

6.1 ELECTRICAL MACHINES - III

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:

- Describe 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
- Distinguish and select suitable resource of energy required for a particular area and environment.

DETAILED CONTENTS

1	Synchronous Machines	(36 hrs)
1.1	Main constructional features of synchronous machine including commutator and brushless excitation system	
1.2	Generation of three phase emf	
1.3	Production of rotating magnetic field in a three phase winding	
1.4	Concept of distribution factor and coil span factor and emf equation Armature reaction at unity, lag and lead power factor	
1.5	Operation of single synchronous machine independently supplying a load - Voltage regulation by synchronous impedance method	
1.6	Need and necessary conditions of parallel operation of alternators Synchronizing an alternator (Synchroscope method) with the bus bars	
1.7	Operation of synchronous machine as a motor –its starting methods	
1.8	Effect of change in excitation of a synchronous motor	
1.9	Concept and Cause of hunting and its prevention	
1.10	Rating and cooling of synchronous machines	
1.11	Applications of synchronous machines (as an alternator, as a synchronous condenser)	

2. Special Purpose Machines (28 hrs)

Construction and working principle of linear induction motor, stepper motor, Servomotor, Submersible Motor, Introduction to Energy efficient Motors.

LIST OF PRACTICALS

1. Demonstration of revolving field set up by a 3-phase wound stator
2. To plot relationship between no load terminal voltage and excitation current in a synchronous generator at constant speed
3. Determination of the relationship between the voltage and load current of an alternator, keeping excitation and speed constant
4. Determination of the regulation and efficiency of alternator from the open circuit and short circuit test
5. Synchronization of polyphase alternators and load sharing
6. Determination of the effect of variation of excitation on performance of a synchronous 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
4. Electrical Engineering by JB Gupta, SK Kataria and sons, New Delhi
5. Electrical Machines by Samarjit Ghosh, Pearson Education (Singapore) Pte, Ltd. 482, FIE Patparganj, Delhi 110092
6. 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

6.2 ELECTRICAL POWER-II

L T P
4 - 3

RATIONALE

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

LEARNING OUTCOME

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

- Identify the faults in overheads and underground power system
- Operate and maintain protective switchgears
- Handle, operate and maintain protective devices
- Use and select protective relays and protective scheme
- Maintain over-voltage protection scheme
- Calculate the power bill using different tariff schemes

DETAILED CONTENTS

1. Faults: (06 hrs)

Common type of faults in both overhead and underground systems, symmetrical/ unsymmetrical faults. Single line to ground fault, double line to ground fault, 3-phase to ground fault open circuit , simple problems relating to fault finding.
2. Switch Gears (16 hrs)
 - 2.1 Purpose of protective gear. Difference between switch, isolator and circuit breakers. Function of isolator and circuit breaker. Making capacity and breaking capacity of circuit breaker (only definition)
 - 2.2 Principles of Arc extinction in OCB and ACB, Constructional features of OCB, VCD, ACB, and their working,

- 2.3 Circuit breakers. Types of circuit breakers, bulk and minimum oil circuit breakers, air blast circuit breakers, SF₆ circuit breakers
- 2.4 Miniature circuit breakers ACB, ELCB, MCB, for distribution and transmission system (Descriptive)
3. Protection Devices (16 hrs)
- 3.1 Fuses; function of fuse. Types of fuses, HV and LV fuses, rewire-able, cartridge, HRC
- 3.2 Earthing: purpose of earthing, method of earthing, Equipment earthing, Substation earthing, system earthing as per Indian Electricity rules. Methods of reducing earth resistance.
- 3.3 Relays:
- Introduction- types of relays. Electromagnetic, numerical and thermal relays, their construction and working
 - Induction type over-current, earth fault relays, instantaneous over current relay
 - Directional over-current, differential relays, their functions
 - Distance relays, their functions
 - Static numeric and digital relays and their applications
4. Protection Scheme (10 hrs)
- 4.1 Relays for generator protection
- 4.2 Relays for transformer, protection including Buchholtz relay protection
- 4.3 Protection of feeders and bus bars, Over current and earth fault protection.
- 4.4 Distance protection for transmission system
- 4.5 Relays for motor protection
5. Over-voltage Protection (10 hrs)
- 5.1 Protection of system against over voltages, causes of over voltages, utility of ground wire
- 5.2 Lightning arrestors, rod gap, horn gap, metal oxide type.
- 5.3 Transmission Line and substation protection against over-voltages and lightning
6. Various Types of Tariffs: (06 hrs)
- 6.1 Concept of Tariffs
- 6.2 Block rate, flat rate, maximum demand and two part tariffs
- 6.3 Simple problems

