5.1 ELECTRICAL MACHINES - II

L	T	P
4	-	3

RATIONALE

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

LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Demonstrate the constructional features of a synchronous machine and its working as a synchronous motor
- Operate the synchronous motor as synchronous condenser
- Use 3-ϕ induction motor in the industry for various operations
- Operate and maintain three phase squirrel cage and three phase slip using induction motors.
- Start and reverse the direction of rotation of three phase induction motors using different types of starters.
- Conduct speed control of three phase induction motor.
- Operate and maintain double cage induction motors.
- Recognize the condition of cogging and crawling in three phase induction motors.
- Operate different types of single phase induction motors.

DETAILED CONTENTS

1. Induction Motors (36 hrs)

   1.1 Salient constructional features of squirrel cage and slip ring 3-phase induction motors
   1.2 Principle of operation, slip and its significance
   1.3 Locking of rotor and stator fields
   1.4 Rotor resistance, inductance, emf and current
   1.5 Relationship between copper loss and the motor slip
   1.6 Power flow diagram of an induction motor
   1.7 Factors determining the torque
   1.8 Torque-slip curve, stable and unstable zones
   1.9 Effect of rotor resistance upon the torque slip relationship
   1.10 Double cage rotor motor and its applications

1.11 Starting of 3-phase induction motors, DOL, star-delta, auto transformer
1.12 Causes of low power factor of induction motors
1.13 Testing of 3-phase motor on no load and blocked rotor test and to find efficiency
1.14 Speed control of induction motor
1.15 Harmonics and its effects, cogging and crawling in Induction Motors.

2. Single Phase Induction Motors (28 hrs)

2.1 Single phase induction motors; Construction characteristics and applications

2.2 Nature of field produced in single phase induction motor

2.3 Split phase induction motor

2.3.1 Capacitors start and run motor
2.3.2 Shaded pole motor
2.3.3 Reluctance start motor

2.4 Alternating current series motor and universal motors

2.5 Single phase synchronous motor

2.5.1 Reluctance motor
2.5.2 Hysteresis motor

LIST OF PRACTICALS

1. Study of ISI/BIS code for 3-phase induction motors
2. Perform at least two tests on a 3- phase induction motor as per BIS code
3. Determination of efficiency by (a) no load test and blocked rotor test on an induction motor (b) direct loading of an induction motor (refer BIS code)
4. Determination of effect of rotor resistance on torque speed curve of an induction motor
5. Observe the performance of a ceiling fan (I-ϕ) induction motor) without capacitor
6. To observe effect of change in capacitor on the performance of 1-phase induction motor

INSTRUCTIONAL STRATEGY

Teacher should lay-emphasis on development of understanding amongst students about basic principles of operation and control of electrical machines. This may be achieved by conducting quiz tests and by giving home assignments. The teachers should also conduct laboratories classes themselves encouraging each should to perform with his/her own hands and draw conclusions.

RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, New Delhi
2. Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar
3. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi
   Electrical Engineering by JB Gupta, SK Kataria and sons, New Delhi
4. Electrical Machines by Samarjit Ghosh, Pearson Education (Singapore) Pte, Ltd. 482, FIE Patparganj, Delhi 110092
5. Electrical Machines by DR Arora, Ishan Publications, Ambala City.

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (hrs)	Marks Allocation (%)
1	36	60
2	28	40
Total	**64**	**100**

5.2 ELECTRICAL POWER – 1

L	T	P
4	-	-

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.

LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Distinguish and select suitable resource of energy required for a particular area and environment
- Calculate effective cost generation
- Select suitable supporting structure, insulators, conductors and other accessories for transmission lines and distribution lines
- Prepare layout plan for HT and LT lines/distribution system
- Prepare estimate for HT and LT (OH and underground cables) lines
- Operate and maintain indoor and outdoor substations
- Use various methods for improvement of power factor

DETAILED CONTENTS

1. Power Generation (10 hrs)

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

2. Economics of Generation (08 hrs)

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.

