

## 6.1 UTILIZATION OF ELECTRICAL ENERGY (UEE)

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### RATIONALE

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

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

### DETAILED CONTENTS

- |     |  |         |
|-----|--|---------|
| 1.  | Electric Drives:   | (8 hrs) |
| 1.1 | Advantages of electric drives  |         |
| 1.2 | Characteristics of different mechanical loads  |         |
| 1.3 | Types of motors used in electric drive   |         |
| 1.4 | Electric braking   |         |
|     | 1.4.1 Plugging   |         |
|     | 1.4.2 Rheostat braking   |         |
|     | 1.4.3 Regenerative braking   |         |
| 1.5 | Methods of power transfer by direct coupling by using devices like belt drive, gears, pulley drives etc.   |         |
| 1.6 | Examples of selection of motors for different types of domestic loads  |         |
| 1.7 | Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel. |         |
| 1.8 | Specifications of commonly used motors e.g. squirrel cage, slip ring induction motors, AC series motors, FKW motors  |         |

2. Illumination: (8 hrs)
- 2.1 Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light
  - 2.2 Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux.
  - 2.3 Laws of illumination - simple numericals
  - 2.4 Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for filament lamp, mercury vapour lamp, fluorescent lamp, metal halide lamp, neon lamp.
  - 2.5 Calculation of number of light points for interior illumination, calculation of illumination at different points, considerations involved in simple design problems. Illumination schemes; indoor and outdoor. Illumination levels
  - 2.6 Main requirements of proper lighting; absence of glare, contrast and shadow
  - 2.7 General ideas about street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc.
3. Electric Heating (6 hrs)
- 3.1 Advantages of electrical heating
  - 3.2 Heating methods:
    - 3.2.1 Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances and thermostat control circuit
    - 3.2.2 Induction heating; principle of core type and coreless induction furnace
    - 3.2.3 Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace
    - 3.2.4 Dielectric heating, applications in various industrial fields
    - 3.2.5 Infra-red heating and its applications
    - 3.2.6 Microwave heating
  - 3.3 Simple design problems of resistance heating element
4. Electric Welding: (6 hrs)
- 4.1 Advantages of electric welding
  - 4.2 Welding method

- 4.2.1 Principles of resistance welding, types – spot, projection seam and butt welding and welding equipments used
- 4.2.2 Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method of and their applications. Power supply required. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper
- 4.3 Introduction to TIG, MIG Welding
- 5. Electrolytic Processes: (6 hrs)
  - 5.1 Need of electro-deposition
  - 5.2 Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing
  - 5.3 Equipment and accessories for electroplating
  - 5.4 Factors affecting electro-deposition
  - 5.5 Principle of galvanizing and its applications
  - 5.6 Principles of anodising and its applications
  - 5.7 Electroplating on non-conducting materials
  - 5.8 Manufacture of chemicals by electrolytic process
  - 5.9 Manufacturing of chemicals by electrolysis process
- 6. Electrical Circuits used in Refrigeration and Air Conditioning and Water Coolers: (6 hrs)
  - 6.1 Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants
  - 6.2 Description of Electrical circuit used in
    - a) refrigerator,
    - b) air-conditioner, and
    - c) water cooler
- 7. Electric Traction: (6 hrs)
  - 7.1 Advantages of electric traction
  - 7.2 Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main lines and their speed-time curves
  - 7.3 Different accessories for track electrification; such as overhead capacitor wire, conductor rail system, current collector-pentagraph
  - 7.4 Factors affecting scheduled speed
  - 7.5 Electrical block diagram of an electric locomotive with description of various equipment and accessories
  - 7.6 Types of motors used for electric traction
  - 7.7 Starting and braking of traction motors
  - 7.8 Introduction to EMU and metro railways

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

**LIST OF PRACTICALS**

1. Study of different types of sources of light and make connections, and to measure intensity of light with lux-meter:
  - 1.1 Fluorescent lamp
  - 1.2 HP mercury vapour lamp
  - 1.3 HP sodium vapour lamp
  - 1.4 Compact Fluorescent lamp (CFL)
2. Study of induction furnace by visiting a factory and to prepare a report
3. Study of welding equipment along with its accessories
4. Study on the electroplating plant by visiting an industry and preparing a report
5. Study of refrigerator/air conditioner and to prepare a report of its electrical circuit
6. Power factor improvement of a single-phase load using capacitor bank
7. Study of an electric locomotive by visiting any railway repair shop at a nearby station

**RECOMMENDED BOOKS**

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

## 6.2 INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

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### 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.