Note: Students may be taken to various Sub-stations/ Grid Stations. Students must be familiarized with present tariff system employed by State Electricity Boards.

LIST OF PRACTICALS

1. Testing of the dielectric strength of transformer oil and air
2. Study of different types of circuit breakers and isolators by visiting power station
3. Plot the time current characteristics of over current relay
4. Power measurement by using CTs and PTs
5. Earthing of different equipment/Main Distribution Board and Energy Meter Box
6. Perform the overload and short circuit test of MCB as per IS specifications
7. Plot the time-current characteristics of Kit-Kat fuse wire
8. Measurement of current on any LT line with clip meter

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of generating stations and substations be arranged and various equipment, accessories and components explained to the students. The protection schemes should be shown at the site and engineers from field may be invited for delivering expert lectures on these topics. Help of Video Films may be taken to explain the layout; construction and working of different power equipment.

RECOMMENDED BOOKS

1. Testing, Commissioning , Operation and Maintenance of Electrical Equipment by S Rao, Khanna Technical Publication, New Delhi
2. Electrical Power – II by SK Sahdev, Uneek Publications, Jalandhar (Pb)
3. Electrical Power Systems by CL Wadhwa, Wiley Eastern Ltd., New Delhi
4. Textbook of Electrical Technology by BL Theraja, S Chand and Co., New Delhi
5. Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
6. A Course in Electrical Power by ML Soni, PV Gupta and Bhatnagar, Dhanpat Rai & Sons, New Delhi
7. Principles of Power Systems by VK Mehta, S Chand and Co., New Delhi
8. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (%)
1	06	10
2	16	25
3	16	25
4	10	15
5	10	15
6	06	10
Total	64	100

6.3 UTILIZATION OF ELECTRICAL ENERGY

L T P
5 - -

RATIONALE

This subject assumes importance in view of the fact that an electrical technician has to work in a wide spectrum of activities wherein he has to make selection from alternative schemes making technical and economical considerations; e.g. to plan and design an electrical layout using basic principles and handbooks, to select equipment, processes and components in different situations. The contents have been designed keeping the above objectives in view. Besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas

LEARNING OUTCOME

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

- Design lighting scheme for domestic, industrial and commercial installation
- Design and select a suitable heating arrangement for a particular job
- Handle and maintain electric welding equipment
- Handle and maintain electrolytic plant
- Find faults in electric circuits of refrigerators
- Apply electric drives as per need
- Maintain electric traction lines and track

DETAILED CONTENTS

- | | | |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1. | Illumination | (12 hrs) |
| 1.1 | Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light | |
| 1.2 | Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux. | |
| 1.3 | Laws of illumination – simple numericals | |
| 1.4 | Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for fluorescent lamp, mercury vapour sodium lamp, fluorescent lamp, halogen lamp, neon lamp, compact fluorescent lamp(CFL), types of chokes. | |