3. Transmission Systems (20 hrs)

3.1 Layout of transmission system, selection of voltage for H.T and L.T lines, advantages of high voltage for Transmission both AC and DC

3.2 Comparison of different system: 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 (14 hrs)

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. Substations: (08 hrs)

5.1 Brief idea about substations; out door grid sub-station 220/132 KV, 66/33 KV outdoor substations, pole mounted substations and indoor substation

5.2 Layout of 33/11 kV/400V distribution substation and various auxiliaries and equipment associated with i

6. Power Factor: (4 hrs)

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

Note: students should visit power generation plants, sub-stations etc.

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 (Hrs)	Marks Allocation (%)
1	10	15
2	08	10
3	20	35
4	14	20
5	08	10
6	04	10
Total	**64**	**100**

5.3 PROGRAMMABLE LOGIC CONTROLLERS & MICRO CONTROLLERS

L	T	P
4	-	4

RATIONALE

A diploma holder when employed in automated industrial process controls or in automated power station will be required to know the basics of Programmable Logic Controllers, their working and their programming. In industry, many manufacturing processes demand a sequence of operation, which are to be performed repetitively. Early automation systems were mechanical in design, timing and sequencing being effected by gears and cams. Slowly these design concepts were replaced by electrical drives which were controlled by relays and now by programmable logic controllers (PLCs). A PLC is a solid state device, designed to operate in noisy industrial environments and can perform all logic functions. PLCs are widely used in all industries for efficient control operations. A diploma holder in industry is called upon to design , modify and troubleshoot such control circuits. Looking at the industrial applications of PLCs in the modern industry, this subject finds its usefulness in the present curriculum.

Microcontrollers have also assumed great significance in the field of electronics and comma goods industry, and thus considered to be an important field of engineering. This subject aims to expose the students to both of these and give them adequate knowledge of these topics.

LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Programme (ladder logic) to PLC for industrial processes
- Change conventional process to automation
- Check and repair faults in domestic appliances
- Check and take corrective actions for programming in PLC’s
- Interface and sequence industrial processes
- Nodify complicated processes with the help of PLC

DETAILED CONTENTS

1. Introduction to Microprocessors (02 hrs)

   Architecture of 8086, Pin Configuration

2. Introduction to PLC (06 hrs)

What is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc.

3. Working of PLC (08 hrs)

- Basic operation and principles of PLC
- Architectural details processor
- Memory structures, I/O structure
- Programming terminal, power supply

4. Instruction Set (08 hrs)

- Basic instructions like latch, master control self holding relays.
- Timer instruction like retentive timers, resetting of timers.
- Counter instructions like up counter, down counter, resetting of counters.
- Arithmetic Instructions (ADD,SUB,DIV,MUL etc.)
- MOV instruction
- RTC(Real Time Clock Function)
- Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal

5. Ladder Diagram Programming (06 hrs)

Programming based on basic instructions, timer, counter, sequencer, and comparison instructions using ladder program.

6. Applications of PLCs (04 hrs)

- Assembly line
- Packaging
- Process controls
- Car parking
- Doorbell operation
- Traffic light control
- Microwave Oven
- Washing machine
- Motor in forward and reverse direction
- Star-Delta, DOL Starters
- Paint Industry
- Filling of Bottles
- Room Automation

7. Micro Controller Series (MCS)-51 Over View (08 hrs)

- Pin details
- I/o Port structure
- Memory Organisation
- Special function registers

8. Instruction Set Addressing Modes (06 hrs)

- Timer operation
- Serial Port operation
- Interrupts

9. Assembly language programming (06 hrs)

- Assemblers and Compilers
- Assembler Directives

10. Design and Interface (04 hrs)

Examples like: keypad interface, 7- segment interface, LCD, stepper motor. A/D, D/A, RTC interface.

11. Introduction of PIC Micro controllers (04 hrs)

12. Application of Micro controllers (02 hrs)

LIST OF PRACTICALS

PLCs

1. Demonstration of various omponents/sub-components of a PLC, Learning functions of different modules of a PLC system
2. Practical steps in programming a PLC (a) using a Hand held programmer (b) using computer interface
3. Demonstration to step 5 programming language, ladder diagram concepts, instruction list syntax
4. Basic logic operations, AND, OR, NOT functions
5. Logic control systems with time response as applied to clamping operation
6. Sequence control system e.g. in lifting a device for packaging and counting
7. Use of PLC for an application(teacher may decide)

Micro Controllers

8. Demonstration and study of architecture of 8086 kit, basic sub systems and input output connectors, functions keys on micro controllers kit
9. Demonstration and study of Micro Controllers (8051) kit
10. Testing of general input/output on Micro controller board

INSTRUCTIONAL STRATEGY

Introduce the subject and make the students familiar with applications of PLCs and Microcontrollers. The inputs shall start with theoretical inputs to architecture, instruction set, assembly language programming, Small projects may be identified, be designed and implemented. PLC ladder diagram and programming should be supplemented with visits to industry. More emphasis may be given to practical work.

