3.1 FUNDAMENTALS OF ELECTRICAL ENGINEERING

	L	P
Periods/week	5	3

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 acquaintance with various terms knowledge of fundamental concepts of electricity, magnetism and various principles related to it.

DETAILED CONTENTS

1. (a) Application and Advantages of Electrical Energy (04 Periods)

- Different forms of energy
- Advantages of electrical energy
- Uses of electrical energy

(b) Basic Electrical Quantities

- Basic concept of charge, current, voltage, resistance, power, energy and their units
- Conversion of units of work, power and energy from one form to another

2. DC Circuits (12 Periods)

2.1 Ohm's law, resistances in series and parallel

2.2 Kirchhoff's laws and their applications in solving electrical network problems

2.3 Network theorems such as Thevenin's theorem, superposition theorem Maximum power and transfer theorem and Norton's theorem

3. Batteries (15 Periods)

3.1 Basic idea about primary and secondary cells

3.2 Working principle, construction and applications of Lead acid, Nickel Cadmium and Silver Oxide Cells

3.3 Capacity and efficiency of lead acid battery

3.4 Charging methods used for lead acid accumulator

3.5 Care and maintenance of a lead acid battery

3.6 Grouping of cells in series and parallel (simple numerical problems)

3.7 Testing of lead Acid battery for fully charged conditions and their specifications

3.8 Application of lead acid battery

3.9 Idea about batteries used in UPS

4. Magnetism and Electromagnetism: (08 Periods)

4.1 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.

4.2 Force on a conductor placed in the magnetic field

4.3 Series magnetic circuits, simple problems

4.4 Concept of hyteresis, loop and hysteresis loss.

5. Electromagnetic Induction: (10 Periods)

5.1 Faraday's Laws of electromagnetic induction

5.2 Lenz's law

5.3 Fleming's Right and Left Hand Rule

5.4 Principle of self and mutual induction

5.5 Principle of self and mutually induced e.m.f. and simple problems

5.6 Inductances in series and parallel

5.7 Energy stored in a magnetic field

5.8 Concept of eddy currents, eddy current loss

6. AC Fundamentals (06 Periods)

6.1 Concept of a.c. generation (single phase and three phase)

6.2 Difference between a.c and d.c

6.3 Concept of alternating current and voltage, equation of instantaneous values, average value, r.m.s value, form factor, power factor etc.

6.4 Concept of phasor and phase difference

6.5 Representation of alternating sinusoidal quantities by vectors

6.6 Phasor algebra (addition, subtraction, multiplication and division of complex quantities)

7. AC Circuits (15 Periods)

7.1 AC through pure resistance, inductance and capacitance

7.2 Alternating voltage applied to RL,RC and RLC series and parallel circuits (impedance triangle, phasor diagram and their solutions)

7.3 Concept of susceptance, conductance and admittance

7.4 J-notation and its application in solving problems in ac circuits

7.5 Power in pure resistance, inductance, capacitance and series RL, RC, RLC circuits

7.6 Active and reactive components of current and their significance

7.7 Power factor and its practical significance

8. Poly-Phase Systems (10 Periods)

8.1 Advantages of 3 phase over single phase system

8.2 Star and delta connections (derive relationship between phase and line voltages, phase and line currents in star delta connections

8.3 Power in 3 phase circuits and measurement by two wattmeter method

8.4 Measurement of power and power factor of a 3-phase load by two wattmeter method using balanced/unbalanced load.

LIST OF PRACTICALS

1. (a) Determination of voltage-current relationship in a dc circuit under specific physical conditions and to draw conclusions (to verify ohm's law)

   (b) Filament lamp

   - Measure the resistance of a cold lamp filament with the help of calculations.
   - 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 current and voltage

2. (a) To verify that $R_t = R_1+R_2+\ldots$ where R_1, R_2 etc. are resistances connected in series

   (b) To verify $\frac{1}{Rt} = \frac{1}{R_1} + \frac{1}{R_2} + \text{- - - - - -} + \frac{1}{R_m}$

   Where R_1, R_2 etc. are resistances connected in parallel

3. Verification of Kirchhoff's current and voltage laws applied to DC circuits

   a) To construct a circuit arrangement consisting of resistances in series, parallel combination
   b) Identification of node points in the circuit
   c) To see that algebraic sum of currents at node point is zero
   d) To see that algebraic sum of emfs and voltage drops in a closed loop is zero

4. To observe the a.c and d.c wave shapes on CRO.

5. 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

6. To construct an RL and RC circuit and to measure

a) Impedance of the circuit
b) Phase angle between voltage and current
c) Construct impedance triangle

7. Measurement of power and power factor of a single phase RLC circuit. To calculate KVA and KVAR

8. Measurement of power and power factor of a 3-phase circuit by using 2- wattmeter method using induction motor as a load and to calculate KVA and KVAR

9. Testing a battery for its charged condition i.e testing of gravity

Note: The results should be verified analytically also.

INSTRUCTIONAL STRATEGY

Basic electrical engineering being a fundamental subject need to be handled very carefully and in a manner such that students develop clear understanding of principles and concepts and develop skill in their application in solving related problems. Teacher may lay emphasis on laboratory experiments and give lot of tutorial work to students in order to given them an opportunity in mastering the basics in solving related problems.

