equipment along with its accessories

4. Study on the electroplating plant by visiting an industry and preparing a report

5. Study of refrigerator/air conditioner and to prepare a report of its electrical circuit

6. Power factor improvement of a single-phase load using capacitor bank

7. Study of an electric locomotive by visiting any railway repair shop at a nearby station

RECOMMENDED BOOKS

1. Art and Science of Utilization of Electrical Energy by H Partap, Dhanpat Rai & Sons, Delhi


3. A.Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi

4. Modern Electric Traction by H Partap, Dhanpat Rai & Sons, Delhi

5. Utilization of Electrical Energy by OS Taylor, Pitman Publications

6.2 INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

RATIONALE

In his career as a supervisor, an electrical engineering technician will be called upon to inspect, test and modify the work done by skilled workers or artisans working under him. Many times it will become necessary for him to demonstrate the correct method and procedure of doing certain operations. Normally manufacturers of heavy electrical equipment provide service manuals, instructions for installation, maintenance and fault location. Indian Electricity Rules and Indian Standard Specifications also provide enough guidelines.

This syllabus has been designed to provide certain guidelines and broad principles regarding the above activities. Appropriate field trips will reinforce the learning.

DETAILED CONTENTS

1. Tools, accessories and instruments required for installation, maintenance and repair work
   (03 hrs)

   Knowledge of Indian Electricity rules, safety codes causes and prevention of accidents, artificial respiration, workmen's safety devices

2. Installation
   (10 hrs)

   2.1 Installation of transmission and Distribution Lines:

   Erection of steel structures, connecting of jumpers, tee-off points, joints and dead ends; crossing of roads, streets, power/telecommunication lines and railway crossings, clearances; earthing of transmission lines and guarding, spacing and configuration of conductors: Arrangement for suspension and strain insulators, bird guards, anti-climbing devices and danger plates; sizes of conductor, earthwire and guy wires, Testing and Commissioning.

   Laying of service lines, earthing, provision of service fuses, installation of energy meters

   2.2 Laying of Underground Cables:

   Inspection, storage, transportation and handling of cables, cable handling equipment, cable laying depths and clearances from other services such as: water, sewerage, gas, heating and other mains, and also a series of power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying (including laying of cable from the drum, laying cable in the trench, taking all measurements and making as installed drawings, back
filling of trenches with earth or sand, laying protective layer of bricks etc), laying of cables into pipes and conduits and within buildings, introduction to cable filling compounds, epoxy resins and hardeners, cable jointing and terminations, testing and commissioning.

2.3 Elementary idea regarding, inspection and handling of transformers; Pole mounted substations, plinth mounted substations, grid substation, busbars, isolation, voltage and current transformers, lightning arrestors, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches.

2.4 Testing of various electrical equipment such as electrical motor, transformers cables and generator and motor control centres, medium voltage distribution panels, power control centres, motor control centres, lighting arrangement, storage, pre-installation checks, connecting and starting, pre-commissioning checks, drying out

3. Maintenance

3.1 Types of maintenance, maintenance schedules, procedures

3.2 Maintenance of Transmission and Distribution System

Authorized persons, danger notice, caution notice, permit to work, arranging of shutdowns personally and temporary earths cancellation of permit and restoration of supply.

Patrolling and visual inspection of lines - points to be noted during patrolling from ground; special inspections and night inspections;

Location of faults using Meggar, effect of open or loose neutral connections, provision of proper fuses on service lines and their effect on system, causes and dim and flickering lights.

3.3 Maintenance of Distribution Transformers

Transformer maintenance and points to be attended to in respect of various items of equipment

Checking of insulation resistance, transformer oil level and BDV test of oil, measurement of earth resistance

3.4 Maintenance of Grid Substations

Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches. Power transformers
3.5 Maintenance of Motors

Overhauling of motors, preventive maintenance, trouble shooting of electric motors

3.6 Domestic Installation

Introduction, testing of electrical installation of a building, testing of insulation resistance to earth, testing of insulation and resistance between conductors continuity or open circuit test, short circuit test, testing of earthing continuity location of faults IE rules for domestic installation

LIST OF PRACTICALS

1. Identification of tools and equipment

2. Giving exposure to students at actual sites

3. Study of codes and practices

Important Note:

The teachers must organise study/field visit(s) of 15 days duration. Students have to submit a complete report of the visit regarding above mentioned topics. There will be sessional and viva voce marks for above activities.

