

6.1 CONTROL OF ELECTRICAL MACHINES

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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)
Introduction, motor current at starting and during running. Manual and automatic primary resistor, increment resistor, line reactor and auto-transformer starters. Closed circuit transition auto-transformer starter, star-delta starter (open circuit and closed circuit transition). Two speed two winding and one winding motor starters. Forward/reverse starter.
4. Starters for Wound Rotor Induction Motors (8 hrs)
Introduction, motor current at start and during running, manual starter using master controllers, definite time limit starters using individual timer and motor driven cam times 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 conveyor 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. Learning programme entry and editing of PLC using Hand held programmer.
2. Learning programme entry and editing on PLC through personal computer which is interfaced to PLC through a software package.
3. Writing, testing and debugging of simple programmes to control the working of different components like motors, solenoid operated cylinder pistons, relays, flashers etc. using sensors on a PLC trainer.
4. Wiring of different types of starters for three phase wound and squirrel cage induction motor.
5. Study of some actual control drawings from industry.
6. Design and modification of control circuit as per required control requirements.

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

1. Control of Electrical Machines by S.K. Bhattacharya and Brijinder Singh. New Age Publishers , New Delhi
2. Industrial Control Electronics. John Webb, Kevin Greshock, Maxwell Macmillan International editions.

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic(s)	Time allotted in hours	Marks Allocation
1	Basics of Control System	2	5
2	Control Components	10	15
3	Starters for 3 phase squirrel cage Induction Motors	10	15
4	Starters for wound rotor Induction Motors	8	10
5.	Protection of Motor	6	10
6.	Industrial Control Circuits	6	10
7	Static Control of Machines	10	15
8.	Programmable Logic Controllers	12	20
	Total	64	100

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 (04 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 (42 hrs)
- 3.1 Types of maintenance, maintenance schedules, procedures
- 3.2 Maintenance of Transmission and Distribution System
- Authorized persons, danger notice, caution notice, permit to work, arranging of shutdowns personally and temporary earths cancellation of permit and restoration of supply.
- Patrolling and visual inspection of lines - points to be noted during patrolling from ground; special inspections and night inspections;
- Location of faults using Meggar, effect of open or loose neutral connections, provision of proper fuses on service lines and their effect on system, causes and dim and flickering lights.
- 3.3 Maintenance of Distribution Transformers
- Transformer maintenance and points to be attended to in respect of various items of equipment
- Checking of insulation resistance, transformer oil level and BDV test of oil, measurement of earth resistance
- 3.4 Maintenance of Grid Substations
- Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches. Power transformers

3.5 Maintenance of Motors

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

3.6 Domestic Installation

Introduction, testing of electrical installation of a building, testing of insulation resistance to earth, testing of insulation and resistance between conductors continuity or open circuit test, short circuit test, testing of earthing continuity location of faults IE rules for domestic installation

Note : The subject teacher should plan in advance about the visits to the actual sites and establish liaison with the appropriate authorities/ persons with the help of HOD and Principal of the institution.

LIST OF PRACTICALS

1. Identification of tools and equipment used for installation and maintenance of electrical equipment
2. Study of codes and practices pertaining to safety in installation and maintenance of electrical equipment.
3. Study of electrical equipment by visiting a grid power station/ sub station and to prepare a report of maintenance system adopted there.
4. Study of the testing of electrical equipment by visiting a grid power station/ sub station and to prepare a report.
5. Study of motors and their repair and overhauling by visiting a repair workshop or manufacturing unit.
6. Study of maintenance of electrical distribution system by visiting a sub station and to prepare a report.
7. Study of Power factor improvement of a single-phase load using capacitor bank

RECOMMENDED BOOKS

1. Testing, Commissioning , Operation and Maintenance of Electrical Equipment by S Rao, Khanna Technical Publication, New Delhi
- 2.. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1.	Tools, Accessories and instruments required for installation	4	5
2.	Installation	18	30
3.	Maintenance	42	65
Total		64	100

6.3 ELECTRICAL POWER-II (Generation and 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 substations, power stations and well designed laboratory experiences. A practice-oriented approach to the teaching of this subject is suggested.