- 1.5 Calculation of number of light points for interior illumination, calculation of illumination at different points, considerations involved in simple design problems. Illumination schemes; indoor and outdoor illumination levels
 - 1.6 Main requirements of proper lighting; absence of glare, contrast and shadow
 - 1.7 General ideas about time switches, street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc.
2. Electric Heating (10 hrs)
- 2.1 Advantages of electrical heating
 - 2.2 Heating methods:
 - 2.2.1 Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit
 - 2.2.2 Induction heating; principle of core type and coreless induction furnace, their construction and applications
 - 2.2.3 Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace
 - 2.2.4 Dielectric heating, applications in various industrial fields
 - 2.2.5 Infra-red heating and its applications (construction and working of two appliances)
 - 2.2.6 Microwave heating and its applications (construction and working of two appliances)
 - 2.2.7 Solar Heating
 - 2.3 Calculation of resistance heating elements (simple problems)
3. Electric Welding: (08 hrs)
- 3.1 Advantages of electric welding
 - 3.2 Welding method
 - 3.2.1 Principles of resistance welding, types – spot, projection, seam and butt welding, welding equipment
 - 3.2.2 Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method and their applications. Power supply requirement. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper
4. Electrolytic Processes: (10 hrs)
- 4.1 Need of electro-deposition
 - 4.2 Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing and buffing

- 4.3 Equipment and accessories for electroplating
 - 4.4 Factors affecting electro-deposition
 - 4.5 Principle of galvanizing and its applications
 - 4.6 Principles of anodizing and its applications
 - 4.7 Electroplating of non-conducting materials
 - 4.8 Manufacture of chemicals by electrolytic process
5. Electrical Circuits used in Refrigeration, Air Conditioning and Water Coolers: (10 hrs)
- 5.1 Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants
 - 5.2 Description of Electrical circuit used in
 - a) Refrigerator,
 - b) Air-conditioner, and
 - c) Water cooler
6. Electric Drives: (20 hrs)
- 6.1 Advantages of electric drives
 - 6.2 Characteristics of different mechanical loads
 - 6.3 Types of motors used as electric drive
 - 6.4 Electric braking
 - 6.4.1 Plugging
 - 6.4.2 Rheostatic braking
 - 6.4.3 Regenerative braking
 - 6.5 General idea about the methods of power transfer by direct coupling by using devices like belt drive, gears, chain drives etc.
 - 6.6 Examples of selection of motors for different types of domestic loads
 - 6.7 Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.
 - 6.8 Specifications of commonly used motors e.g. squirrel cage motors, slip ring induction motors, AC series motors, Fractional kilo Watt(FKW) motors
 - 6.9 Selection of motors for Domestic Appliances
7. Electric Traction: (10 hrs)
- 7.1 Advantages of electric traction
 - 7.2 Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main line and their speed-time curves
 - 7.3 Different accessories for track electrification; such as overhead catenary wire, conductor rail system, current collector-pentagraph

- 7.4 Factors affecting scheduled speed
- 7.5 Electrical block diagram of an electric locomotive with description of various equipment and accessories used.
- 7.6 Types of motors used for electric traction
- 7.7 Power supply arrangements
- 7.8 Starting and braking of electric locomotives
- 7.9 Introduction to EMU and metro railways
- 7.10 Train Lighting Scheme

Note: Students should be taken for visits to nearest electrified railway track and railway station to study the electric traction system.

INSTRUCTIONAL STRATEGY

It is desired to give ample practical examples in the class while teaching this subject. Teacher must supplement his/her classroom teaching with aids such as models, charts, and video films from time to time. This subject requires demonstrations and exposure to actual workplace/industry/field. For this purpose, the subject teacher should do advance planning for visits/studies related to each topic in consultation with HOD and Principal of the polytechnic/institution.

RECOMMENDED BOOKS

1. Art and Science of Utilization of Electrical Energy by H Partap, Dhanpat Rai & Sons, Delhi
2. Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana
3. Utilization of Electrical Energy by Sahdev, Uneek Publication, Jalandhar
4. A Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
5. Modern Electric Traction by H Partap, Dhanpat Rai & Sons, Delhi
6. Utilization of Electrical Energy by OS Taylor, Pitman Publications
7. Generation, Distribution and Utilization if Electrical Power by CL Wadhwa, Wiley Eastern Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (%)
1	12	15
2	10	15
3	8	10
4	10	10
5	10	10
6	20	25
7	10	15
Total	80	100

6.4 BASICS OF MANAGEMENT

L T P

3 - -

RATIONALE

The diploma holders are generally expected to take up middle level managerial positions, their exposure to basic management principles is very essential. Topics like Structure of Organization, Leadership, Motivation, Ethics and Values, Marketing management, Financial management, Customer Relationship Management (CRM) & Total Quality Management (TQM), etc. have been included in the subject to provide elementary knowledge about these management areas.. This course explores cyber-security measures and the different forms of cybercrime and emergent forms of cyber-warfare.

