UTILITY OF ELECTRICAL ENERGY

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 selections 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 them 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 students with 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: (14 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 Rheostatic 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: (14 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, compact fluorescent lamps (CFL)

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 (10 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

   a. Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace

   b. Dielectric heating, applications in various industrial fields

   c. Infra-red heating and its applications

   d. Microwave heating

3.3 Simple design problems of resistance heating element

4. Electric Welding: (10 hrs)

4.1 Advantages of electric welding

4.2 Welding methods

   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: (10 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 electroplating process
5.9 Manufacturing of chemicals by electrolysis process

6. Electrical Circuits used in Refrigeration and Air Conditioning and Water Coolers: (10 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: (12 hrs)

7.1 Advantages of electric traction
7.2 Different systems of electric traction, DC and AC systems, diesel electric system, Electric Traction, types of services – urban, sub-urban, and main lines and their speed-time curves
7.3 Different accessories for track electrification; such as overhead 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 Railway track to study the electric traction system. A visit to nearby Railway electric locomotive repair shop will be very useful.

TEACHING STRATEGY

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
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

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CONTROL OF ELECTRICAL MACHINES

RATIONALE

A diploma holder in industry is called upon to design and modify electrical control circuits. He is also required to carry out trouble shooting in control circuits. To achieve these skills it is necessary that he should be well conversant with various types of motor starters and control systems used in industry. Knowledge of static control of machines using Digital logic gates and programmable control of machines is also necessary as these are increasingly being used in industry today.

DETAILED CONTENTS

1. Basics of Control Systems: (2 hrs)
   Definitions of open loop, closed loop systems, block diagram, stability

2. Control Components: (10 hrs)
   Fuses, switches and fuse switch units, moulded case and miniature circuit breakers, contactors, contactor ratings, different types of relays, latching relay, frequency relays, Bimetallic Ratchet and Magnetic type overload relays. Thermal, pneumatic and electronic timers, phase failure relay (Single phase preventer), push button switches, drum switches, limit switches, speed actuating switches, solenoid valves, pressure switches, temperature switches, float switches, control transformer, symbols for various components, control diagrams.

3. Starters for 3 phase Squirrel Cage Induction Motors: (10 hrs)

4. Starters for Wound Rotor Induction Motors (8 hrs)
   Induction motor current at start and during running, manual starter using master controllers, definite time limit starters using individual timer and motor driven cam timer for each step, secondary frequency acceleration starter.
5. Protection of Motor
   (6 hrs)
   Co-ordination of fuse, overload and contactor characteristics, Overload and short circuit protection, winding temperature protection, under voltage and phase failure protection.

6. Industrial Control Circuits
   (6 hrs)
   Introduction, planar machine, skip hoist, automatic control for a water pump, control of electrical ovens, overhead crane, battery operated truck, air compressor, conveyer system, elevator, trouble shooting in control circuits.

7. Static Control of Machines
   (10 hrs)
   Advantages and disadvantages of static control compared to magnetic control. Development of simple control circuits using logic gates, off-return and retentive memory elements. Input and output devices for solid state logic circuits. Study of some industrial control circuits like product dispersion, product inspection converyer system etc. using shift registers, counters, decoder, mono shot, clock, down counter and encoder.

8. Programmable Logic Controllers
   (12 hrs)
   Parts of a programmable controller, inputs/output section, central processing unit, input image table, output image table, user program memory, variable data memory, complete scan cycle, the programming terminals, programming basics, relay, timer, Counter and Sequencer type instructions, analog operation.

LIST OF PRACTICALS

1. Study of some actual control drawings from industry.

2. Design and modification of control circuit as per required control requirements.

3. Wiring of different types of starters for three phase wound and squirrel cage induction motor.

4. Learning program entry and editing of PLC using Hand held programmer.

5. Learning program entry and editing on PLC through personal computer which is interfaced to PLC through a software package.

6. Writing, testing and debugging of simple programs to control the working of different components like motors, solenoid operated cylinder pistons, relays, flashers etc. using sensors on a PLC trainer.
INSTRUCTIONAL STRATEGY

This being a subject of practical nature, teacher may co-relate theory with practices in the industry. Students may be encouraged to perform practicals in the laboratory with their own involvement. Industrial visits may also be organized to demonstrate the electric motor control practically.

BOOKS RECOMMENDED


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ELECTRICAL POWER-II
(Power System Protection)

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 test laboratory(ies). A practice-oriented approach to the teaching of this subject is suggested.

DETAILED CONTENTS

1. Power System Faults (16 hrs)

   Common type of faults in both overhead and underground systems
   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, basics of fault calculations., Fault clearing process.