RECOMMENDED BOOKS

1) Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA
2) Introduction to PLCs by Gary Dunning. McGraw Hill
3) Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh
4) Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar
5) Module on "Allen Bradlag PlC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
6) Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh
7) The 8051 Micro controller by 1 Scot Mackenzie, Prentice Hall International, London
8) The 8051 Micro controllers Architecture, programming and Applications by Ayala; Penram International
9) Process Control Instrumentation Technology by Johnson, Curits; EE Edition, Prentice Hall of India, New Delhi
10) Microcontrollers by Ayala
11) Microcontrollers by Mazidi
12) Microcontrollers by Neil Makanzie
13) Microcontrollers by Deshmukh

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (%)
1.	02	05
2.	06	12
3.	08	11
4.	08	10
5.	06	10
6.	04	05
7.	08	12
8.	06	10
9.	06	10
10.	04	05
11.	04	05
12.	02	05
Total	**64**	**100**

5.4 INSTALLATIONS AND MAINTENANCE OF ELECTRICAL EQUIPMENT

L	T	P
4	-	-

RATIONALE

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

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

LEARNING OUTCOME

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

- Erect/install various electrical equipment as per IER Act by adopting all safety measures.
- Prepare specifications for different items required for transmission lines.
- Design and excavation of cable trenches.
- Lay underground cables
- Test cables and their termination.
- Check HT/LT circuit treeless, transformers and related equipment in a substation
- Carry out earthing net more laid and make earth prits and takes earth resistance values.
- Find fault in a transmission/distribution system.
- Carry out preventive maintenance to minimize breakdowns.

DETAILED CONTENTS

1. Tools and Accessories (4 hrs)

   Tools, accessories and instruments required for installation, maintenance and repair work. Knowledge of Indian Electricity rules, safety codes, causes and prevention of accidents, artificial respiration of an electrocuted person, workmen's safety devices

2. Installation (18 hrs)

2.1 Installation of transmission and Distribution Lines:

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

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

2.2 Laying of Underground Cables:

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

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

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

3. Maintenance (42 hrs)

3.1 Types of maintenance, maintenance schedules, procedures

3.2 Maintenance of Transmission and Distribution System

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

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

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

3.3 Maintenance of Distribution Transformers

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

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

3.4 Maintenance of Grid Substations

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

3.5 Maintenance of Motors

Over hauling of motors, preventive maintenance, trouble shooting of electric motors

3.6 Domestic Installation

Introduction, testing of electrical installation of a building, testing of insulation resistance to earth, testing of insulation and resistance between conductors continuity or open circuit test

INSTRUCTIONAL STRATEGY

This subject needs theoretical and practical inputs. Demonstration at actual site may be arranged for conceptual understanding. The subject teacher should plan in advance about the visits to the actual sites and establish liaison with the appropriate authorities/ persons with the help of HOD and Principal of the institution. The students be taken to actual workplace and explain various test procedures.

RECOMMENDED BOOKS

1. Testing, Commissioning , Operation and Maintenance of Electrical Equipment by S Rao, Khanna Technical Publication, New Delhi

2.. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Hrs)	Marks Allocation (%)
1	4	5
2	18	30
3	42	65
Total	**64**	**100**

5.5 ESTIMATING AND COSTING IN ELECTRICAL ENGINEERING

L	T	P
3	-	4

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.

LEARNING OUTCOME

After undergoing the subject, student will be able to:

- Determine various types of wiring systems and how they are being used
- Practice and execute any type of wiring
- Estimate and determine the cost of wiring installation
- Estimate the material required for HT and LT lines
- Prepare a tender document for a particular job
- Estimate the material required for pole-mounted sub-stations

DETAILED CONTENTS

1. Introduction (04 hrs)

   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.