LEARNING OUTCOME

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

- Explain the principles of management including its functions in an organisation.
- Have insight into different types of organizations and their structures.
- Inculcate leadership qualities to motivate self and others.
- Manage human resources at the shop-floor
- Maintain and be a part of healthy work culture in an organisation.
- Use marketing skills for the benefit of organization .
- Maintain books of accounts and take financial decisions.
- Undertake store management.
- Use modern concepts like TQM, TPM and CRM.
- Distinguish and classify the forms of cybercriminal activity and the technological and 'social engineering' methods used to undertake such crimes.
- Analyse and assess the impact of cybercrime on government, businesses, individuals and society.

DETAILED CONTENTS

- | | | |
|-----------|----------------------------------------------------------------------------------------------------------------------------|-----------------|
| 1. | Principles of Management | (06 hrs) |
| 1.1. | Introduction, importance and general functions of management. | |
| 1.2. | Concept and Types of an organization - Sole trading ,partnership, companies, corporation, PSU's and cooperative societies. | |
| 1.3. | Structure of an organisation - | |
| | a) Line organization | |
| | b) Staff organisation | |
| | c) Functional organization | |
| | d) Line and staff organization | |

- 1.4. Hierarchical Management Structure
 - Top, middle and lower level management
- 1.5. Departmentalization
 - Introduction and its advantages.

2. **Leadership and Motivation** (06 hrs)
 - 2.1 Leadership
 - a) Definition and Need of Leadership
 - b) Qualities of a good leader
 - c) Manager vs. leader
 - d) Theories of leadership –trait theory and Behaviour theory.
 - 2.2 Motivation
 - e) Definition and characteristics of motivation
 - f) Factors affecting motivation
 - g) Maslow’s Need Hierarchy Theory of Motivation and X&Y need Hierarchy theory of motivation.

3. **Work Culture** (06 hrs)
 - 3.1. Introduction and importance of Healthy Work Culture in organization
 - 3.2. Components of Culture
 - 3.3. Importance of attitude, values and behaviour
Behavioural Science – Individual and group behavior.
 - 3.4. Professional ethics – Concept and need of Professional Ethics and human values.

4. **HRM and its functions** (04 hrs)
 - 4.1 Human Resource Management
 - Manpower Planning, recruitment and selection
 - Training and development of work force at the shop-floor.
 - Performance appraisal
 - Wages, salary and incentive schemes

5. **Marketing and sales** (06 hrs)
 - 5.1 Marketing
 - Introduction, importance and its functions
 - Marketing mix for industries and service sector
 - Basic Marketing strategies
 - 5.2 Sales
 - Difference between marketing and selling
 - Advertisement- print media and electronic media
 - Market-Survey and Sales promotion.

6. **Basic of Accounting and Finance** (06 hrs)
- 6.1 Basic of Accounting:
- Meaning and definition of accounting
 - Double entry system of book keeping
 - Trading account, PLA account and balance sheet of a company
- 6.2 Objectives of Financial Management
- Profit Maximization v/s Wealth Maximization
7. **Material and Stores Management** (04hrs)
- Introduction, functions and objectives of material management
 - Purchasing: definition and procedure
 - Just in time (JIT)
8. **TQM , TPM** (02 hrs)
- Total Quality Management (TQM) and Total Preventive Maintenance (TPM) - Concepts and importance
9. **Customer Relationship management (CRM)** (02 hrs)
- Customer Relationship management - Concepts and importance
10. **Cyber Security** (06 hrs)
- Introduction to Cyberspace and Cyber Law, Pros and Cons of social media.
 - Different Components of cyber Laws; Cyber Law and Netizens
 - Categories of Cyber Crime: Personal, Business, Financial, Office Security
 - Cyber Crime – Complete transparency, hacking/cracking, denial of service, IP piracy, phishing, hetaerism etc. Cyber Attack – cyber attackers.
 - Introduction to IPR, copyright & patent

INSTRUCTIONAL STRATEGY

It is observed that the diploma holders generally take up middle level managerial positions, therefore, their exposure to basic management principles is very essential. Accordingly students may be given conceptual understanding of different functions related to management. Some of the topics may be taught using question answer, assignment or seminar method. The teacher will discuss success stories and case studies with students, which in turn, will develop appropriate managerial qualities in the students. In addition, expert lectures may also be arranged from within the institutions or from management organizations. Appropriate extracted reading material and handouts may be provided.