DETAILED CONTENTS

- | | | |
|-----|---|----------|
| 1. | Power Generation | (10 hrs) |
| 1.1 | Main resources of energy, conventional and non-conventional | |
| 1.2 | Different types of power stations, thermal, hydro, gas, diesel and nuclear power stations. Flow diagrams and brief details of their operation, comparison of the generating stations on the basis of running cost, site, starting, maintenance etc. | |
| 1.3 | Importance of non-conventional sources of energy in the present scenario. Brief details of solar energy, bio-energy, wind energy | |
| 2. | Economics of Generation | (6 hrs) |
| 2.1 | Fixed and running cost, load estimation, load curves, demand factor, load factor, diversity factor, power factor and their effect on cost of generation, simple problems there on. | |
| 2.2 | Base load and peak load power stations, inter-connection of power stations and its advantages, concept of regional and national grid. | |
| 3. | Switch gears | (16 hrs) |
| 3.1 | 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) | |
| 3.2 | Principles of Arc extinction in OCB and ACB, Constructional features of OCB, ACB, and their working, | |
| 3.3 | Circuit breakers. Types of circuit breakers, bulk and minimum oil circuit breakers, air blast circuit breakers, SF ₆ circuit breakers | |

- 3.4 Miniature circuit breakers(MCB) and ELCB for distribution and transmission system (Descriptive)
4. Protection Devices (12 hrs)
- 4.1 Fuses; function of fuse. Types of fuses, HV and LV fuses, rewire-able, cartridge, HRC
- 4.2 Earthing: purpose of earthing, method of earthing, Equipment earthing, Substation earthing, system earthing as per Indian Electricity rules. Methods of reducing earth resistance.
- 4.3 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) Distance relays, their functions
 - e) Idea of static relays and their applications
5. Protection Scheme (10 hrs)
- 5.1 Relays for generator protection
- 5.2 Relays for transformer, protection including Buchholtz relay protection
- 5.3 Protection of feeders and bus bars. Over current and earth fault protection,
- 5.4. Distance protection for transmission system
- 5.5. Relays for motor protection
6. Over-voltage Protection (10 hrs)
- 6.1 Protection of system against over voltages, causes of over voltages, utility of ground wire
- 6.2 Lightning arrestors, Rod gap, horn gap, metal oxide type.
- 6.3 Transmission Line and substation protection against over-voltages and lightning

LIST OF PRACTICALS

Visit to power station/sub station for the conduct of following practical work:

1. Testing of the dielectric strength of transformer oil
2. Working of different types of circuit breakers and isolators
3. Working of different types of protective relays
4. Working of CTs and PTs
5. Earthing of different equipment

6. Testing of MCB as per IS specifications

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of generating stations and sub stations 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, Unique International 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 FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1.	Power Generation	10	15
2.	Economics of Generation	6	10
3.	Switch gears	16	25
4.	Protection Devices	12	20
5.	Protection Scheme	10	15
6.	Over-Voltage Protection	10	15
Total		64	100

6.4 Elective -II

6.4 (a) 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 Case studies of energy audit of distribution system, AC motors, Industries.
 - 4.5 Organisation of energy audit activities.
5. 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.

INSTRUCTIONAL STRATEGY

While explaining the need and importance of energy management, the teacher should give students home assignments based on energy conservation. The students should be made familiar with the energy efficient devices, various approaches to conserve energy, energy auditing procedure etc. Best learning will take place if students are given real life problems on energy audit.

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, fertilizer industry, cement industry. CII, Energy Management Cell etc

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1.	Energy Management	12	20
2.	Energy conservation	12	20
3.	Energy Efficient Devices	20	30
4.	Energy audit	15	25
5.	Environmental impact assessment	5	5
Total		64	100

6.4 Elective -II

6.4 (b) 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

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|----|---|----------|
| 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, deflective 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 photo detection, photo multiplier 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.
1. 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.

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1.	Introduction	8	10
2.	Light Wave Fundamentals	10	15
3.	Optical Fibre wave guides	10	15
4.	Light Sources	8	15
5.	Light Detectors	8	15
6.	Optical Fibre Joints	8	15
7.	Distribution Networks and Fibre Components	10	15
Total		64	100

6.4 Elective-II

6.4 (c) MICRO-CONTROLLERS AND PLCs

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RATIONALE

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

Micro-controllers have also assumed a great significance in the electronic and consumer goods industry and are a very vital field..