2. Switch gears (24 hrs)

   a) 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)

   b) Circuit breakers. Principles of Arc extinction, Types of circuit breakers, bulk and minimum oil circuit breakers, air blast circuit breakers, SF6 circuit breakers, Vacuum Circuit Breakers(VCBs), circuit breaker time( Total Break Time), Circuit Breaker rating

   c) Miniature circuit breakers,s ACB, ELCB, MCB, for distribution and transmission system (Description only)

3. Protection Devices (16 hrs)

   a) Fuses; function of fuse. Types of fuses, HV and LV fuses, rewire-able, cartridge type HRC fuse.

   b) Earthing, purpose of earthing: neutral earthing, equipment earthing, substation earthing, transformer earthing, system earthing as per Indian Electricity rules and earth leakage Protection, earthing transformer, reactance earthing.

   c) Relays:
- Introduction, types of relays. Electromagnetic and thermal relay, their construction and working
- Induction type over-current, earth fault relays, instantaneous over current relay
- Directional over-current, different relays their functions
- Idea of static relays and their applications
- Programmable Relays

4. Protective Relaying (6 hrs)
   a) Faults, causes, and effects
   b) Importance of protective relaying and protective zones
   c) Primary and back-up protection methods – time grading, duplication principle
   d) Power Line carrier channel (PLCC)
   e) System security and SCADA

5. Protection Schemes (10 hrs)
   a) Introduction to over current and earth fault protection
   b) Basics of differential protection
   c) Basics of distance protection
   d) Protection of transmission lines: Directional Time and Current graded system, Earth fault protection schemes
   e) Protection of transformers: Protection requirements and safety devices with power transformers, Buchholtz relay.
   f) Protection of Generators: Abnormal conditions and protection system e.g. external faults, thermal overloading, unbalanced loading, status winding fault, Rotor, stator winding faults, excitation failure, over speed, reverse power
   g) Substation protection: Bus protection by over current relays: Distance protection of incoming lines as a remote back-up

6. Transient Over Voltages: (8 hrs)
   a) Choice of insulation levels of substation equipment
   b) Lightening, different types of lightening arresters
   c) Traveling waves and surge absorbers, wave traps
   d) Protection of rotating machines against over-voltage surges
   e) Insulation coordination

RECOMMENDED BOOKS

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


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

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**Elective -II**

**ENERGY MANAGEMENT**

**RATIONALE**

One of the reasons for India not being 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**

1. Energy Management (12 hrs)
   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 viz Solar power system, Solar cookers, boilers and light etc
   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 upgradation, avoidable losses.
   4.5 Case studies of energy audit of distribution system, AC motors, Industries.
   4.6 Organisation of energy audit activities.

5. Environmental impact assessment (05 hrs)
   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.
4. Energy conservation case studies in ceramic industry, sugar industry, fertiliser industry, cement industry. CII, Energy Management Cell etc

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Elective -II

OPTICAL FIBRE COMMUNICATION

RATIONALE

Progressing from communication over copper wire to today's fibre optic communication, we have increased 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 years. 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 of optical fibre communication, application of fibre optic communication

2. Light Wave Fundamentals (10 hrs)
   Nature of light, acceptance angle and numerical aperture, electromagnetic waves, dielectric wave guide, modes in planar guide dispersion and distortion in wave guide.

3. Optical Fibre Wave guides (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, photo multiplier semiconductor photodiode, PIN diode and avalanche photodiode.

6. Optical Fibre Joints (8 hrs)
   Fibre cabling, Fibre jointing
   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, Fibre detectors

RECOMMENDED BOOKS


5. Optical Communication Systems by J. Gower; Prentice Hall India, New Delhi.


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# Elective-II

## MODERN ELECTRIC TRACTION SYSTEM

### RATIONALE

Nowadays 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**
   - 1.1. Electric Traction System.
   - 1.2. Advantages over other systems
   - 1.3. Types of electric traction systems
   - 1.4. Choice of traction system in India
   - 1.5. Historical background of track electrification in India.

2. **System of Tract Electrification**
   - 2.1. Single phase low frequency system
   - 2.2. Three phase low frequency system
   - 2.3. Composite System
   - 2.4. Disadvantages of Single phase to d.c. System
   - 2.5. Comparison between pure a.c. and d.c system.

3. **Track Mechanics**
   - 3.1. Types of services (Urban, Suburban and Mainline)
   - 3.2. Speed time curve
   - 3.3. Tractive effort and traction effort speed characteristics
   - 3.4. Power of traction motor
   - 3.5. Specific energy consumption
   - 3.6. Mechanics of train movement, co-efficient
   - 3.7. Factors affecting slip.