RECOMMENDED BOOKS

1. Principles of Management by Philip Kotler TEE Publication
2. Principles and Practice of Management by Shyamal Bannerjee: Oxford and IBM Publishing Co, New Delhi.
3. Modern Management Techniques by SL Goel: Deep and Deep Publications Pvt Limited , Rajouri Garden, New Delhi.
4. Management by James AF Stoner, R Edward Freeman and Daniel R Gilbert Jr. : Prentice Hall of India Pvt Ltd, New Delhi.
5. Essentials of Management by H Koontz, C O' Daniel , McGraw Hill Book Company, New Delhi.
6. Intellectual Property Rights and the Law by Dr. GB Reddy.
7. Service Quality Standards, Sales & Marketing Department, Maruti Udyog Ltd.
8. Nandan Kamath, A Guide to Cyber Laws & IT Act 2000 with Rules & Notification
9. Keith Merrill & Deepti Chopra (IK Inter.), Cyber Cops, Cyber Criminals & Internet

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	06	12
2.	06	12
3.	06	12
4.	04	9
5.	06	12
6.	06	12
7.	04	9
8.	02	05
9.	02	05
10.	06	12
Total	48	100

ELECTIVE**6.5.1 INSTRUMENTATION**

L	T	P
4	-	-

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

LEARNING OUTCOME

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

- Describe basic measuring systems.
- Use various measuring devices.
- Use instrument for measurement of a particular electrical quantity.
- Use instruments for measurement of a particular non-electrical quantity.
- Explain controlling system of a particular instrument.

DETAILED CONTENTS

1. Measurements: (04 hrs)
 Importance of measurement, Basic measuring systems, advantages and limitations of each measuring systems, generalized measurement system, signal conditioning and display devices
2. Transducers: (08 hrs)
 Theory, construction and use of various transducers (resistance, inductance, capacitance, electromagnetic, piezo electric type)
3. Measurement of Displacement and Strain: (10 hrs)
 Displacement Measuring Devices: wire wound potentiometer, LVDT, strain gauges 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 hrs)

Different types of force measuring devices and their principles, load measurements by using elastic Transducers and electrical strain gauges. Load cells, proving rings. Measurements of torque by brake, dynamometer, electrical strain gauges, speed measurements; different methods, devices.

5. Pressure Measurement: (08 hrs)

Bourdon pressure gauges, electrical pressure pick ups and their principle, construction and applications. Use of pressure cells.

6. Flow Measurement: (06 hrs)

Basic principles of magnetic and ultrasonic flow meters

7. Measurement of Temperature: (10 hrs)

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

8. Measurement of other non electrical quantities such as humidity, pH level and vibrations (08 hrs)

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 No.	Time Allotted (Hrs)	Marks Allocation (%)
1	04	05
2	08	15
3	10	15
4	10	15
5	08	10
6	06	10
7	10	15
8	08	15
Total	64	100

ELECTIVE
6.5.2 NON-CONVENTIONAL SOURCES OF ENERGY

L T P
4 - -

RATIONALE

Energy is a crucial input in the process of economic, social and industrial development. High-energy consumption has traditionally been associated with higher quality of life, which in turn is related to Gross National Product (GNP). Since the conventional energy resources are under strain of depletion, it is high time to tap the non-conventional energy sources. The electrical diploma holder will have to face this challenge. Therefore this subject is introduced in the curriculum to familiarize the diploma students with non-conventional engineering sources, so that they may exploit them in near future.