### DETAILED CONTENTS

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

Knowledge of Indian Electricity rules, safety codes causes and prevention of accidents, artificial respiration, workmen's safety devices
2. Installation (10 hrs)
  - 2.1 Installation of transmission and Distribution Lines:
 

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

Laying of service lines, earthing, provision of service fuses, installation of energy meters
  - 2.2 Laying of Underground Cables: (08 hrs)
 

Inspection, storage, transportation and handling of cables, cable handling equipment, cable laying depths and clearances from other services such as: water, sewerage, gas, heating and other mains, and also a series of power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying (including laying of cable from the drum, laying cable in the trench, taking all measurements and making as installed drawings, back

filling of trenches with earth or sand, laying protective layer of bricks etc), laying of cables into pipes and conduits and within buildings, introduction to cable filling compounds, epoxy resins and hardeners, cable jointing and terminations, testing and commissioning.

- 2.3 Elementary idea regarding, inspection and handling of transformers; Pole mounted substations, plinth mounted substations, grid substation, busbars, isolation, voltage and current transformers, lightning arrestors, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches.
- 2.4 Testing of various electrical equipment such as electrical motor, transformers cables and generator and motor control centres, medium voltage distribution panels, power control centres, motor control centres, lighting arrangement, storage, pre-installation checks, connecting and starting, pre-commissioning checks, drying out
3. Maintenance (41 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, short circuit test, testing of earthing continuity location of faults IE rules for domestic installation

## LIST OF PRACTICALS

1. Identification of tools and equipment
2. Giving exposure to students at actual sites
3. Study of codes and practices

### Important Note:

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

## RECOMMENDED BOOKS

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

## 6.3 POWER-II (POWER SYSTEM PROTECTION)

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### 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 substation, power stations and well designed laboratory experiences. A practice-oriented approach to the teaching of this subject is suggested.

### DETAILED CONTENTS

1. Power System Faults (10 hrs)
 

Types of faults, single line to ground, double line to ground, three phase to ground, open conductors, severity of faults and their effects on system
2. Switch gears (32 hrs)
  - 2.1 Purpose of protective gear. Difference between switch, isolator and circuit breakers. Function of isolator and circuit breaker. Making and breaking capacity of circuit breaker (only definition)
  - 2.2 Principles of Arc extinction by OCB and ACB, Constructional features of OCB, ACB, and their working,
  - 2.3 Circuit breakers. Types of circuit breakers, bulk and minimum oil circuit breakers, air blast circuit breakers, SF<sub>6</sub> circuit breakers
  - 2.4 Miniature circuit breakers ACB, ELCB, MCB, for distribution and transmission system (Descriptive)
3. Protection Devices (18 hrs)
  - 3.1 Fuses; function of fuse. Types of fuses, HV and LV fuses, rewire-able, cartridge, HRC
  - 3.2 Earthing, purpose of earthing: Equipment earthing, Substation earthing, system earthing as per Indian Electricity rules.
  - 3.3 Relays:
    - a) Introduction, types of relays. Electromagnetic and thermal relays, their construction and working



- b) Induction type over-current, earth fault relays, instantaneous over current relay
  - c) Directional over-current, differential relays, their functions
  - d) Idea of static relays and their applications
4. Protection Scheme (10 hrs)
- 4.1 Relays for generator protection
  - 4.2 Relays for transformer, protection including Buchholtz relay protection
  - 4.3 Protection of feeders and bus bars. Over current and earth fault protection, distance protection
  - 4.4. Relays for motor protection
5. Over-voltage Protection (10 hrs)
- 5.1 Protection of system against over voltage; causes of over voltage, function of ground wire
  - 5.2 Lightning arrestors, Rod gap, horn gap, metal oxide type.
  - 5.3 Line protection