RECOMMENDED BOOKS


2. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana
6.3 POWER-II (POWER SYSTEM PROTECTION)

RATIONALITY
In view of the complexities associated with the modern interconnected power stations, the responsibilities and the job requirements of a diploma pass out have become more complex than what they used to be earlier. He is required to work with modern electrical equipment and maintain reliability of supply. The course is designed to understand the concepts, principles involved in the construction and working of generating stations and protective switch gear system so that one can handle, install, maintain them and also take decisions at his/her level in different situations. The teaching of this subject requires reinforcement in the form of visits to substation, power stations and well designed laboratory experiences. A practice-oriented approach to the teaching of this subject is suggested.

DETAILED CONTENTS

1. Power System Faults (10 hrs)
   Types of faults, single line to ground, double line to ground, three phase to ground, open conductors, severity of faults and their effects on system

2. Switch gears (32 hrs)
   2.1 Purpose of protective gear. Difference between switch, isolator and circuit breakers. Function of isolator and circuit breaker. Making and breaking capacity of circuit breaker (only definition)
   2.2 Principles of Arc extinction by OCB and ACB, Constructional features of OCB, ACB, and their working,
   2.3 Circuit breakers. Types of circuit breakers, bulk and minimum oil circuit breakers, air blast circuit breakers, SF₆ circuit breakers
   2.4 Miniature circuit breakers ACB, ELCB, MCB, for distribution and transmission system (Descriptive)

3. Protection Devices (18 hrs)
   3.1 Fuses; function of fuse. Types of fuses, HV and LV fuses, rewire-able, cartridge, HRC
   3.2 Earthing, purpose of earthing: Equipment earthing, Substation earthing, system earthing as per Indian Electricity rules.
   3.3 Relays:
   a) Introduction, types of relays. Electromagnetic and thermal relays, their construction and working
b) Induction type over-current, earth fault relays, instantaneous over current relay

c) Directional over-current, differential relays, their functions

d) Idea of static relays and their applications

4. Protection Scheme (10 hrs)

4.1 Relays for generator protection

4.2 Relays for transformer, protection including Buchholtz relay protection

4.3 Protection of feeders and bus bars. Over current and earth fault protection, distance protection

4.4. Relays for motor protection

5. Over-voltage Protection (10 hrs)

5.1 Protection of system against over voltage; causes of over voltage, function of ground wire

5.2 Lightning arrestors, Rod gap, horn gap, metal oxide type.

5.3 Line protection

RECOMMENDED BOOKS


2. Electrical Power Systems by CL Wadhwa, Wiley Eastern Ltd., New Delhi

3. Textbook of Electrical Technology by BL Theraja, S Chand and Co., New Delhi

4. Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi

5. A Course in Electrical Power by ML Soni, PV Gupta and Bhatnagar, Dhanpat Rai & Sons, New Delhi


7. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana
6.4 (a) Elective -II
ENERGY MANAGEMENT

RATIONALE

One of the reasons for India not being able to catch up with the desired extent of modernization of industrial processes in light of challenges posed by multinationals is the non-availability of required energy supply. The solution primarily lies in tapping all possible energy generation sources but efficient use of available energy is also important. Energy management focuses on these aspects and the course will develop a awareness amongst the diploma engineers and will enable them to practice the energy management techniques in whatever field they are engaged in.

DETAILED CONTENTS

1. Energy Management (12 hrs)
   1.1 Overview of energy management, need for energy conservation, (Started with oil crisis) Environmental Aspects, Alternative sources of energy.
   1.2 Need for Energy conservation with brief description of oil and coal crisis.
   1.3 Environmental aspects
   1.4 Alternate sources of energy.
   1.1 Energy efficiency - its significance

2. Energy Conservation (12 hrs)
   2.1 Energy conservation in Domestic Sector- Lighting, home appliances
   2.2 Energy conservation in Industrial sector- Motors, Industrial lighting Distribution system, Pumps, Fans, Blowers etc.,
   2.3 Energy conservation in Agriculture sector Tubewell pumps, diesel-generating sets, standby energy sources.
   2.4 Macro Level approach for energy conservation at design stage.