LEARNING OUTCOME

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

- Explain the need and significance of non-conventional energy sources.
- Apply working principle of solar, thermal and photovoltaic energy conversion
- Use bio-mass energy conversion methods.
- Apply working principle of wind conversion technologies with respect to mechanical and electrical energy generation.
- Apply working principle of geothermal and tidal energy conversion.
- Use principle of magneto hydro dynamic power generation.
- Use principle of thermo electric power.

DETAILED CONTENTS

1. Introduction: (06 hrs)
 Importance of Non conventional sources of energy, present scenario and issues regarding energy generation, future prospects
2. Solar Energy: (14 hrs)
 Principle of conversion of solar radiation into heat and electricity generation , solar photo-voltaic cell, application of solar energy like solar water heaters, solar dryers, solar furnaces, solar cookers, solar PV lighting, PV pumping, solar pv power plant and its types
3. Hydro Energy: (06 hrs)
 Hydro-electric Power Plants, Mini and Micro hydro-electric power generation.

4. Bio-energy: (08 hrs)
Bio-mass Conversion Technologies- wet and dry processes. Methods for obtaining energy from biomass. Power generation by using gasifiers
5. Wind Energy: (06 hrs)
Wind Energy Conversion, Windmills, Electricity generation from wind, wind turbines, its types, controls and energy storage
6. Geo-thermal and Tidal Energy: (10 hrs)
Geo-thermal sources, Ocean thermal electric conversion, open and closed cycles, hybrid cycles. Geothermal energy conversion principle, Prime movers for geo-thermal energy conversion. Electricity generation through tidal energy.
7. Magneto Hydro Dynamic(MHD) Power Generation, its working principle (02 hrs)
8. Chemical Energy Sources: (06 hrs)
Design and operating principle of a fuel cell, conversion efficiency, output and e.m.f of fuel cells, applications.
9. Thermo Electric Power: (06 hrs)
Basic principle, performance analysis of thermo electric power generation, thermoelectric materials and their application.

INSTRUCTIONAL STRATEGY

The teacher should make the students aware about the depletion of energy sources and the availability of alternate sources of energy. Their feasibility and limitations. The need for adopting non-conventional energy sources should be made clear to students. Teacher must give practical application of these energy sources in nearby surrounding areas.

RECOMMENDED BOOKS :

1. Solar Energy – Principles of Thermal Collection and Storage by SP Sukhatme, Tata McGraw Hill Education Pvt Ltd, New Delhi.
2. Non-Conventional Energy Resources by RK Singal, SK Kataria and Sons, New Delhi
3. Solar Energy Utilization; GD Rai ; Khanna Publishers, New Delhi.
4. Reviews of Renewable Energy Sources, Vol. 3, Edited by MS. Sodha, S.S. Mathur, MAS Malik, TC Kandpal ; Wiley Eastern Limited, New Delhi.

5. Renewable Energy Sources and Conversion Technology by NK Bansal, Manfred Kleemann, Michael Meliss, Tata McGraw Hill Publishing Co. Ltd New Delhi.
6. Energy Today and Tomorrow; Maheshwar Dayal; Publications Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi.
7. Energy Technology (non-conventional, renewable and conventional) by S Rao and BB Parulekar, Khanna Publishers, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allocation (%)
1	06	05
2	14	20
3	06	10
4	08	15
5	06	10
6	10	15
7	02	5
8	06	10
9	06	10
Total	64	100

ELECTIVE

6.5.3 AUTO ELECTRICALS

L T P
4 - -

RATIONALE

Diploma holders in Electrical Engineering have to deal with different types of batteries, their charging and testing, regulators, lighting system and various other electrical accessories used in automobiles. Hence the subject of automotive electric equipment is very essential for these technicians.

LEARNING OUTCOME

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

- Identify various auto-electrical faults/troubles and their causes.
- Analyse and rectify various auto-electrical troubles with the help of troubleshooting charts
- Use suitable instruments and tools for diagnosis and testing of automotive electrical system
- Explain censoring system, ECM etc.
- Describe different type of accessories used in automobiles
- Explain charging and starting system

DETAILED CONTENTS

1. Introduction (04 hrs)

Various Electrical and Electronics equipment components/systems in Automobile. Their functions and demands, earth return system, types of earthing, 6V, 12V system.
2. Batteries (15 hrs)
 - 2.1. Lead Acid Batteries: Construction, working, elements, types, materials used, electrolyte and its strength, effect of added plate area and temperature, rating, capacity, efficiency, temperature characteristics, terminal voltages, charging and discharging.