### RECOMMENDED BOOKS

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

## 6.4 (a) Elective -II ENERGY MANAGEMENT

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### RATIONALE

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

### DETAILED CONTENTS

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|----|---|----------|
| 1. | Energy Management   | (12 hrs) |
|    | 1.1 Overview of energy management, need for energy conservation, (Started with oil crisis) Environmental Aspects, Alternative sources of energy.                            |          |
|    | 1.2 Need for Energy conservation with brief description of oil and coal crisis.   |          |
|    | 1.3 Environmental aspects   |          |
|    | 1.4 Alternate sources of energy.  |          |
|    | 1.1 Energy efficiency- its significance   |          |
| 2. | Energy Conservation   | (12 hrs) |
|    | 2.1 Energy conservation in Domestic Sector- Lighting, home appliances   |          |
|    | 2.2 Energy conservation in Industrial sector- Motors, Industrial lighting Distribution system, Pumps, Fans, Blowers etc.,   |          |
|    | 2.3 Energy conservation in Agriculture sector Tubewell pumps, diesel-generating sets, standby energy sources.   |          |
|    | 2.4 Macro Level approach for energy conservation at design stage.   |          |
| 3. | Energy Efficient Devices  | (20 hrs) |
|    | 3.1 Need for energy efficient devices   |          |
|    | 3.2 Initial cost versus life cycle, cost analysis on life cycle basis   |          |
|    | 3.3 Energy efficient motors as compared to standard motors.   |          |
|    | 3.4 BIS specification for energy efficient motors, Salient design features,   |          |
|    | 3.5 Efficiency as a function of load, safety margins  |          |
|    | 3.6 Energy efficient lighting system different sources, lumens/watt, LEDs, role of voltage on efficiency  |          |
|    | 3.7 Distribution system- Optimum cable size, amorphous core transformer, role of power factor, use of compensating capacitors-manual and automatic, location of capacitors. |          |

4. Energy Audit (15 hrs)
- 4.1 Energy Audit Methodology
  - 4.2 Efficiency of energy conversion processes, monitoring system
  - 4.3 Specific energy consumption –three pronged approach, fine tuning, technical up gradation, avoidable losses.
  - 4.4 gradation, avoidable losses.
  - 4.5 Case studies of energy audit of distribution system, AC motors, Industries.
  - 4.6 Organisation of energy audit activities.
1. Environmental impact assessment
- 5.1 Need for Environmental impact Assessment
  - 5.2 Standard format for assessment and its completion
  - 5.3 Evaluation of the assessment.

**RECOMMENDED BOOKS:**

1. Manual on energy efficiency at design stage, CII energy management cell.
2. Manual on energy efficiency in pumping system, CII energy management cell.
3. Manual on variable speed drives for energy efficiency CII energy management cell.
4. Energy conservation case studies in ceramic industry, sugar industry, fertiliser industry, cement industry. CII, Energy Management Cell etc

## 6.4 (b) Elective -II OPTICAL FIBRE COMMUNICATION

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### RATIONALE

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

### DETAILED CONTENTS

1. Introduction (8 hrs)  
Historical perspective, basic communication systems, optical frequency range, advantages optical fibre communication, application of fibre optic communication
2. Light Wave Fundamentals (10 hrs)  
Nature of light, acceptance angle and numerical aperture, electromagnetic waves, dielective wave guide, modes in planar guide dispersion and distortion in wave guide.
3. Optical Fibre Waveguides (10 hrs)  
Fibre structure, step-index fibre, graded – index fibre, attention, modes in step, index and graded index fibres, pulse dispersion and information rate in optical fibres construction of optical fibres, optic fibre cables.
4. Light Sources (8 hrs)  
Light emitting diodes (LEDs), Operating characteristics of LEDs, Laser principles, Laser diodes, Operating characteristics of laser-diodes, distributed feedback laser diode, optical amplifier, fibre laser.
5. Light Detectors (8 hrs)  
principles of photodetection, photomultiplier semiconductor photodiode, PIN diode and avalanche photodiode.

6. Optical Fibre Joints (8 hrs)  
Fibre, alignment and joint loss, fibre end preparation, splices, connectors, source coupling.
7. Distribution Networks and Fibre Components (10 hrs)  
Distribution network, directional couplers, star couplers, Switches fibre optical isolators, attenuators, wave length division multiplexing.

### **RECOMMENDED BOOKS**

1. Optical Fibre Communication by Joseph. C. Palais, Pearson Education Publications, Published by Addison Wesley Longman (Singapore) Pte. Ltd., Delhi.
2. Optical Fibre Communication and its Applications by S.C.Gupta, Prentice Hall India – New Delhi.
3. Fibre-Optic Communication Systems by G.P. Agrawal; John Wiley and Sons, New Delhi.
4. Optical Fibres Communication, by John M. Senior, Prentice Hall India, New Delhi.
5. Optical Communication Systems by J. Gower; Prentice Hall India, New Delhi.
6. Optical Fibre Communication by Gerd Keiser; MC Graw Hill, International Editions.