RECOMMENDED BOOKS

1. Fundamentals of Electrical Engineering by Sahdev, Uneek Publication, Jalandhar
2. Basic Electrical Engineering by PS Dhogal, Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. Electrical Science by VK Mehta, S Chand and Co., New Delhi
4. Electrical Engineering by DR Arora, Ishan Publications, Ambala
5. Electrical Technology by JB Gupta, SK Kataria and Sons, New Delhi
6. Electrical Technology by BL Theraja, S Chand & Co., New Delhi
7. Electrical Science by S. Chandhni, R Chakrabarti and PK Chattopadhyay. Narosa Publishing House Pvt. Ltd., New Delhi
8. Basic Electrical Engineering by Mool Singh, Galgotia Publication Pvt. Ltd., New Delhi
9. Principles of Electrical Engineering by BR Gupta, S Chand & Co., New Delhi
10. Handbook of Electrical Engineering by SL Bhatia, Khanna Publishers, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	04	05
2	12	15
3	15	15
4	08	10
5	10	15
6	06	05
7	15	20
8	10	15
Total	**80**	**100**

3.2 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

	L	P
Periods/week	4	2

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 (03 Periods)

   Classification of materials into conducting, semi conducting and insulating materials through a brief reference to their atomic structure and energy bands

2. Conducting Materials (12Periods)

   2.1 Introduction
   2.2 Resistance and factors affecting it such as alloying and temperature etc
   2.3 Classification of conducting material as low resistivity and high resistivity materials,
   Low resistance materials

   a. Copper- 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

   b. Aluminium - General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solderability, contact resistance. Applications of aluminium in the field of electrical engineering

   c. Steel - General properties as conductor: Resistivity, corrosion, temperature coefficient, density, mechanical properties, solderability, Applications in the field of electrical engineering

   Introduction to bundle conductors and its applications

   Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), and their practical applications with reasons for the same

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

3. Review of Semi-conducting Materials (05 Periods)

Semi Conducting material such as Germanium, Silicon, Carbon-their atomic structure/application/against , pure and impure semi conductors and their use for making electronic devices. Material used for special purpose semiconductor, diode, contacts, power transistor, substrate, integrated circuits and power handling devices.

4. Insulating materials; General Properties (12 Periods)

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, weatherability

4.5 Mechanical properties, mechanical structure, tensile structure

5. Insulating Materials and their applications (13Periods)

5.1 Plastics

a. Definition and classification
b. Thermosetting materials:
Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and melamine - formaldehyde), epoxy resins - their important properties and applications

c. Procedure of preparation of plastic (PVC)

d. Thermo-plastic materials:
Polyvinyl chloride (PVC), polyethelene, silicons, their important properties and applications

5.2 Natural insulating materials, properties and their applications

a. Mica and Mica products
b. Asbestos and asbestos products
c. Ceramic materials (porcelain and steatite)
d. Glass and glass products
e. Cotton
f. Silk
g. Paper (dry and impregnated)
h. Rubber, Bitumen

i. Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
j. Enamels for winding wires
k. Glass fibre sleeves

5.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF6 $^{\text{their}}$ properties and applications

6. Magnetic Materials (11 Periods)

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, method of reduction of eddy current loss and hysteresis loss

6.2 Soft Magnetic Materials

a) Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines
b) Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine
c) Nickel-iron alloys
d) Soft Ferrites

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

7. Special Materials (04 Periods)

Thermocouple, bimetals, leads soldering and fuses material, mention their applications

8. Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc (04 Periods)

LIST OF PRACTICALS

1. A market survey of different Electrical and Electronics materials available in market will be conducted by students. They will submit a report, which will include names, types, specifications, identification, testing of components, manufacturing details and related cost.
2. Case study/data manuals of different wires/cables/fuses/sockets etc.. A report will be submitted by the students.

INSTRUCTIONAL STRATEGY

The teacher should bring different materials, electronic components and devices in the class while taking lectures and explain and make students familiar with them. Also he may give emphasis on practical applications of these devices and components in the field. In addition, the students should be given exercises on identification of materials used in various electronic gadgets etc .and be encouraged to do practical work independently and confidently.

RECOMMENDED BOOKS

Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi

Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi

Electrical Engineering Materials by Sahdev, Uneek International Publications

Electronic Components and Materials by SM Dhir, Tata Mc Graw Hill, New Delhi

Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi

Electrical and Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi

Electrical and Electronics Engineering Materials DR Arora, Ishan Publications, Ambala City

Electrical Engineering Materials by Rakesh Dogra, SK Kataria and Sons, NEW Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Period)	Marks Allocation (%)
1	03	05
2	12	20
3	05	05
4	12	20
5	13	25
6	11	15
7	04	05
8	04	05
Total	**64**	**100**

3.3 ELECTRONICS DEVICES AND CIRCUITS

	L	P
Periods/week	5	3

RATIONALE

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

In this course, topics like semi-conductor theory, semi-conductor Diodes, Bipolar transistors, rectifiers, single stage and multistage amplifiers and field effect transistors have been included.