DETAILED CONTENTS

1. Microcontroller series (MCS) – 51 Overview (08 hrs)
 - Pin details
 - I/O Port structure
 - Memory Organization
 - Special Function Registers (SFRS)
 - External Memory

2. Instruction Set; Addressing Modes, Instruction types (8 hrs)
 - Timer operation
 - Serial Port operation
 - Interrupts

3. Assembly language programming (08 hrs)
 - Assembler directives
 - Assembler operation

4. Design and Interface (08 hrs)

Examples like:
keypad interface, 7- segment interface etc

5. Introduction to PLCs (06 hrs)

What is PLC, limitations of relays. Advantages of PLCs over electromagnetic relays, Different programming languages, PLC manufacturer etc.

- 6 Working of PLC (06 hrs)
- Basic operation and principle of PLC,
 - Architectural details – Processor
 - Memory structure, I/O Structure
 - Programming terminal, Power Supply
- 7 Instruction Set (08 hrs)
- Basic instructions like latch, master control self holding relays.
 - Timer instructions like on-delay timers, off-delay timers, retentive timers, resetting of timers.
 - Counter instructions like up counter, down counter, resetting of counters.
 - Sequencers, output sequencers, input sequencers time driven and event driver sequencers masking etc.
 - Comparison instruction like equal, not equal, greater, greater than equal, less than less than equal mask equal, limit etc.
- 8 Ladder diagram programming (06 hrs)
Programming based on Basic instructions, timer counter, sequencer to comparison instruction using ladder diagrams.
- 9 Applications of PLCs (06 hrs)
- Assembly
 - CNC Machines
 - Packaging
 - Process control
 - Car parking
 - Doorbell operation
 - Traffic light control
 - sorting of objects etc
 - microwave oven
 - Washing machine

LIST OF PRACTICALS

Micro-Controllers

1. Familiarization with Micro-Controller Kit
2. Assembly Language Programming
3. Use of Assembler for making programme
4. Interfacing of key Board and 7 Segment Display with Micro Controller PLCs

PLCs

1. Familiarization with the working of PLC
2. Components/sub-components of a PLC, learning functions of different modules of a PLC system
3. Introduction to step 5 programming language, ladder diagram concepts, instruction list syntax
4. Basic logic operations, AND, OR, NOT, functions
5. Logic control systems with time response as applied to clamping operation
6. Sequence control system e.g in lifting a device for packaging and counting
7. Use of PLC for various mechanical outputs viz motion of a piston in a single cylinder multiple cylinders, driving machine operation etc.
8. Familiarization of the working of PLC
9. Writing entering and testing programs using a hand-held programmer for the following operations
 - Ladder Logic
 - Timers
 - Counters
 - Sequencers
10. Writing, entering and testing programs using computers for the following operations.
 - Ladder Logic
 - Timers
 - Counters
 - Sequencers

INSTRUCTIONAL STRATEGY

The inputs shall start with theoretical inputs to architecture, instruction set, assembly language programming, Small projects may be identified, be designed and implemented. PLC ladder diagram and programming should be supplemented with visits to industry. More emphasis may be given to practical work.

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1.	Microcontroller series (MCS) – 51 Overview	8	10
2.	Instruction Set; Addressing Modes, Instruction types	8	10
3.	Assembly language programming	8	10
4.	Design and Interface	8	15
5.	Introduction to PLCs	6	10
6.	Working of PLC	6	10
7.	Instruction Set	8	15
8.	Ladder diagram programming	6	10
9	Application of PLCs	6	10
Total		64	100

6.5 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. 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 are arrived 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
 - 5.2 Elementary knowledge of Factory Act, 1948 and Payment of Wages Act 1936, Workmen Compensation Act, Industrial Dispute act 1947, Employees State Insurance Act 1978
- (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

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
11. Intellectual Property Rights and the Law by Dr. GB Reddy.