4. **Power Supply arrangement**
   - 4.1. Constituents of Power supply system i.e. substation
   - 4.2. Sectioning and paralleling post.
   - 4.3. Subsection and post
   - 4.4. Sub-sectioning post and elementary sections
   - 4.5. Major control posts or switching substations
   - 4.6. Major equipment of substations.

5. **Equipment used in and outside the Locomotive**
   - 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

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

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

8.1 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

9.1 Electrical equipment for power generation and accessories for control of air conditioning equipment.
a) Motor generator set
b) Star-delta starter and pre-cooling plug socket
c) Compressor – condenser and air conditioning unit motors
d) Main control panel.
e) 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. This exposure will reinforce theory taught.

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

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<tr>
<td>2.</td>
<td>System of Tract Electrification</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>3.</td>
<td>Track Mechanics</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>4.</td>
<td>Power Supply arrangement</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>5.</td>
<td>Equipment used in and outside the locomotive</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>6.</td>
<td>Traction Motors and Traction Motor Control</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>7.</td>
<td>Braking</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>8.</td>
<td>Train Lighting</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>9.</td>
<td>Railway Coach Air-conditioning</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>64</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

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. Since diploma technicians are expected to take up middle level managerial positions, their exposure to basic management principles is very essential. Based on the broad competencies listed above, following detailed contents have been finalized to develop the appropriate competencies.

DETAILED CONTENTS

(1) Entrepreneurship (10 hrs)
   1.1 Concept/meaning and its need
   1.2 Competencies/qualities of an entrepreneur
   1.3 Entrepreneurial Support System e.g., District Industry Centres (DICs), Commercial Banks, State Financial Corporations, 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 and national level

(2) Market Survey and Opportunity Identification (Business Planning) (10 hrs)
   2.1 How to start a small scale industry
   2.2 Procedures for registration of small scale industry
   2.3 List of items reserved for exclusive manufacture in small scale industry
   2.4 Assessment of demand and supply in potential areas of growth
   2.5 Understanding business opportunity
   2.6 Considerations in product selection
   2.7 Data collection for setting up small ventures

(3) Project Report Preparation (08 hrs)
   3.1 Preliminary Project Report
   3.2 Techno-Economic feasibility report
   3.3 Project Viability Report

(4) Managerial Aspects of Small Business (10 hrs)
4.1 Principles of Management, Definitions, functions of management viz planning, organization, coordination and control
4.2 Structure of an industrial organization.
4.3 Basic principles of financial management
4.4 Marketing Techniques
4.5 Personnel Management, staff development and training strategies
4.6 Importance and techniques of communication in business

(5) Legal Aspects of Small Business (10 hrs)
5.1 Elementary knowledge of Income Tax, Sales Tax, Patent Rules, Excise Rules, provident fund

(6) Environmental Considerations (04 hrs)
6.1 Concept of ecology and environment
6.2 Factors contributing to Air, Water, Noise pollution
6.3 Air, water and noise pollution standards and control
6.4 Norms and standards of State pollution Board
6.5 Disaster Management – basic idea

(7) Miscellaneous (12 hrs)
7.1 Human resource development in an organization
7.2 Motivation – Incentives, Rewards, Job Satisfaction
7.3 Leadership- types, qualities, functions and factors of effective leadership
7.4 Labor Welfare schemes including wage payment- types, system of wage payment and incentives
7.5 Workers participation in management, case studies in effective Management.
7.6 Accident and Safety: Classification, precaution and treatment after accident, safety practices promotion, personal protection equipment (PPFs) for safety at work places.
7.7 Introduction to Total Quality Management (TQM) and steps to achieve this.
7.8 Intellectual Property Rights (IPR): Concept, definition, infringements and remedies related to patents, copy rights, trademarks, designs. Introduction to registering procedure
INSTRUCTIONAL STRATEGY

The aim of this subject is to develop conceptual understanding by giving inputs and exposure about starting one's own business venture/enterprise. The teacher will discuss success stories and case studies with students, which in turn, will develop managerial qualities in the students. There may be guest lectures by successful diploma holding entrepreneurs and field visits also.