DETAILED CONTENTS

1. Introduction (04 Periods)

   1.1 Brief history of development of electronics
   1.2 Active and passive components

2. Semi-conductor Theory (10 Periods)

   2.1 Atomic structure, crystalline structure
   2.2 Energy band theory of crystals, energy band structure of insulator, semiconductor and conductor, generation and recombination of electron hole pairs. Energy band structure of Silicon and Germanium
   2.3 Concept of Doping, intrinsic and extrinsic semiconductors
   2.4 Effect of temperature on intrinsic and extrinsic semiconductors

3. Semiconductor Diodes (14 Periods)

   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 in 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), ripple factor, rectifier efficiency
   3.4 Operation of filter circuits
   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 Use of zener diode for voltage stabilization

4. Bi-polar Transistors (10 Periods)

   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 collector (CC), current relation and their input/output characteristics; comparison of the three configurations

5. Transistor Biasing and Stabilization (12 Periods)

5.1 Transistor biasing, its need, operating point, effect of temperature on the operating point of a transistor and need of stabilization of operating point.
5.2 Different biasing circuits, limitations
5.3 Use of data book to know the parameters of a given transistor

6. Single-Stage Transistor Amplifiers (10 Periods)

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 Frequency response of a single stage transistor amplifier

7. Multi-Stage Transistor Amplifiers (08 Periods)

7.1 Need of multi-stage transistor amplifiers – different types of couplings, their purpose and applications.
7.2 RC coupled two-stage amplifiers, circuit details, working, frequency response, applications
7.3 Loading effect in multistage amplifiers
7.4 Elementary idea about direct coupled amplifier, its limitations and applications
7.5 Transformer coupled amplifiers, its frequency response.

8. Field Effect Transistor (FET) (06 Periods)

8.1 Construction, operation, characteristics and applications of a N channel JFET and P channel JFET
8.2 JFET as an amplifier
8.3 Types, construction, operation, characteristics and applications of a MOSFET
8.4 Comparison between BJT, JFET and MOSFET

9 Operational Amplifiers (08 period)

- Characteristics of an ideal operational amplifier and its block diagram
- Definition of differential voltage gain, CMRR, PSRR, slew rate and input offset current
- Operational amplifier as an inverter, scale changer, adder, subtractor, differentiator, and integrator

LIST OF PRACTICALS

1. a) Identification and testing of electronic components such as resistor, inductor, capacitor, diode, transistor and different types of switches used in Electronic circuits

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 zener diode and finding its reverse breakdown voltage
   b) Fabrication of a zener diode voltage stabilizer circuit using PCB
4. Observation of input and output wave shapes of a half-wave rectifier
5. Observation of input and output wave shapes of a full wave rectifier
6. Plotting input and output characteristics of a transistor in CB configuration
7. Plotting input and output characteristics of a transistor in CE configuration
9. To study the effect of coupling capacitor on lower cut off frequency and upper cut off frequency by plotting frequency response curve of a two stage RC coupled amplifier
10. To plot V-I characteristics of a FET
11. To use IC 741 (op-amplifier) as

    i) Inverter, ii) Adder, iii) Subtractor iv) Integrator

INSTRUCTIONAL STRATEGY

This subject gives the knowledge of fundamental concepts of basic electronics. The teacher should give emphasis on understanding of concepts and various term used in the subject. The students be made familiar with diodes, transistors, resistors, capacitors, inductors etc. and electrical measuring instruments etc. Practical exercises will reinforce various concepts. Application of Semiconductor Diodes, Transistors, Field Effect Transistors etc must be told to students.

RECOMMENDED BOOKS

1. Basic Electronics and Linear Circuit by NN Bhargava, Kulshreshta and SC Gupta, Tata McGraw Hill Education Pvt Ltd, New Delhi
2. Electronic Principles by SK Sahdev, Dhanpat Rai & Co., New Delhi
3. Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi
4. Electronic Components and Materials by SM Dhir, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi
5. Principles of Electronics by SK Bhattacharya and Renu Vig, SK Kataria and Sons, Delhi
6. Electronics Devices and Circuits by Millman and Halkias; McGraw Hill

7. Principles of Electronics by Albert Paul Malvino; Tata McGraw Hill Education Pvt Ltd, New Delhi
8. Basic Electronics – Problems and Solutions by Albert Malvino and David J. Bates; Tata McGraw Hill Education Pvt Ltd, New Delhi
9. Basic Electronics by J.S. Katre, Sandeep Bajaj, Tech. Max. Publications, Pune
10. Analog Electronics by DR Arora, Ishan Publications, Ambala City
11. Analog Electronics by JC Karhara, King India Publication, New Delhi
12. Electrical Devices and Circuits by Rama Reddy, Narosa Pulishing House Pvt. Ltd., New Delhi
13. Electronic Devices and Circuits by Dharma Raj Cheruku and Battula Tirumala Krishna: Pearson Education (Singapore) Pvt Ltd., Indian Branch, 482 F.I.E Patparganj, Delhi- 92
14. Basic Electronics by JB Gupta, SK Kataria and Sons, New Delhi
15. Grob's Basic Electronics- A text Lab Manual (Special Indian Edition) by Schultz, Tata McGraw Hill Education Pvt Ltd, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Period)	Marks Allocation (%)
1	04	05
2	10	10
3	14	20
4	10	10
5	12	15
6	10	10
7	08	10
8	06	10
9	06	10
Total	**80**	**100**

3.4 FUNDAMENTALS OF MECHANICAL AND CIVIL ENGINEERING

	L	T	P
Periods/week	5	-	3

RATIONALE

A diploma holder has to assist in activities of 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 and mechanical engineering. The subject of Fundamentals of Mechanical and Civil Engineering has been included to impart basic knowledge of Civil and Mechanical engineering to the students.

