FOURTH SEMESTER
ELECTRICAL ENGINEERING

ELECTRICAL ENGINEERING DESIGN AND DRAWING

L	T	P
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Subject Code - 084001

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)

UNIT I   (24 Periods)

Symbols and Signs Conventions   (02 Sheets)

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

Panels/Distribution Boards   (03 Sheets)

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

UNIT II   (24 Periods)

Orthographic projections of Simple Electrical Parts   (04 Sheets)

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.

Orthographic Projection of MachineParts   (04 Sheets)

- 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)

UNIT III   (24 Periods)

Contactor Control Circuits: Schematic and wiring diagram (03 Sheets)

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

UNIT IV   (08 Periods)

Earthing – Layout of earthing of substation, earthing of poles, transformers

(03Sheets)

UNIT V   (16 Periods)

Key diagram of 33/11 KV substation   **(02 Sheets)**

Design/Drawing of application circuit used in intelligent building   **(04 Sheets)**

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 Delh

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

Unit	Time Allotted (Periods)	No. Of Marks Allotted (%)
1	24	25
2	24	25
3	24	25
4	08	10
5	16	15
Total 05	**96**	**100**

D.C. MACHINES AND TRANSFORMERS

L	T	P
5	-	3

Subject Code - 084002

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

UNIT 1. Introduction to Electrical Machines   (08 Periods)

Definition of motor and generator, concept of torque, Torque development due to alignment of two fields and the concept of torque angle, Electro-magnetically induced emf, Elementary concept of an electrical machine,

UNIT 2. DC Machines   (30 Periods)

Main constructional features, Types of armature winding, Function of the commutator for motoring and generation action, Factors determining induced emf, Factors determining the electromagnetic torque, Types of dc generation on the basis of excitation, voltage built up in a dc shunt generator, Significance of back e.m.f., the relation between back emf and Terminal voltage, Armature Reaction, Commutation methods to improve commutation, Performance and characteristics of different types of DC motors , Speed control of dc shunt/series motors, Need of starter, three point dc shunt motor starter and 4-point starter, Applications of DC motors, Losses in a DC machine, Determination of losses by Swinburne's test

UNIT 3. Transformers (single phase)   (30 Periods)

Introduction, Constructional features of a transformer and parts of transformer , Working principle of a transformer, EMF equation, Transformer on no-load and its phasor diagram, Transformer – neglecting voltage drop in the windings – Ampere turn balance – its phasor diagram ,Mutual and leakage fluxes, leakage reactance, Transformer on load, voltage drops and its phasor diagram Equivalent circuit, Relation between induced emf and terminal voltage, regulation of a transformer mathematical relation, Losses in a transformer, Open circuit and short circuit test. Calculation of efficiency, condition for maximum efficiency-maintenance of Transformer, scheduled Maintenance, Auto transformer construction, saving of copper, working and applications

UNIT 4. Transformers three phase   (12 Periods)

Construction of three phase transformers and accessories of transformers such as Conservator, breather, Buchholz Relay, Tap Changer (off load and on load) (Brief idea), Types of three phase transformer i.e. delta-delta, delta-star, star-delta and star-star, Conditions for parallel operation (only conditions are to be studied), On load tap changer, Difference between power and distribution transformer, Cooling of transformer.

LIST OF PRACTICALS

1. Speed control of dc shunt motor (i) Armature control method (ii) Field control method

2. Study and connection of dc series motor with starter.

3. Study and connection of 3 point starter for starting D.C. shunt motor and change its direction of rotation. Also draw load characteristics

4. 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.

5. To find the efficiency and regulation of single phase transformer by actually loading it.

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

7. 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

8. 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

UNIT	Time Allotted (Period)	Marks Allocation (%)
1	8	10
2	30	40
3	30	35
4	12	15
TOTAL	80	100

DIGITAL ELECTRONICS AND MICROPROCESSORS

L	T	P
5	-	3

Subject Code - 084003

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

UNIT 1 Introduction& Number System   (14 Period)

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

1.2 Number System- 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.

1.3 Codes and Parity- 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 & error correction, Alpha numeric codes : ASCII and EBCDIC

UNIT 2 Logic Gates, Families & Simplification   (14 Period)

2.1 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,RTL, TTL , ECL and CMOS families.

2.2 Logic Simplification- 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.

UNIT 3- Combinational logic& Synchronous sequential logic circuits

                                                                        (18 Period)

3.1 **Arithmetic Circuits**- 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

3.2 Decoders, Multiplexers and De Multiplexers- 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.

3.3 Flip flops- 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.

UNIT 4. Counters, Shift Register and A/D & D/A Converters   (14 Period)

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

4.2 Shift Register- 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, Synchronous generators

4.3 A/D and D/A Converters- Working principle of A/D and D/A converters.

(B) MICROPROCESSORS

UNIT 5. Evolution, Architecture & Programming   (20 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. 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

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 Hi ll 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 A.K.Ray

SUGGESTED DISTRIBUTION OF MARKS

UNIT 1	Time Allotted (Period)	Marks Allocation (%)
1	14	16
2	14	16
3	18	25
4	14	16
5	20	27
Total	**80**	**100**

GENERATION, TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER

Subject Code - 084006

L	T	P
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

Unit 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.