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. Industrial management by N. Mohan, and AP Verma, SK Kataria and Sons, Nai Sarak, Delhi-110006
9. Total Quality Management by Dr DD Sharma, Sultan Chand and Sons, New Delhi.
10. Principles of Management by Philip Kotler TEE Publication

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Topic</th>
<th>Time Allotted (hrs)</th>
<th>Marks Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Entrepreneurship</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>Market Survey and Opportunity Identification</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>(Business Planning)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Project Report Preparation</td>
<td>08</td>
<td>10</td>
</tr>
<tr>
<td>4.</td>
<td>Managerial Aspects of Small Business</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>5.</td>
<td>Legal Aspects of Small Business</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>6.</td>
<td>Environmental Considerations</td>
<td>04</td>
<td>10</td>
</tr>
<tr>
<td>7.</td>
<td>Miscellaneous</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>64</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
MAJOR PROJECT WORK
(Industry oriented – Practice based)

L    T     P
-    -     12

Project work aims at developing professional skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of a practical problem undertaken as a project work. The students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be explained the objectives of the project work and then asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective departments may have a brainstorming session to identify suitable project assignments. The project assignment can be individual or a group assignment. There should preferably be not more than 4 students if the project work is given to a group. The students should identify themselves or be given project assignment at least two to three months in advance. The identified project work must lead to students exposure and interaction with industry/field organizations in the world of work.

Each teacher is expected to guide the project work of 4-5 students at a time. 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
h) Projects related to wastage reduction
i) Projects related to energy audit

For Students of Electrical Engineering Diploma Programme the project work can be grouped under the following five groups. A number of projects have been mentioned under each 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 160 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 project within these groups provided 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 a small transformer (500 VA or so)
1.1.2 Construction of phase sequence indicator
1.1.3 Construction of hot air drier
1.1.4 Construction of a Simple loop generator
1.1.5 Design and fabrication of 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 of load of an indoor distribution 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 (FKW)
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 starting 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 energize it and prepare list of material and cost estimates.
1.2.4 To provide a service connection to a consumer's 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 500-1000 watt.

1.4 **Power Electronics based projects**

**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**

1.5.1 MCBs
1.5.2 Iron clad Main Switch Electrodes
1.5.3 Accessories including wires and cables used for household installation
1.5.4 Special purpose Cables, Teflon, paper insulated etc.
1.5.5 Starters for three phase and single phase induction motors of different makes (eg. Seimens, Crompton Greaves, 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:
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Performance criteria</th>
<th>Max. marks</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Selection of project assignment</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Planning and execution of considerations</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Quality of performance</td>
<td>20</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>Providing solution of the problems or production of final product</td>
<td>20</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>Sense of responsibility</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Self expression/communication skills</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7.</td>
<td>Interpersonal skills/human relations</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>8.</td>
<td>Report writing skills</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
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<tr>
<td>9.</td>
<td>Viva voce</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>4</td>
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<tr>
<td></td>
<td><strong>Total marks</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>80</strong></td>
<td><strong>60</strong></td>
<td><strong>40</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

**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.

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 organizations 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.
GENERAL SKILL DEVELOPMENT CAMP-II

As per general feedback received from the employers regarding Technician Engineers during formal interactions, the pass outs of polytechnics are labeled of falling short of employable skills which comprises of Communication, inter-personal relationship, leadership qualities, team work, problem solving, managing task, managing self etc. in addition to technical knowledge and skills. We have, therefore, added papers such as English and Communication Skills and Entrepreneurship Development and Management in the curriculum in addition to proposed camps of 3-4 days to be conducted in polytechnics on common and vital issues e.g. Environmental Awareness, Entrepreneurship Development and Generic Skill Development.

It is proposed that a camp of 3-4 days duration on Generic Skills Development (GSD) during 6th semester be organized by arranging expert lectures/discussion sessions either by polytechnic teachers or by eminent educationists from the neighborhood to deal with the following topics. Few students may also be encouraged to prepare on some of these topics and make presentation during the camp. Expert lectures must be followed by distribution of relevant handouts for further study. The attendance of students should be compulsory and marks be awarded under provision of Student Centred Activities. It is envisaged that such camps will bring in a significant improvement in confidence level and personality of the pass outs from polytechnics.

Suggested list of topics for arranging lectures/discussion sessions:

1. **Ethics and Values**
   1.1 Introduction and importance
   1.2 Ethics and values in profession and society
   1.3 Dignity of labour
   1.4 Net etiquettes

2. **Group Dynamics**
   2.1 Introduction
   2.2 Leadership
   2.3 Communication in group
   2.4 Team work

3. **Personality Development**
   3.1 PR technique
   3.2 Positive attitude
   3.3 Self-esteem
   3.4 Creativity

4. **SWOT Analysis**
   4.1 Importance
   4.2 Introduction to SWOT analysis steps
   4.3 SWOT analysis parameters