DETAILED CONTENTS
PART-A

MECHANICAL ENGINEERING

Theory

1. Transmission of Power (20 Periods)

    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. Air Conditioning System (24 Periods)

    2.1 Basic principle of refrigeration and air conditioning
    2.2 Working of centralized air conditioner
    2.3 Concept of split air conditioner and its applications

3. Pumps - Types and their uses (06 Periods)

PART B

CIVIL ENGINEERING

Theory

4. Construction Materials (12 Periods)

    Properties and uses 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

5. Foundations (08 Periods)

    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

6. Concrete (06 Periods)

Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/ field testing of concrete, mixing of concrete

7. RCC (04 Periods)

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

LIST OF PRACTICLES

1. Observe operation of a centrifugal pump and location of common faults
2. Decide the type of foundation too be used for various types of electrical machinery and installation. Prepare a foundation for installation of a motor/ generator.
3. Identify various types of drives used in an IC engines and describe their function
4. Observe operation of air conditioning system. Identify locations of faults.
5. Trace the various paths of hot gases, cool gases, control system in a split air conditioner model. Identify the possible location of faults/ malfunctioning.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on basic principles and use charts in class, visits to Labs and industry may be arranged to demonstrate certain materials and practices.

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

Civil Engineering

1. Textbook of Concrete Technology 2nd Edition by Kulkarni, PD Ghosh RK and Phull, YR; New Age International (P) Ltd., Publishers, New Delhi
2. Materials of Construction by Ghose; Tata McGraw Hill Publishing Co., Ltd., New Delhi
3. Civil Engineering Materials by TTTI, Chandigarh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
4. Concrete Technology by Gambhir; Tata McGraw Hill Publishing Co., Ltd., New Delhi
5. Building Construction by J Jha and Sinha; Khanna Publishers, Delhi
6. Building Construction by Vazirani and Chandola; Khanna Publishers, New Delhi Delhi
7. Civil Engineering Materials by SV Deodhar and Singhai; Khanna Publishers, New Delhi Delhi
8. Soil Mechanics and foundation Engineering by SK Garg; Khanna Publishers, New Delhi Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1	20	17
2	24	27
3	06	06
4	12	25
5	08	10
6	06	08
7	04	07
Total	**80**	**100**

3.5 ELECTRICAL MEASURMENT AND MEASURING INSTRUMENTS

	L	P
Periods/week	5	3

RATIONALE

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

DETAILED CONTENTS

1. Introduction to Electrical Measuring Instruments (07 Periods)

    1.1 Concept of measurement and measuring instruments
    1.2 Types of electrical measuring instruments – indicating, integrating and recording type instruments
    1.3 Essentials of indicating instruments – deflecting, controlling and damping torque

2. Ammeters and Voltmeters (Moving coil and moving iron type) (15 Periods)

    2.1 Concept of ammeters and voltmeters and difference between them
    2.2 Extension of range of voltmeters and ammeter
    2.3 Construction and working principles of moving Iron and moving coil instruments
    2.4 Merits and demerits, sources of error and application of these instruments

3. Wattmeters (Dynamometer Type) (06 Periods)

    Construction, working principle, merits and demerits of dynamometer type wattmeter, sources of error

4. Energy meter (Induction type) (08 Periods)

    Construction, working principle, merits and demerits of single-phase and three-phase energy meters

    4.1 Errors and their compensation

    4.2 Simple numerical problems

    4.3 Construction and working principle of maximum demand indicators

5. Miscellaneous Measuring Instruments (22 Periods)

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), signal generator, AC milivoltmeter, tachometer

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

6. Electronic Instruments (10 Periods)

6.1 Cathode Ray Oscilloscope: Block diagram, working principle of CRO and its various controls. Applications of CRO

6.2 Digital multi-meter, basic principle, constructional brief, display system

7. LCR meters (07 Periods)

Study of LCR meter and its applications
Digital LCR and Q meter

8. Power Measurements in 3-Phase Circuits by (05 Periods)

(i) 2 wattmeter method in balanced and unbalanced circuits and simple problems
(ii) Three wattmeter method

LIST OF PRACTICALS

1. Use of analog and digital multimeter for measurement of voltage, current (a.c/d.c) and resistance.
2. To calibrate 1-phase energy meter by direct loading method.
3. To measure the value of earth resistance using earth tester.
4. To measure power, power factor in a single-phase circuit, using wattmeter and power factor meter and to 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 and frequency of a sinusoidal signal using CRO time base as well as Lissagous pattern and draw wave shape of signal.
7. Measurement of power in a 3 phase circuit using CT, PT and 3-phase wattmeter.
8. Use of LCR meter, digital LCR meter for measuring inductance, capacitance and resistance.
9. To record all electrical quantities from the meters installed in the institution premises.
10. To measure Energy at different Loads using Single phase Digital Energy meter.

INSTRUCTIONAL STRATEGY

After making the students familiar with measuring instruments, they should be made conceptually clear about the constructional features and make them confident in making connection of various measuring instruments. Teacher should demonstrate the application of each measuring instrument in laboratory and encourage students to use them independently.

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, Satya Publication, New Delhi
7. Basic Electrical Measurements by Melville B. Staut
8. Electrical Measurement and Measuring Instruments by JB Gupta, SK Kataria and Sons, New Delhi
9. Electrical Measurement and Measuring Instruments by ML Anand, SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Period)	Marks Allocation (%)
1	07	10
2	15	20
3	06	05
4	08	10
5	22	25
6	10	10
7	07	10
8	05	10
Total	**80**	**100**

3.6 ELECTRICAL WORKSHOP PRACTICE

	L	P
Periods/week	-	6

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 as mentioned in the Electricity Rules and shock treatment including first aid

2. Types of wiring and to make different light control circuits in the following types of wiring Casing and capping, (PVC) conduct, baten wiring

3. Study of ISI standard for MCBs and ELCBs Conduct one test on MCB on above basis

4. Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and MCBs Types of wiring and to make different light control circuits in the following types of wiring.