Unit 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.

Unit 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

Unit 4. Distribution System   (20 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 and Ring main distribution system.

4.2 Constructional features of LT (400Volt), HT (11Kv) underground cables, advantages and disadvantages of under ground systems with respect to overhead system.

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

4.4 Distribution losses.

Unit 5. Power Factor and tariffs   (10 Periods)

5.1 Concept of power factor, Reasons and disadvantages of low power factor, Methods for improvement of power factor using capacitor banks, Static VAR Compensator (SVC)

5.2. Various types of Tariffs

5.3 Concept of Tariffs

5.4 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 No.	Time Allotted (PERIODS)	Marks Allocation (%)
1	15	18
2	10	13
3	25	31
4	20	25
5	10	13
Total	**80**	**100**

ELECTRICAL CIRCUITS AND ANALYSIS

L	T	P
5	-	3

Subject Code - 084004

UNIT 1   (10 periods)

D.C. Network analysis:- Introduction, characteristic of network element, series resistive circuit, parallel resistance circuit, series parallel circuit, Kirchhoff's law, Ohm's law, nodal analysis, mesh analysis (or loop analysis), star delta conversion, voltage source and current source, Superposition's theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer Theorem.

UNIT II   (30 periods)

Steady state analysis of AC circuits:- Generation of alternating emf, definitions related to alternating quantities, instantaneous, average and RMS Value of AC Quantity.

Concepts of resistance, inductance, capacitance, impedance, reactance, admittance and susceptance.

Phasor representation of an AC quantity, complex and polar form, j- notation.

Series RL circuit, series RC circuit, series RLC Circuit and phasor diagram, impedance in series AC Circuits, Q factor in series AC circuit, Admittance, conductance and susceptance of series AC circuit, series resonance.

Parallel AC circuit and phasor diagram, Admittance, conductance and susceptance of parallel AC circuit, resonance in parallel circuit, Q factor in parallel circuit.

Average power Of AC quantity.

UNIT III   (20 periods)

A.C. Network analysis:- Superposition's theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer Theorem For AC Applications, star delta connection and relation between line and phase voltage/current, active and reactive power concept in AC system for balance and unbalance load, concepts of power factor.

UNIT IV   (20 periods)

(i)   **Three Phase AC Circuit :-** Three phase system and it's applications, advantages and disadvantages of three phase power system over single phase power system, Measurements of three phase power by two wattmeter and one wattmeter method .

(ii)   **Network Topology :-** definition of graph, tree, basic cut set and tie set matrices and planar network, loop and nodal method of analysis.

(iii) **Signal and System:-** types of signal and system and their properties, Continuous time signals (CT signals) - Discrete time signals (DT signals) -

Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic & A periodic signals, Deterministic & Random signals, Energy & Power signals-CT systems and DT systems-Classification of systems–Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non causal, Stable & Unstable.

(iv) Control System:- Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. Block diagrams and signal flow graphs, block reduction technique, Transfer functions, Block diagram algebra and Signal Flow graph

List of Practicals

1. To determine and verify Superposition theorem.
2. To determine and verify Thevenin's theorem.
3. To determine and verify Norton's theorem.
4. To determine and verify Maximum power transfer theorem.
5. To determine the output of RL,RC,RLC series and parallel Circuit.
6. Transient response in R-L and R-C Network
7. Transient response in R-L-C Series & Parallel circuits Network:
8. Determination of Impedance (Z) and Admittance(Y) parameters of two port network

RECOMMENDED BOOKS :

1. Network Theory by A.K.Chakraborty, P.K. Satpathy, S.P. Ghosh, Tata McGraw Hill Education Pvt Ltd, New Delhi .
2. Network Theory by A.V. Bakshi, U.A. Bakshi, Technical Publication, pune.
3. Basic Electronics and Linear Circuit by NN Bhargava, Kulshreshta and SC Gupta, Tata McGraw Hill Education Pvt Ltd, New Delhi
4. Electronic Principles by SK Sahdev, Dhanpat Rai & Co., New Delhi
5. Control system engineering by I.J.Nagrath,M. Gopal, New age Publication

SUGGESTED DISTRIBUTION OF MARKS

No. Of units	Time allotted (periods)	Marks Allotted (%)
1	10	15
2	30	35
3	20	25
4	20	25
Total	**80**	**100**

ESTIMATING AND COSTING IN ELECTRICAL ENGINEERING

Subject Code - 084005

L	T	P
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

UNIT I

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.

UNIT II

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)

UNIT III

Estimating and Costing **(42 Periods)**

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

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)

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.

UNIT IV

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

No. Of Unit	Time Allotted (periods)	Marks Allotted(%)
1	12	15
2	18	20
3	42	40
4	24	25
Total 04	**96**	**100**