3. Energy Efficient Devices (20 hrs)
   3.1 Need for energy efficient devices
   3.2 Initial cost versus life cycle, cost analysis on life cycle basis
   3.3 Energy efficient motors as compared to standard motors.
   3.4 BIS specification for energy efficient motors, Salient design features,
   3.5 Efficiency as a function of load, safety margins
   3.6 Energy efficient lighting system different sources, lumens/watt, LEDs, role of voltage on efficiency
   3.7 Distribution system- Optimum cable size, amorphous core transformer, role of power factor, use of compensating capacitors-manual and automatic, location of capacitors.
4. Energy Audit (15 hrs)

4.1 Energy Audit Methodology
4.2 Efficiency of energy conversion processes, monitoring system
4.3 Specific energy consumption –three pronged approach, fine tuning, technical up
4.4 gradation, avoidable losses.
4.5 Case studies of energy audit of distribution system, AC motors, Industries.
4.6 Organisation of energy audit activities.

1. Environmental impact assessment
   5.1 Need for Environmental impact Assessment
   5.2 Standard format for assessment and its completion
   5.3 Evaluation of the assessment.

RECOMMENDED BOOKS:

1. Manual on energy efficiency at design stage, CII energy management cell.
4. Energy conservation case studies in ceramic industry, sugar industry, fertiliser industry, cement industry. CII, Energy Management Cell etc
6.4 (b) Elective -II
OPTICAL FIBRE COMMUNICATION

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RATIONALE

Progressing from communication over copper wire to today’s fibre optic communication, we have increase our ability to transmit more information, more quickly and over longer distances. This has expanded our boundaries and it finding a good slot in communication system. It is replacing the old technology. Operational fiber optical systems are now in common and new installations and applications appear continually. The growth is expected to continue for many year. Basic concepts of optical fibre communication have been dealt in this subject.

DETAILED CONTENTS

1. Introduction (8 hrs)
   Historical perspective, basic communication systems, optical frequency range, advantages optical fibre communication, application of fibre optic communication

2. Light Wave Fundamentals (10 hrs)
   Nature of light, acceptance angle and numerical aperture, electromagnetic waves, dielective wave guide, modes in planar guide dispersion and distortion in wave guide.

3. Optical Fibre Waveguides (10 hrs)
   Fibre structure, step-index fibre, graded – index fibre, attention, modes in step, index and graded index fibres, pulse dispersion and information rate in optical fibres construction of optical fibres, optic fibre cables.

4. Light Sources (8 hrs)
   Light emitting diodes (LEDs), Operating characteristics of LEDs, Laser principles, Laser diodes, Operating characteristics of laser-diodes, distributed feedback laser diode, optical amplifier, fibre laser.

5. Light Detectors (8 hrs)
   principles of photodetection, photomultiplier semiconductor photodiode, PIN diode and avalanche photodiode.
6. **Optical Fibre Joints**
   (8 hrs)
   Fibre, alignment and joint loss, fibre end preparation, splices, connectors, source coupling.

7. **Distribution Networks and Fibre Components**
   (10 hrs)
   Distribution network, directional couplers, star couplers, Switches fibre optical isolators, attenuators, wave length division multiplexing.

**RECOMMENDED BOOKS**


RATIONAL
Now a days electrical energy finds major application in electric traction besides diesel locomotives. Therefore a diploma holder is required to have elementary knowledge of electric drives used in traction and their accelerating and breaking arrangements.

DETAILED CONTENTS

1. Introduction (4 hrs)
   1.1. Electric Traction System.
   1.2. Advantages over other system
   1.3. Types of electric traction systems
   1.4. Choice of traction system in India
   1.5. Historical background of track electrification in India.

2. System of Tract Electrification (6 hrs)
   2.1 Single phase low frequency D.C. System.
   2.2 Three phase low frequency system
   2.3 Composite System
   2.4 Disadvantages of Single phase to D.C. System
   2.5 Comparison between pure A.C. and D.C system.

3. Track Mechanics (8 hrs)
   3.1 Types of services (Urban, Suburban and Mainline)
   3.2 Speed time curve
   3.3 Ttractive effort & traction effort speed characteristics
   3.4 Power of traction motor
   3.5 Specific energy consumption
   3.6 Mechanics of train movement, co-efficient
   3.7 Factors affecting slip.
   3.8 Simple numerical problems.