   4.1 Casing and Capping (PVC) wiring
   4.2 Conduit wiring (surface/concealed)

5. Construction of distribution and extension board with two 5A sockets and two I5A sockets, a fuse and indicator with series test lamp provision controlled by their respective switches.

6. Testing of domestic wiring installation using meggar.

7. Fault finding and repair of a tube light circuit.

8. Carry out pipe/ plate earthing for a small house and 3 phase induction motor. Testing the earthing using earth tester.

9. Connection of single phase and three phase motors through an appropriate starter.

10. Winding/ rewinding of a fan (ceiling and table) and choke.

11. Repair of domestic electric appliances such as electric iron, geyser, fan, heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnace and weighing machine.

Note: Students may be asked to study control circuit of a passenger lift, automatic milling machine, etc. using relays.

4.1 ELECTRICAL ENGINEERING DESIGN AND DRAWING

	L	P
Periods/week	-	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 co-relate through sketches and drawings
iii) Prepare working drawings of 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 (To make 25 Sheets)

1. Symbols and Signs Conventions **(2 Sheets)** (06 Periods)

   Various Electrical Symbols used in Domestic and Industrial Installation and Power System as per BIS

2. Panels/Distribution Boards **(3 Sheets)** (18 Periods)

   Design and Drawing of panels/Distribution board using MCBs, ELCB, main switches and change over switches for domestic installation, industrial and commercial installation.

3. Orthographic projections of Simple Electrical Parts **(4 Sheets)** (12 Periods)

   - Pin type and shackle type insulator (Pin Type 11kV/66kV)
   - Bobbins of a small transformer / choke
   - Stay insulators/Suspension type insulators
   - Free hand sketching of M.C.B. and E.L.C.B Placed on Distribution Board.

4. Orthographic Projection of Machine Parts **(4 Sheets)** (12 Periods)

   - Rotor of a squirrel cage induction motor
   - Motor body (induction motor) as per IS Specifications (using outside dimensions)
   - Slip rings of 3-phase induction Motor.
   - Stator of 3 phase Induction motor (Sectional View)

5. Contactor Control Circuits: Schematic and wiring diagram **(3 Sheets)** (24 Periods)

- DOL Starter of 3-phase induction Motor
- Forwarding/reversing of 3-phase induction motor
- Limit switch control of a 3-phase induction motor
- Sequence operation of two motors using T.D.R.
- Two speed motor control
- Automatic star-delta starter for 3-phase induction motor

6. Earthing – Layout of earthing of substation, earthing of poles, transformers (3Sheets) (08 Periods)

7. Key diagram of 33/11 KVA substation (2 Sheets) (06 Periods)

8. Design/Drawing of application circuit used in intelligent building(04sheets) (10 Periods)

   a. Security system/intelligent camera/automatic recording/photography system
   b. Stage lighting
   c. Safety system
   d. Centralized air-conditioning system
   e. Computer Networking

INSTRUCTIONAL STRATEGY

Teacher should identify/prepare more exercises on the pattern shown above. The teacher should make the students confident in making drawing and layouts of electrical wiring installations and doing estimation and costing. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

RECOMMENDED BOOKS

1. Electrical Engineering Design and Drawings by Surjeet Singh, Dhanpat Rai and Co, 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, Uneek Publications, Jalandhar
5. Electrical Engineering Drawing by Surjit Singh, SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	06	6
2	18	18
3	12	12
4	12	12
5	24	24
6	08	08
7	06	10
8	10	10
Total	**96**	**100**

4.2 D.C. MACHINES AND TRANSFORMERS

	L	P
Periods/week	5	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. 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 (08 Periods)

    1.1 Definition of motor and generator, concept of torque
    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

2. DC Machines (30 Periods)

    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
    2.4 Factors determining the electromagnetic torque
    2.5 Types of dc generation on the basis of excitation, voltage built up in a dc shunt generator
    2.6 Significance of back e.m.f., the relation between back emf and Terminal voltage
    2.7 Armature Reaction
    2.8 Commutation methods to improve commutation
    2.9 Performance and characteristics of different types of DC motors
    2.10 Speed control of dc shunt/series motors
    2.11 Need of starter, three point dc shunt motor starter and 4-point starter
    2.12 Applications of DC motors
    2.13 Losses in a DC machine
    2.14 Determination of losses by Swinburne’s test

3. Transformers (single phase) (30 Periods)

    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 – neglecting voltage drop in the windings – Ampere turn balance – its phasor diagram
3.7 Mutual and leakage fluxes, leakage reactance
3.8 Transformer on load, voltage drops and its phasor diagram
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 of efficiency, condition for maximum efficiency-maintenance of Transformer, scheduled Maintenance
3.13 Auto transformer construction, saving of copper, working and applications
3.14 Different types of transformers including dry type transformer.

4. Transformers three phase (12 Periods)

4.1 Construction of three phase transformers and accessories of transformers such as Conservator, breather, Buchholz Relay, Tap Changer (off load and on load) (Brief idea)
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
4.5 Difference between power and distribution transformer
4.6 Cooling of transformer

LIST OF PRACTICALS

1. 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. Speed control of dc shunt motor (i) Armature control method (ii) Field control method
3. Study and connection of dc series motor with starter (to operate the motor on no load for a moment)
4. Study and connection of 3 point starter for starting D.C. shunt motor and change its direction of rotation. Also draw load characteristics
5. To perform open circuit and short circuit test for determining: (i) equivalent circuit (ii) the regulation and (iii) efficiency of a transformer from the data obtained from open circuit and short circuit test at full load
6. To find the efficiency and regulation of single phase transformer by actually loading it.
7. Checking the polarity of the windings of a three phase transformer and connecting the windings in various configurations
8. Finding the voltage and current relationships of primary and secondary of a three phase transformer under balanced load in various configurations conditions such as
   (a) Star-star
   (b) Star delta
   (c) Delta star
   (d) Delta - Delta configuring conditions
9. To test primary/ secondary windings of a transformer.