- 2.2. Battery Testing: Electrolyte testing by hydrometer, voltage test, high discharge and cadmium test. (voltage)
- 2.3. Battery Charging: Constant potential and constant current, initial charging, normal charging, trickle charging, intermittent charging, boost charging.
- 2.4. Battery Defects: Stipulation, plates decay, working, erosion, cracking, sedimentation, separator defects, short circuits, overcharging
- 2.5. Basic description of Alkaline Batteries:
- 2.6. Lithium ion battery: Construction and working
3. Charging System (11 hrs)
 - 3.1. Circuits, function and various components, dynamo and alternator, types, construction, working, advantages and disadvantages of dynamo and alternators, drives, cut out relay.
 - 3.2. Regulation: Functions of various components of two unit, three unit and heavy duty Regulators, Regulators for alternators.
4. Starting System (11 hrs)

Function of various components, torque terms, principle and constructional details of starter motor, switches, types, starter to engine drive and their types, integrated started motor.
5. Lighting System (09 hrs)
 - 5.1. Various lighting circuits, head lamp, type and constructional details, sealed beam, double filaments, asymmetric and dual units, vertical and side control of lamps, fog light, side light, brake light, instrument light, indicator lights, reversing light, lamp mounting.
 - 5.2. Wiring: HT and LT, their specifications, cable colour codes, wiring Harness, Cable connections, Wiring diagrams of cars and two wheeler, Fuses, faults and rectification.
6. Electrical Accessories (09 hrs)

Fuel gauges - bimetallic and balancing coil type, Air pressure gauges, temperature gauges, Ammeter, warning light, speedometer, wind screen wipers, horns, horn relay, electric fuel pump, Faults and rectification.

7. Miscellaneous Electrical Equipment (05 hrs)

Impulse Speedometer, tachometer, heaters, defrosters, Air conditioner, and Electric door locks, window actuation, Seat adjusters.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while imparting instructions. As far possible, subject teaching should be supplemented by demonstrations in the laboratory. During practical work, individual students should be given opportunities to perform practicals independently.

RECOMMENDED BOOKS

1. Automobile Engineering by Dr. Kirpal Singh, Standard Publishers, Delhi
2. Automotive Electrical Equipment by P.L. Kohli, Tata McGraw Hill, Delhi
3. Automotive Electrical Equipment by William H. Crouse, Tata McGraw Hill, Delhi
4. Automobile Engineering by Dr. R.B. Gupta, Satya Prakashan, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	06
2	15	22
3	11	18
4	11	18
5	09	14
6	09	14
7	05	08
Total	64	100

6.6 MAJOR PROJECT WORK

L T P
- - 10

RATIONALE

Major Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period.

LEARNING OUTCOMES

After undergoing the project work, students will be able to:

Apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place the learner for project oriented practical training in actual work situation for the stipulated period with a view to:

- Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study
- Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
- Develop first hand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.
- Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.

General Guidelines

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if

the project work is given to a group. The project work identified in collaboration with industry should be preferred.

This practical training cum project work **should not be considered** as merely conventional industrial training in which students are sent at work places with either minimal or no supervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.

Some of the project activities are given below:

- Projects related to designing small electrical equipment / instruments.
- Projects related to increasing productivity in electrical manufacturing areas.
- Projects related to quality assurance.
- Projects connected with repair and maintenance of plant and equipment.
- Projects related to design of PCBs.
- Projects related to design of small oscillators and amplifier circuits.
- Projects related to design, fabrication, testing and application of simple digital circuits and components.
- Projects related to microprocessor/microcontroller based circuits/ instruments.