4. Power Supply arrangement (8 hrs)
   4.1 Constituents of Power supply system i.e. substation
   4.2 Sectioning and paralleling post.
   4.3 Subsection and post
   4.4 Sub-sectioning post and elementary sections
   4.5 Major control posts or switching substations
   4.6 Major equipment of substations.
5. Equipment used in and outside the Locomotive (8 hrs)
   5.1 Block diagram of Locomotive
   5.2 Overhead equipment
   5.3 Section Insulator
   5.4 Polygon OHE
   5.5 Supporting structure
   5.6 Current collector
   5.7 Circuit breaker
   5.8 Tap changer
   5.9 Transformer
   5.10 Rectifier connections
   5.11 Smoothing reactors

6. Traction Motors and Traction Motor Control (8 hrs)
   6.1 Desirable characteristic of traction motors.
   6.2 Comparative study of characteristic of Induction motor.
   6.3 Linear induction motor and their suitability for traction applications.
   6.4 Series parallel control of traction motors.
   6.5 Advantages of series parallel control
   6.6 Simple numerical problems

7. Braking (8 hrs)
   7.1 Requirements of braking system.
   7.2 Types of brakes (Mechanical, hydraulic, magnetic and eddy current)
   7.3 Electrical braking – plugging
   7.4 Rheostatic and Regenerative braking.

8. Train Lighting (8 hrs)
   8.1 Systems of train lighting
   8.2 Special requirements of train lighting
   8.3 Single Battery system
   8.4 Double Battery parallel block systems
   8.5 Principal equipment of Double Battery system
   8.6 Modified Train Lighting System
   8.7 Silicon Blocker Rectifier
   8.8 End on generation.

9. Railway Coach Air-conditioning (6 hrs)
   9.1 Electrical equipment for power generation and accessories for control of air conditioning equipment.
   9.1.1 Motor generator set
9.1.2 Star-delta starter and pre-cooling plug socket
9.1.3 Compressor – condenser and air conditioning unit motors
9.1.4 Main control panel.
9.1.5 Batteries

9.2 Circuit explanation of schematic diagram for air conditioning equipment.
9.3 Starting of plant when coach is stationary and when no ac supply is available.
9.4 Starting the plant when coach is running and the generator is generating.

INSTRUCTIONAL STRATEGY

Since the subject is field oriented and there is no laboratory arrangement in polytechnic. The students should be taken to locomotive yard, railway workshops to show the working in actual

RECOMMENDED BOOKS

1. Art and Science of utilization of electrical energy by H. Partab, Dhanpat Rai and Sons, Delhi
2. Modern Electric Traction by Partab, Dhanpat Rai and Sons, Delhi
### 7.5 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

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**RATIONALE**

Entrepreneurship Development and Management is one of the core competencies of technical human resource. Creating awareness regarding entrepreneurial traits, entrepreneurial support system, opportunity identification, project report preparation and understanding of legal and managerial aspects can be helpful in motivating technical/vocational stream students to start their own small scale business/enterprise. Based on the broad competencies listed above, following detailed contents are arrived to develop the stated competencies.

**DETAILED CONTENTS**

1. **Entrepreneurship** (4 hrs)
   - 1.1 Concept/Meaning
   - 1.2 Need
   - 1.3 Competencies/qualities of an entrepreneur

2. **Entrepreneurial Support System** (6 hrs)
   - 2.1 District Industry Centres (DICs)
   - 2.2 Commercial Banks
   - 2.3 State Financial Corporations
   - 2.4 Small Industries Service Institutes (SISIs), Small Industries Development Bank of India (SIDBI), National Bank for Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State level

3. **Market Survey and Opportunity Identification (Business Planning)** (6 hrs)
   - 3.1 How to start a small scale industry
   - 3.2 Procedures for registration of small scale industry
   - 3.3 List of items reserved for exclusive manufacture in small scale industry
   - 3.4 Assessment of demand and supply in potential areas of growth
   - 3.5 Understanding business opportunity
   - 3.6 Considerations in product selection
   - 3.7 Data collection for setting up small ventures

4. **Project Report Preparation** (6 hrs)
   - 4.1 Preliminary Project Report
   - 4.2 Techno-Economic feasibility report
   - 4.3 Project Viability
(5) Managerial Aspects of Small Business (8 hrs)

5.1 Principles of Management (Definition, functions of management viz planning, organisation, coordination and control)
5.2 Operational Aspects of Production
5.3 Inventory Management
5.4 Basic principles of financial management
5.5 Marketing Techniques
5.6 Personnel Management
5.7 Importance of Communication in business