INSTRUCTIONAL STRATEGY

Electrical machines being a core subject of electrical diploma curriculum, where a student will deal with various types of electrical machines which are employed in industry, 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. Special care has to be taken on conceptual understanding of concepts and principles in the subject. For this purpose exposure to industry, work places, and utilization of various types of electrical machine for different applications may be emphasized. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, Education Pvt Ltd. New Delhi
2. Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar
3. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi
4. Electrical Machines by JB Gupta, SK Kataria and Sons, New Delhi
5. Electrical Machines by Fitzgerald
6. Electrical Machines by Smarajit Ghosh-Pearson Publishers, Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	08	10
2	30	40
3	30	35
4	12	15
Total	**80**	**100**

4.3 DIGITAL ELECTRONICS AND MICROPROCESSOR

	L	P
Periods/week	5	3

RATIONALE

The syllabus has been designed to make the students having knowledge about the fundamental principles of digital electronics, microprocessor and to get familiar with the available IC chips. This subject aims to give a background in the broad field of digital systems design and microprocessors.

DETAILED CONTENTS

(A) Digital Electronics

1. Introduction (02 Period**)**

Distinction between analog and digital signal, Applications and advantages of digital signals.

2. Number System (06 Period**)**

Binary, Octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa, binary addition, subtraction, multiplication and division including binary points. 1's and 2's complement method of addition/subtraction.

3. Codes and Parity (06 Period**)**

Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code, Concept of parity, single and double entry and error detection, Alpha numeric codes : ASCII and EBCDIC

4. Logic Gates and Families (05 Period**)**

Concept of negative and positive logic, Definition, Symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates, Logic family classification: Definition of SSI, MSI,LSI, VLSI,TTL and CMOS families.

5. Logic Simplification (08 Period**)**

Postulates of Boolean algebra, De Morgan's Theorems . Various identities. Formulation of truth table and Boolean equation for simple problem. Implementation of Boolean (logic) equation with gates. Karnaugh map (upto 4variables) and simple applications in developing combinational logic circuits.

6. Arithmetic Circuits (06 Period**)**

Half adder and Full adder circuit, design and implementation, Half and Full subtractor circuit, design and implementation, 4 bit adder/subtractor, Adder and Subtractor IC

7. Decoders, Multiplexers and De Multiplexers (06 Period**)**

Four bit decoder circuits for 7 segment display and decoder/driver ICs, Multiplexers and De-Multiplexers, Basic function and block diagram of MUX and DEMUX. Different types and ICs.

8. Latches and flip flops (06 Period**)**

Concept and types of latch with their working and applications, Operation using waveforms and truth tables of RS, T, D, Master/Slave JK flip flops, Difference between a latch and a flip flop.

9. Counters (06 Period**)**

Introduction to Asynchronous and Synchronous counters, Binary counters, Divide by N ripple counters, Decade counter, Up/Down counter, Ring counter.

10. Shift Register (06 Period**)**

Introduction and basic concepts including shift left and shift right : Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.

11. A/D and D/A Converters (02 Period**)**

Working principle of A/D and D/A converters.

(B) MICROPROCESSORS

12. Evolution and Architecture of a Microprocessor (08 Period**)**
(With reference to 8085 microprocessor)

Typical organization of a microcomputer system and functions of its various blocks. Concept of Bus, bus organization of 8085, Function block diagram of 8085, Pin details of 8085, Steps to execute a stored program.

13. Programming (With respect to 8085 microprocessor) (12 Period**)**

Brief idea of machine and assembly languages, Machines and Mnemonic codes. Instruction format and Addressing mode. Identification of instruction as to which addressing mode they belong. Concept of instruction set. Explanation of the instructions of the following groups of instruction set. Data transfer group, Arithmetic Group, Logic Group, Stack, I/O and Machine Control Group. Programming exercises in assembly language.(Examples can be taken from the list of experiments)

LIST OF PRACTICALS

1. Verification & interpretation of truth tables for AND, OR, NOT NAND, NOR and Exclusive OR (EXOR) gates.
2. To design a half adder & full adder using gates and verification of their operation construction of a full adder circuit using XOR and NAND gates and verify its operations.
3. To design a half subtractor & full subtractor circuit with the help of gates & verify their operation.
4. 4 bit adder /subtractor circuit using an IC verify the operation.
5. Verify of truth table for decoder ICs.

6. Verification of truth table of JK & JK Master slave flip flops.
7. To design a 4bit SISO, SIPO, PISO, PIPO shift registers using JK/D flip flop and verification of their operation.
8. Design decode counter and it's verification.
9. Design Analog to Digital & Digital to Analog converters and their verification.
10. To design a 4 bit binary counter & verify its truth table.
11. Steps to enter, modify data/program and to execute a program on 8085 kit.
12. Writing and execution of ALP for addition and subtractions of two 8 bit numbers.
13. Writing and execution of ALP for multiplication and division of two 8 bit numbers.
14. Writing and execution of ALP for arranging 10 numbers in ascending/descending order

Section 1.01 INSTRUCTIONAL STRATEGY

The digital systems and microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing), A/D, D/A Converters and other topics. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. Programming exercises other than the tested in circulation may be given to the students.