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Percentage Weightage	Marks Allocation
1.	Entrepreneurship	10	15.63	10
2.	Market Survey and Opportunity Identification (Business Planning)	10	15.63	20
3.	Project Report Preparation	08	12.5	10
4.	Managerial Aspects of Small Business	10	15.63	15
5.	Legal Aspects of Small Business	10	15.63	15
6.	Environmental Considerations	04	6.25	10
7.	Miscellaneous	12	18.75	20
Total		64	100	100

6.6 MAJOR PROJECT WORK (Industry oriented – Practice based)

L	T	P	Cr
-	-	10	5

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
- g) Projects related to wastage reduction
- h) 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**
 - 1.3 MCBs
 - 1.4 Iron clad Main Switch Electrodes
 - 1.5 Accessories including wires and cables used for household installation
 - 1.6 Special purpose Cables, Teflon, paper insulated etc.
 - 1.7 Starters for three phase and single phase induction motors of different makes(eg. 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
Total marks		100	100	80	60	40	20

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.

6.7 PC MAINTENANCE AND REPAIR

L	T	P	Credit
3	-	2	4

RATIONALE

The personal computer (PC) is the tool that defines today's current age and culture. A right understanding about any tool is required to use it effectively. There has been a complete revolution in this area, because of rapid advancements in the field of electronics. The PC is the most logical of modern machines and is no more difficult to understand its function, to know what is inside it and thus master its working. It is very important to learn the various components of a PC, and how these parts work together. All technically trained individuals must understand the general nature of PC, operation of memory, I/O techniques, interfacing applications etc. Looking at the importance and usefulness, this subject has been included in the curriculum.

DETAILED CONTENTS

1. Introduction: (8 hrs)
 - a) Origin of PC
 - b) Hardware and software
 - c) Operating system
 - d) Programming Languages

2. Hardware Components (20 hrs)
 - a) Motherboard
 - b) Microprocessors and coprocessors
 - c) Memory – ROM, RAM and Cache
 - d) Chipsets and support circuits
 - Function
 - System control, peripheral control and memory control
 - e) Bus architecture
 - Bus functions
 - Various buses – ISA, EISA, VESA, PCI
 - f) Mass storage Devices
 - Hard disks, Floppy disks, Compact disks
 - g) Input – Output Devices
 - Keyboards, Mouse

- Display system, Video adapters, Audio, Printers, Modems
 - Serial and parallel ports- IEEE 1284, RS 232- C
- h) General information about computer viruses and anti viruses.
3. Interfacing Components and Techniques (8 hrs)
- a) Interface systems and standards
 - b) Programmable Peripheral Interface (PPI) chips – 8255 and 8155
 - c) Their pin diagrams and programming
4. Local Area Networking (6 hrs)
- a) Networking topologies, standards, cabling, configuration
 - b) IEEE standards for LANs
5. Concept of Internet (6 hrs)
- a) Internet protocols, HTTP
 - b) Simple Network Management Protocol (SNMP)
 - c) Domain Name Systems (DNS)
 - d) Security
 - e) Electronic Mail
 - f) World Wide Web
 - g) Concept of ATM networks

LIST OF PRACTICALS

1. Familiarization of complete PC hardware
2. Familiarization of the serial and parallel ports and other peripherals of a PC
3. Interconnections of the various peripherals and energizing the PC
4. Installation of various software on a PC.
5. Familiarization of standard anti-virus such as Norton, Dr. Solomon, McAfee etc, their installation and application for removal of viruses
6. Faultfinding and trouble shooting of PC and its peripherals.
7. Experimental setup for a LAN in a laboratory.

INSTRUCTIONAL STRATEGY

This being a highly practice oriented course, students must be provided with ample opportunity to work on personal computers and practice on all the concepts and procedures learnt in the class

RECOMMENDED BOOKS

1. Hardware Bible ; Winn. L. Rosch, Techmedia
2. The complete PC upgrade and maintenance guide, Mark Minasi, BPB Publications
3. Computer Networks, A. Tanenbaum, PHI Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1.	Introduction	8	15
2.	Hardware Components	20	40
3.	Interfacing Components and Techniques	8	20
4.	Local Area Network	6	15
5.	Concept of Internet	6	10
Total		48	100