(6) Legal Aspects of Small Business (6 hrs)

6.1 Elementary knowledge of Income Tax, Sales Tax, Patent Rules, Excise Rules
6.2 Factory Act and Payment of Wages Act

(7) Environmental considerations (6 hrs)

7.1 Concept of ecology and environment
7.2 Factors contributing to Air, Water, Noise pollution
7.3 Air, water and noise pollution standards and control
7.4 Personal Protection Equipment (PPEs) for safety at work places

(8) Miscellaneous (6 hrs)

8.1 Human relations and performance in organization
8.2 Industrial Relations and Disputes
8.3 Relations with subordinates, peers and superiors
8.4 Motivation – Incentives, Rewards, Job Satisfaction
8.5 Leadership
8.6 Labour Welfare
8.7 Workers participation in management

(9) Motivation (4 hrs)

9.1 Factors determining motivation
9.2 Characteristics of motivation
9.3 Methods of improving motivation
9.4 Incentives – pay, promotion, rewards

(10) Leadership (2 hrs)

10.1 Need for leadership
10.2 Functions of a leader
10.3 Factors to be considered for accomplishing effective leadership
### RECOMMENDED BOOKS

1. *A Handbook of Entrepreneurship*, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. *Entrepreneurship Development* by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi
3. *Environmental Engineering and Management* by Suresh K Dhamija, SK Kataria and Sons, New Delhi
4. *Environmental and Pollution Awareness* by Sharma BR, Satya Prakashan, New Delhi
5. *Thakur Kailash, Environmental Protection Law and policy in India: Deep and Deep Publications, New Delhi*
6. *Handbook of Small Scale Industry* by PM Bhandari
8. *Total Quality Management* by Dr DD Sharma, Sultan Chand and Sons, New Delhi.
9. *Principles of Management* by Philip Kotler TEE Publication
6.6 MAJOR PROJECT WORK

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- - 12

Project work aims at developing skills in the students whereby they apply the totality of knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The students should identify or given project assignment at least two to three months in advance. The project work identified in collaboration with industry should be preferred.

Each teacher is expected to guide the project work of 5-6 students. The project assignments may consist of:

a) Projects related with repair and maintenance of machine parts
b) Estimating and costing projects
c) Design of components/ parts/ jigs / fixtures
d) Projects related to quality control
e) Project work related to increasing productivity
f) Project connected with work study
g) Projects relating to erection, installation, calibration and testing
g) Projects related to wastage reduction
h) Progress related to energy audit

For Students of Electrical Engineering Diploma Programme the project work can be grouped under the following three heads, 1.1, 1.2, 1.3, 1.4 and 1.5 is compulsory for all. A number of projects have been mentioned under each head (i.e. group). A student should take at least two projects both of which should not be from the same group. If more than two projects are taken to make up a total of 256 hours, then more than 1 may be taken from the same group as long as at least two groups are covered.

NOTE:

It is pointed out that the specific projects mentioned below under each group are only suggestions and the same may not necessarily be done. The teachers may choose and undertake any other projects within these groups and if they are approved by a committee headed by the head of the department. It will be appreciated if teachers take initiative in developing projects of their own and also encourage the students to do the same. When such projects are added to the following list the number of hours required should be estimated before hand for each of the projects.
1.1 **Electrical Machines and Equipment:**

1.1.1 Construction of small transformer (100 VA)
1.1.2 Construction of phase sequence indicator
1.1.3 Hot air drier
1.1.4 Simple loop generator
1.1.5 Automatic curtain operator
1.1.6 Construction of Automatic Star-Delta starter
1.1.7 Construction of Automatic Water level controller
1.1.8 Balancing load of an indoor transformer
1.1.9 Construction of Choke for fluorescent tubes
1.1.10 Design and construction of fan regulators (inductance type)
1.1.11 Design and construction of fan regulators (Resistance type)
1.1.12 Design and construction of loading rheostats
1.1.13 Design and construction of Desert coolers
1.1.14 Fabrication of electric motor
1.1.15 Rewinding of motors upto 5 HP
1.1.16 Design and construction of Geyser
1.1.17 Electroplating of small domestic gadgets
1.1.18 Erection/installation and commissioning of rotating electrical machine
1.1.19 Fault detection and repair of electrical/electronic instruments
1.1.20 Design and assembly of contactor control circuit for various applications