(a) LIST OF RECOMMENDED BOOKS

1. Digital Electronics: Principles and Integrated Circuits by A.K Maini, Wiley-India Pvt Ltd. Daryaganj, New Delhi
2. Digital Electronics and Applications by Malvino Leach, Tata McGraw Hill Education Pvt Ltd, New Delhi
3. Digital Logic Designs by Morris Mano, Prentice Hall of India, New Delhi
4. Digital Electronics by Soumitra Kumar Mandal, Tata McGraw Hill Education Pvt Ltd,
5. Digital Electronics by V K Sangar , Raj Publishers, Jalandhar
6. Digital Electronics by Tokheim, Tata McGraw Hill Education Pvt Ltd,
7. Digital Electronics by RP Jain, Tata McGraw Hill Education Pvt Ltd, New Delhi
8. Digital Electronics by KS Jamwal, Dhanpat Rai and Co., New Delhi
9. Digital Electronics by Rajiv Sapra, Ishan Publication, Ambala
10. Digital Electronics by BR Gupta, Dhanpat Rai & Co., New Delhi

11. Digital Systems: Principles and Applications by RJ Tocci, Prentice Hall of India, New Delhi

12. Digital Electronics by Rajaraman V., Prentice Hall of India, New Delhi

13. Fundamentals of Digital Electronics by Naresh Gupta, Jain Brothers, New Delhi

14. Microprocessor Architecture, Programming and Applications with 8080/8085 by Ramesh S Gaonker, Willey Eastern Ltd. New Delhi

15. Introduction to Microprocessor by Mathur ,Tata McGraw Hill Education Pvt Ltd , New Delhi

16. Microprocessor and Applications by Badri Ram: Tata McGraw Hill Education Pvt Ltd , New Delhi

17. Microprocessor 8086/88 by B.B. Brey

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Period)	Marks Allotted (%)
1	02	03
2	06	06
3	06	08
4	06	08
5	08	08
6	06	08
7	06	08
8	06	08
9	06	10
10	06	06
11	02	03
12	08	08
13	12	08
Total	**80**	**100**

4.4 GENERATION, TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER

	L	P
Periods/week	5	3

RATIONALE

The majority of the polytechnic passouts who get employment in State Electricity Boards have to perform various activities 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 including 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 Transmission and Distribution of Electrical Power.

DETAILED CONTENTS

1. Power Generation (15 Periods)

    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. Economics of Generation (10 Periods)

    2.1 Fixed and running cost, load estimation, load curves, demand factor, load factor, diversity factor, power factor and their effect on cost of generation, simple problems there on
    2.2 Base load and peak load power stations, inter-connection of power stations and its advantages, concept of regional and national grid
    2.3 Plant capacity factor, plant use factor, Daily load curve.

3. Transmission Systems (25 Periods)

    3.1 Layout of transmission system, selection of voltage for H.T and L.T lines, advantages of high voltage for Transmission of power in both AC and DC
    3.2 Comparison of different systems: AC versus DC for power transmission, conductor material and sizes from standard tables
    3.3 Constructional features of transmission lines: Types of supports, types of insulators, Types of conductors, Selection of insulators, conductors, earth wire and their accessories, Transposition of conductors and string efficiency of suspension type insulators, Bundle Conductors.
    3.4 Mechanical features of line: Importance of sag, calculation of sag, effects of wind and ice related problems; Indian electricity rules pertaining to clearance

3.5 Electrical features of line: Calculation of resistance, inductance and capacitance without derivation in a.c. transmission line, voltage regulation, and concept of corona. Effects of corona and remedial measures

3.6 Transmission Losses

4. Distribution System (16 Periods)

4.1 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

4.2 Preparation of estimates of HT and LT lines (OH and Cables)

4.3 Constructional features of LT (400 V), HT (II kV) underground cables, advantages and disadvantages of underground system with respect to overhead system.

4.4 Calculation of losses in distribution system

4.5 Faults in underground cables-determine fault location by Murray Loop Test, Varley Loop Test

5. Power Factor (04 Periods)

5.1 Concept of power factor

5.2 Reasons and disadvantages of low power factor

5.3 Methods for improvement of power factor using capacitor banks, VAR Static Compensator (SVC)

6. Various types of Tariffs (10 Periods)

6.1 Concept of Tariffs

6.2 Block rate, flat rate, maximum demand and two part tariffs simple problems

LIST OF PRACTICALS

Structured visit to the substations, power stations, and LT/HT lines, student will prepare report and present in a seminar. Evaluation will be based on report s well as presentation.

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment, accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition, viva-voce be conducted to evaluate the knowledge gained during the field visit.