Some of the projects based on above areas are listed below for the benefit of students:

1. Design and fabrication of control panel for various applications in the field of electrical engineering.
2. Rewinding of a single phase/three phase induction motor
3. Fabrication of working model of a solar thermal power plant.
4. Design and fabrication of automated car parking system.
5. Design and fabrication of automated gate control of railway crossing.
6. Design and fabrication of electrical resistive/inductive/capacitive loads.
7. Design and fabrication of remote control of various domestic electrical appliances.
8. Design and fabrication of microcontroller based DC drive system.
9. Design and fabrication of automatic water level control system.

10. Design and fabrication of automatic solar battery charger.
11. Fabrication of automatic star-delta starter.
12. Use of sensor in robotic action.
13. Fabrication of working model of hydro electric power plant.
14. Fabrication of sine wave inverter up to 500VA.
15. Fabrication of water level indicator.
16. Fabrication of rain/fire/ smoke/burglar detector.
17. Fabrication of automatic solar panel based street lights.
18. Fabrication of automatic solar panel based traffic lights
19. Fabrication of automatic voltage stabilizer up to 1 KVA.
20. Fabrication of working model of wind power plant.
21. Fabrication of heat convector blower with humidifier.
22. Fabrication of oil based radiation type room heater.
23. Fabrication of small 1- phase transformer up to 1KVA.
24. Fabrication of UPS up to 500VA.
25. Fabrication of a distribution board as per requirement.
26. Fabrication of Direct-On-Line (DOL) starter.
27. Fabrication of solar tracking system.
28. Fabrication of automatic power factor corrector.
29. Fabrication of electronic choke for fluorescent tubes.
30. Fabrication of electronic fan regulator.
31. Fabrication of desert cooler/ room cooler.
32. Fabrication of electric/solar water heater.
33. Erection, installation & commissioning of electrical equipments.
34. Fault detection & repair of electrical/ electronic instruments.
35. Drawing, estimating and costing of electrical installation of the institution from supplier's pole to the institution distribution board.
36. Drawing, estimating and costing of electrical installation of a workshop having a given number of electrically operated appliances/machines.
37. To study the laying out of underground distribution cable for a small colony starting from main distribution pole.

38. To study the erection of a 5 pole span over head line for a small distance for distribution of electrical energy and to prepare list of material required.
39. Energy audit for the workshop of your institution & to suggest remedies to reduce electricity bills.
40. Estimate the material required to provide a service connection to a consumer's premises for domestic purposes.
41. To survey the load of a given area in a village, small colony, calculate the effective load and find out the sizes of cables/conductors for the proposed distribution system.
42. Designing of light and fan scheme for an institutional or commercial building.
43. To study and estimate the material required during augmentation of a nearby pole mounted sub-station.
44. To study and estimate the material required during augmentation of a nearby indoor sub-station.
45. To study and estimate the material required for a solar power station up to 100KW after visiting the actual site (Such power plants have already been installed at LPU at Jalandhar and PEDDA/CREST in Punjab and Chandigarh).
46. To prepare a proposal for substation of your institution , calculating the total load (estimating and costing)
47. Installation of home security system
48. Detection of electricity theft control system with wireless indication system
49. Fabrication of cyclo-converter (frequency changer)
50. Design and fabrication of panel for automatic switching of DG set with supply system
51. Design and fabrication of wireless AC Power transmission.

NOTE: Each student has to take one project individually and one to be shared with a group of four-five students depending upon cost and time involved.

There is no binding to take up the above projects as it is only a suggestive list of projects.

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

Sr. No.	Performance Criteria	Max.** Marks	Rating Scale				
			Excel lent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9	Viva voce	10%	10	8	6	4	2
Total marks		100	100	80	60	40	20

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

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance to improve and re-evaluate before being disqualified and declared “not eligible to receive diploma”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

Range of maximum marks		Overall grade
i)	More than 80	Excellent
ii)	79 \diamond 65	Very good
iii)	64 \diamond 50	Good
iv)	49 \diamond 40	Fair
v)	Less than 40	Poor

Important Notes

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

2. **The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.**
3. **The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.**
4. **It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.**

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

It is proposed that the institute may organize an annual exhibition of the project work