## 6.4 (c) Elective-II MODERN ELECTRIC TRACTION SYSTEM

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### RATIONALE

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

### DETAILED CONTENTS

- |    |   |         |
|----|---|---------|
| 1. | Introduction  | (4 hrs) |
|    | <ul style="list-style-type: none"> <li>1.1. Electric Traction System.</li> <li>1.2. Advantages over other system</li> <li>1.3. Types of electric traction systems</li> <li>1.4. Choice of traction system in India</li> <li>1.5. Historical background of track electrification in India.</li> </ul>  |         |
| 2. | System of Tract Electrification   | (6 hrs) |
|    | <ul style="list-style-type: none"> <li>2.1 Single phase low frequency D.C. System.</li> <li>2.2 Three phase low frequency system</li> <li>2.3 Composite System</li> <li>2.4 Disadvantages of Single phase to D.C. System</li> <li>2.5 Comparison between pure A.C. and D.C system.</li> </ul>   |         |
| 3. | Track Mechanics   | (8 hrs) |
|    | <ul style="list-style-type: none"> <li>3.1 Types of services (Urban, Suburban and Mainline)</li> <li>3.2 Speed time curve</li> <li>3.3 Tractive effort &amp; traction effort speed characteristics</li> <li>3.4 Power of traction motor</li> <li>3.5 Specific energy consumption</li> <li>3.6 Mechanics of train movement, co-efficient</li> <li>3.7 Factors affecting slip.</li> <li>3.8 Simple numerical problems.</li> </ul> |         |
| 4. | Power Supply arrangement  | (8 hrs) |
|    | <ul style="list-style-type: none"> <li>4.1 Constituents of Power supply system i.e. substation</li> <li>4.2 Sectioning and paralleling post.</li> <li>4.3 Subsection and post</li> <li>4.4 Sub-sectioning post and elementary sections</li> <li>4.5 Major control posts or switching substations</li> <li>4.6 Major equipment of substations.</li> </ul>  |         |

5. Equipment used in and outside the Locomotive (8 hrs)
- 5.1 Block diagram of Locomotive
  - 5.2 Overhead equipment
  - 5.3 Section Insulator
  - 5.4 Polygon OHE
  - 5.5 Supporting structure
  - 5.6 Current collector
  - 5.7 Circuit breaker
  - 5.8 Tap changer
  - 5.9 Transformer
  - 5.10 Rectifier connections
  - 5.11 Smoothing reactors
6. Traction Motors and Traction Motor Control (8 hrs)
- 6.1 Desirable characteristic of traction motors.
  - 6.2 Comparative study of characteristic of Induction motor.
  - 6.3 Linear induction motor and their suitability for traction applications.
  - 6.4 Series parallel control of traction motors.
  - 6.5 Advantages of series parallel control
  - 6.6 Simple numerical problems
7. Braking (8 hrs)
- 7.1 Requirements of braking system.
  - 7.2 Types of brakes (Mechanical, hydraulic, magnetic and eddy current)
  - 7.3 Electrical braking – plugging
  - 7.4 Rheostatic and Regenerative braking.
8. Train Lighting (8 hrs)
- 8.1 Systems of train lighting
  - 8.2 Special requirements of train lighting
  - 8.3 Single Battery system
  - 8.4 Double Battery parallel block systems
  - 8.5 Principal equipment of Double Battery system
  - 8.6 Modified Train Lighting System
  - 8.7 Silicon Blocker Rectifier
  - 8.8 End on generation.
9. Railway Coach Air-conditioning (6 hrs)
- 9.1 Electrical equipment for power generation and accessories for control of air conditioning equipment.
    - 9.1.1 Motor generator set

- 9.1.2 Star-delta starter and pre-cooling plug socket
- 9.1.3 Compressor – condenser and air conditioning unit motors
- 9.1.4 Main control panel.
- 9.1.5 Batteries
  
- 9.2 Circuit explanation of schematic diagram for air conditioning equipment.
- 9.3 Starting of plant when coach is stationary and when no ac supply is available.
- 9.4 Starting the plant when coach is running and the generator is generating.

### **INSTRUCTIONAL STRATEGY**

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

### **RECOMMENDED BOOKS**

1. Art and Science of utilization of electrical energy by H. Partab, Dhanpat Rai and Sons, Delhi
  
2. Modern Electric Traction by Partab, Dhanpat Rai and Sons, Delhi



## 7.5 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

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### RATIONALE

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

#### DETAILED CONTENTS

- |     |  |         |
|-----|--|---------|
| (1) | Entrepreneurship   | (4 hrs) |
|     | 1.1 Concept/Meaning  |         |
|     | 1.2 Need   |         |
|     | 1.3 Competencies/qualities of an entrepreneur  |         |
| (2) | Entrepreneurial Support System   | (6 hrs) |
|     | 2.1 District Industry Centres (DICs)   |         |
|     | 2.2 Commercial Banks   |         |
|     | 2.3 State Financial Corporations   |         |
|     | 2.4 Small Industries Service Institutes (SISIs), Small Industries Development Bank of India (SIDBI), National Bank for Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State level |         |
| (3) | Market Survey and Opportunity Identification (Business Planning)   | (6 hrs) |
|     | 3.1 How to start a small scale industry  |         |
|     | 3.2 Procedures for registration of small scale industry  |         |
|     | 3.3 List of items reserved for exclusive manufacture in small scale industry   |         |
|     | 3.4 Assessment of demand and supply in potential areas of growth   |         |
|     | 3.5 Understanding business opportunity   |         |
|     | 3.6 Considerations in product selection  |         |
|     | 3.7 Data collection for setting up small ventures  |         |
| (4) | Project Report Preparation   | (6 hrs) |
|     | 4.1 Preliminary Project Report   |         |
|     | 4.2 Techno-Economic feasibility report   |         |
|     | 4.3 Project Viability  |         |