RECOMMENDED BOOKS

1. Electrical Power System and Analysis by CL Wadhwa, 3rd edition, New Age International Publishers, New Delhi
2. Substation Design and Equipment by Satnam and PV Gupta, Dhanpat Rai & Sons, New Delhi
3. Electrical Power –I by SK Sahdev, Uneek Publications, Jalandhar
4. Electrical Power System by VK Mehta, S Chand and Co., New Delhi
5. Electrical Power System by JB Gupta, SK Kataria and Sons, New Delhi
6. Sub-Station Design by Satnam, Dhanpat Rai and Co., New Delhi
7. Electrical Power Distribution System by AS Pabla, Tata McGraw Hill, New Delhi
8. Electrical Power System by S Channi Singh, Tata McGraw Publishing Co. New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	15	15
2	10	10
3	25	35
4	16	20
5	04	10
6	10	10
Total	**80**	**100**

4.5 INDUSTRIAL INSTRUMENTATION AND CONTROL

	L	P
Periods/week	5	3

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 for 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. Basics of instrumentation has been dealt with in this subject

DETAILED CONTENTS

1. Measurements (05 Periods)

   Importance of measurement, Basic measuring systems, advantages and limitations of each measuring systems, generalized measurement system, process and process variables

2. Transducers (08 Periods)

   Theory, types of transducers construction and use of various transducers like resistance, inductance, capacitance, electromagnetic, piezoelectric type

3. Measurement of Displacement and Strain (10 Periods)

   Displacement Measuring Devices: wire wound potentiometer, LVDT, strain gauges and their different types such as inductance type, resistive type, wire and foil type 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 Periods)

   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- Manometers, diaphragms (08 Periods)

   Bourdon, bellows, manometer, diaphragm pressure gauges, basic principles, constructional brief and use, pickups, their principle, construction and applications. Use of pressure cells, Dead weight tester

6. Flow Measurement (06 Periods)
   Basic principles of magnetic and ultrasonic flow meters, flow coefficient, Reynolds number and rotameter.

7. Measurement of Temperature (10 Periods)

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

8. Measurement of other non electrical quantities such as humidity, pH level and vibrations, light measurement, speed measurement using Tachometer and Stroboscope (08 Periods)

9. Signal conditioning and telemetry with small simple examples (05 Periods)

10. Recorder and display system brief idea (04 Periods)

11. Control System – Types of control system, open loop and close loop system, components and the circuit, brief description and application in industry, idea about automation (06 Periods)

INSTRUCTIONAL STRATEGY

The teacher should explain the scope of various measuring devices and their practical applications in the field. The transducers and measuring devices must be shown to the students and they should be trained in the reaction, operation, maintenance and calibrations. Frequent visits to nearby process industries will be of immense help to the students.

RECOMMENDED BOOKS

1. Electronic Measurement and Instrumentation by Dr Rajendra Prasad
2. Electronic Measurement and Instrumentation by JB Gupta, SK Kataria and Sons, New Delhi
3. Electrical and Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Co., New Delhi
4. Electronic Instrumentation and Measurement Techniques by WD Cooper, AD Helfrick Prentice Hall of India Pvt. Ltd. New Delhi
5. Industrial Instrumentation by Umesh Rathore, SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	05	06
2	08	10
3	10	12
4	10	12
5	08	10
6	06	06
7	10	16
8	08	10
9	05	06
10	04	06
11	06	06
Total	**80**	**100**

4.6 ESTIMATING AND COSTING IN ELECTRICAL ENGINEERING

	L	P
Periods/week	6	-

RATIONALE

A diploma holder in electrical engineering should be familiar to Indian Standards and relevant Electricity Rules. Preparation of good estimates is a professional's job, which requires knowledge of materials and methods to deal with economics. The contents of this subject have 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 (12 Periods)

   Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule, costing, price list, preparation of tender document (with 2-3 exercises), 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 (18 Periods)

   IE rules and safety cods, Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, 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 (to be prepared/arranged)

3. Estimating and Costing (42 Periods)

   3.1 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 (for house of two room set along with layout sketch), single storey building, auditorium hospital, cinema hall, computer networking, schools and others

   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, starters, preparation of list of materials, estimating and costing exercises on workshop with singe-phase, 3-phase motor load and the light load (3-phase supply system)

3.3 Service line connections estimate for domestic upto 10 KW and Industrial loads upto 20 KW (over-head and underground connections) commercial load upto 100 KW, agriculture load 10 hp motor from pole to energy meter.

4. Estimating the material required for (24 Periods)

a) Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations. Estimating of stay and poles, crossing of telephone lines, railway lines and bridge

b) Substation - Types of substations, substation schemes and components, estimate of 11/0.4 KV pole mounted substation up to 200 KVA rating, methods of earthing of substations, Key Diagram of 66 KV/11KV and 11 KV/0.4 KV Substation and foundation preparation.
Single line diagram, layout sketching of outdoor, indoor 11kV sub-station or 33kV sub-station

INSTRUCTIONAL STRATEGY

Teacher should identify/prepare more exercises on the pattern shown above. The teacher should make the students confident in making drawing and layouts of electrical wiring installations and doing estimation and costing leading to preparation of small tender document.. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

RECOMMENDED BOOKS

1. Electrical Installation, Estimating and Costing by JB Gupta, SK Kataria and Sons, New Delhi
2. Estimating and Costing by SK Bhattacharya, Tata McGraw Hill, New Delhi
3. Estimating and Costing by Surjeet Singh, Dhanpat Rai & Co., New Delhi
4. Estimating and Costing by Qurashi
5. Estimating and Costing by SL Uppal, Khanna Publishers, New Delhi
6. Electrical Estimating and Costing by N Alagappan and B Ekambaram, TMH, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	12	15
2	18	20
3	42	40
4	24	25
Total	**96**	**100**

4.7 INDUSTRIAL TRAINING

Industrial training provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 4 weeks duration to be organised during the semester break starting after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A teacher may guide a group of 4-5 students. A minimum of one visit by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

Internal assessment and external assessment have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behaviour, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry, if any. The components of evaluation will include the following.

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with workers	15%
d)	Industrial training report	55%