2. Types of Wiring (04 hrs)

   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: (20 hrs)

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 (single storey and multi-storey buildings having similar electrical load)

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 and Industrial loads (over-head and under ground connections) from pole to energy meter.

4. Estimating Material Required (12 hrs)

4.1 Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations

4.2 Substation: Types of substations, substation schemes and components, estimate of 11/0.4 KV pole mounted substation up to 200 KVA rating, earthing of substations, Key Diagram of 66 KV/11KV Substation.

4.3 Single line diagram, layout sketching of outdoor, indoor 11kV sub-station or 33kV sub-station

5. Preparation of Tender Documents (08 hrs)

Atleast 2-3 exercises, tender – constituents finalization, specimen tender

LIST OF EXERCISES

1. Prepare detailed tender specifications.
2. Prepare purchase orders.
3. Estimating and costing of a domestic installation cost (Residential building, laboratory room or drawing hall etc) using concept of illumination design.
4. Estimating and costing of an industrial installation (work shop, agriculture, flour mill etc.)
   using concept of illumination design.
5. Estimating and costing of overhead service connection (single phase and three phase).
6. Estimating and costing of overhead, 440V, 3-phase, 4/3 wire distribution line.

7. Estimating and costing of underground service connection (single phase and three phase).
8. Estimating and costing of underground, distribution line using 3 core or 4 core cable for a connected load.
9. Estimating and costing of any one electrical product/equipment.
10. Estimating and costing of repairs and maintenance of any one domestic appliance.
11. Prepare tender notices for given projects

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 No.	Time Allotted (Hrs)	Marks Allocation (%)
1	04	10
2	04	10
3	20	40
4	12	20
5	08	20
Total	**48**	**100**

5.6 MINOR PROJECT WORK

L	T	P
-	-	6

RATIONALE

Minor project work aims at exposing the students to industrial/field practices so as to have an appreciation of size, scale and type of operations; and work culture in the industries.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Apply concepts, principles and practices taught in the classroom in solving field/industrial problems.

GENERAL GUIDELINES

Depending upon the interests of the students and location of the organization, the students may be asked to do Market study in the following cases:

1. Various types of cables available in the market, their current rating/specifications, different makes/manufacturing companies (minimum three), comparison of cost between different makes.

2. Various types of domestic/wiring components such as switches, sockets, holders etc., their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes.

3. Various types of protective devises used in domestic and industrial wiring such as MCBs, ELCB/RCCB, fuses etc. their specifications, make (minimum three), and comparison of cost between different makes.

4. Various types of electric lamps (lumeneries) available in the market, their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes.

5. Various types of Electrical Appliances (domestic and commercial) available in the market, their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes. (compare any one type)

6. Survey and study of house wiring accessories, manufacturers, rates, specifications, their literature collection for their design

7. Study of LT/HT components, detailed specifications from catalogues of manufacturers, drawings, rates, availability in local market

Minor project assignments may also include following studies:

1. Study of different types of sources of light, their connections, and to measure intensity of light with lux-meter:

    1.1 Fluorescent lamp/ tube
    1.2 HP mercury vapour lamp
    1.3 HP sodium vapour lamp
    1.4 Compact Fluorescent lamp (CFL)

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

3. Study of welding equipment along with its accessories

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

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

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

NOTE:

This is only a suggestive list. The students may take any other problem as per their interest. The students of the class may be divided into five groups and work may be assigned to each group as per their interest.

The components of evaluation will include the following :

	Component	**Weightage**
a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with others/workers	15%
d)	Project Report/ Technical report	55%

PERSONALITY DEVELOPMENT CAMP

This is to be organized at a stretch for two to three days during fifth or sixth semester. Extension Lectures by experts or teachers from the polytechnic will be delivered on the following broad topics. There will be no examination for this subject.

1. Communication Skills
2. Correspondence and job finding/applying/thanks and follow-up
3. Resume Writing
4. Interview Techniques: In-Person interviews; telephonic interviews, panel interviews; group interviews and video conferencing etc.
5. Presentation Techniques
6. Group Discussions Techniques
7. Aspects of Personality Development
8. Motivation
9. Leadership
10. Stress Management
11. Time Management
12. Interpersonal Relationship
13. Health and Hygiene