- (5) Managerial Aspects of Small Business (8 hrs)
- 5.1 Principles of Management (Definition, functions of management viz planning, organisation, coordination and control
  - 5.2 Operational Aspects of Production
  - 5.3 Inventory Management
  - 5.4 Basic principles of financial management
  - 5.5 Marketing Techniques
  - 5.6 Personnel Management
  - 5.7 Importance of Communication in business
- (6) Legal Aspects of Small Business (6 hrs)
- 6.1 Elementary knowledge of Income Tax, Sales Tax, Patent Rules, Excise Rules
  - 6.2 Factory Act and Payment of Wages Act
- (7) Environmental considerations (6 hrs)
- 7.1 Concept of ecology and environment
  - 7.2 Factors contributing to Air, Water, Noise pollution
  - 7.3 Air, water and noise pollution standards and control
  - 7.4 Personal Protection Equipment (PPEs) for safety at work places
- (8) Miscellaneous (6 hrs)
- 8.1 Human relations and performance in organization
  - 8.2 Industrial Relations and Disputes
  - 8.3 Relations with subordinates, peers and superiors
  - 8.4 Motivation – Incentives, Rewards, Job Satisfaction
  - 8.5 Leadership
  - 8.6 Labour Welfare
  - 8.7 Workers participation in management
- (9) Motivation (4 hrs)
- 9.1 Factors determining motivation
  - 9.2 Characteristics of motivation
  - 9.3 Methods of improving motivation
  - 9.4 Incentives – pay, promotion, rewards
- (10) Leadership (2 hrs)
- 10.1 Need for leadership
  - 10.2 Functions of a leader
  - 10.3 Factors to be considered for accomplishing effective leadership

**RECOMMENDED BOOKS**

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

## 6.6 MAJOR PROJECT WORK

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

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

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

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

### NOTE:

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

## 1.1 **Electrical Machines and Equipment:**

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

## 1.2 **Electrical Power:**

- 1.2.1 Drawing, estimating and costing of electrical installation of the institution from supplier's pole to the institution distribution board. Drawing, estimating and costing of electrical installation of a workshop having a given number of electrically operated appliances/machines.
- 1.2.2 To lay underground distribution cable for a small colony from main distribution pole
- 1.2.3 To erect a 5 pole span overhead line for a small distance for distribution of electrical energy. To energise it and prepare list of material and cost required
- 1.2.4 To provide a service connection to a consumers premises for domestic purposes

- 1.2.5 To survey the load of given area in a village, small colony, calculate the effective load and find out the sizes of the cables/conductors for the proposed distribution system
- 1.2.6 Designing of light and fan scheme for a institutional or commercial building
- 1.2.7 Augmentation of a nearby pole mounted sub station

### 1.3 **Electronic Based Projects:**

Fabrication of:

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

### 1.4 **Fabrication and Testing of:**

- 1.4.1 Inverter/Emergency light circuit using power transistors
- 1.4.2 SCR based automatic battery charger
- 1.4.3 SCR operated illumination controller
- 1.4.4 SCR operated automatic water level controller
- 1.4.5 SCR based speed controller for DC shunt motor
- 1.4.6 Three phase full wave rectifier using power diodes
- 1.4.7 Timer circuit using 555-IC

- 1.4.8 SCR controlled rectifier circuit
- 1.4.9 Speed control circuit of DC shunt motor using SCR
- 1.4.10 Inverting and non-inverting amplifiers using OP AMP(741)
- 1.4.11 Comparator circuits using OP AMP (741)

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

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

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

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

Sr. No.	Performance criteria	Max. marks	Rating Scale				
			Excellent	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
<b>Total marks</b>		<b>100</b>	<b>100</b>	<b>80</b>	<b>60</b>	<b>40</b>	<b>20</b>

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

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

	<b>Range of maximum marks</b>	<b>Overall grade</b>
i)	More than 80	Excellent
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 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 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.**
3. **The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.**
4. **It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.**

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

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