1.2 **Electrical Power:**

1.2.1 Drawing, estimating and costing of electrical installation of the institution from supplier's pole to the institution distribution board. Drawing, estimating and costing of electrical installation of a workshop having a given number of electrically operated appliances/machines.
1.2.2 To lay underground distribution cable for a small colony from main distribution pole
1.2.3 To erect a 5 pole span overhead line for a small distance for distribution of electrical energy. To energise it and prepare list of material and cost required
1.2.4 To provide a service connection to a consumers premises for domestic purposes
1.2.5 To survey the load of given area in a village, small colony, calculate the effective load and find out the sizes of the cables/conductors for the proposed distribution system

1.2.6 Designing of light and fan scheme for a institutional or commercial building

1.2.7 Augmentation of a nearby pole mounted sub station

1.3 **Electronic Based Projects:**

Fabrication of:

1.3.1 Voltage Stabilizer for refrigerator, air-conditioner
1.3.2 Emergency light using SCR
1.3.3 Power amplifier
1.3.4 Low cost intercom for home
1.3.5 Analog computer
1.3.6 Regulated power supply (+ 12V and + 6V) using 7812, 7912 and 7806, 7906
1.3.7 Automatic battery charger using SCR
1.3.8 Battery operated tube light
1.3.9 Solid state fan regulator
1.3.10 Burglar Alarm
1.3.11 Hearing aid
1.3.12 Automatic street light/dressing table light
1.3.13 Mosquito Repeller
1.3.14 Inverter circuit 500 watt.

1.4 **Fabrication and Testing of:**

1.4.1 Inverter/Emergency light circuit using power transistors
1.4.2 SCR based automatic battery charger
1.4.3 SCR operated illumination controller
1.4.4 SCR operated automatic water level controller
1.4.5 SCR based speed controller for DC shunt motor
1.4.6 Three phase full wave rectifier using power diodes
1.4.7 Timer circuit using 555-IC
1.4.8 SCR controlled rectifier circuit
1.4.9 Speed control circuit of DC shunt motor using SCR
1.4.10 Inverting and non-inverting amplifiers using OP AMP (741)
1.4.11 Comparator circuits using OP AMP (741)

1.5 **Market Survey for Different Types of Electrical Items with Specifications**

1.6 MCBs
1.7 Iron clad Electrodes
1.8 Cables (PVC) used for household
1.9 Special Cables, Teflon, paper insulated etc.
1.10 Starters, Seimen, Crompton, Havels, Hind Electrical etc.

NOTE: The quality of end-product and process adopted by the students in its execution should be taken into consideration along with other parameters while evaluating the students

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

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<th>Sr. No.</th>
<th>Performance criteria</th>
<th>Max. marks</th>
<th>Rating Scale</th>
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<td>1.</td>
<td>Selection of project assignment</td>
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<td>Excellent</td>
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<td>2.</td>
<td>Planning and execution of considerations</td>
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<td>Quality of performance</td>
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<td>4.</td>
<td>Providing solution of the problems or production of final product</td>
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<td>5.</td>
<td>Sense of responsibility</td>
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<td>6.</td>
<td>Self expression/communication skills</td>
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<td>Interpersonal skills/human relations</td>
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<td>Report writing skills</td>
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<td>8</td>
<td>Good</td>
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<td>Fair</td>
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<td>4</td>
<td>Poor</td>
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<tr>
<td>9.</td>
<td>Viva voce</td>
<td>10</td>
<td>Excellent</td>
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<tr>
<td></td>
<td></td>
<td>10</td>
<td>Very Good</td>
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<td>8</td>
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</tbody>
</table>

The overall grading of the practical training shall be made as per following table.

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance to improve and re-evaluated before being disqualified and declared “not eligible to receive diploma”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.
<table>
<thead>
<tr>
<th>Range of maximum marks</th>
<th>Overall grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) More than 80</td>
<td>Excellent</td>
</tr>
<tr>
<td>ii) 79 &lt;&gt; 65</td>
<td>Very good</td>
</tr>
<tr>
<td>iii) 64 &lt;&gt; 50</td>
<td>Good</td>
</tr>
<tr>
<td>iv) 49 &lt;&gt; 40</td>
<td>Fair</td>
</tr>
<tr>
<td>v) Less than 40</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Important Notes

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve another criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.