5.1 ELECTRICAL MACHINES-II

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RATIONALE

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

DETAILED CONTENTS

1. Synchronous Machines (24 hrs)

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

2. Induction Motors (16 hrs)

   2.1 Salient constructional features of squirrel cage and slip ring 3-phase induction motors
   2.2 Principle of operation, slip and its significance and connection of submersible motor (monoblock)
   2.3 Locking of rotor and stator fields
   2.4 Rotor resistance, inductance, emf and current
   2.5 Relationship between copper loss and the motor slip
   2.6 Power flow diagram of an induction motor
   2.7 Factors determining the torque
   2.8 Torque-slip curve, stable and unstable zones
   2.9 Effect of rotor resistance upon the torque slip relationship
   2.10 Double cage rotor motor and its applications

2.11 Starting of 3-phase induction motors, DOL, star-delta, auto transformer
2.12 Causes of low power factor of induction motors
2.13 Testing of 3-phase motor on no load rotor test and find efficiency
2.14 Speed control of induction motor, conventional and thyristorized

3. Fractional Kilo Watt (FKW) Motors (18 hrs)

3.1 Single phase induction motors; Construction characteristics and applications
3.2 Nature of field produced in single phase induction motor
3.3 Split phase induction motor
  3.3.1 Capacitors start and run motor
  3.3.2 Shaded pole motor
  3.3.3 Reluctance start motor
3.4 Alternating current series motor and universal motors
3.5 Single phase synchronous motor
  3.5.1 Reluctance motor
  3.5.2 Hysteresis motor

4. Special Purpose Machines (8 hrs)

Construction and working principle, linear induction motor, stepper motor, schrage motor.

LIST OF PRACTICALS

1 Synchronous machines:
1.1 Demonstration of revolving field set up by a 3-phase wound stator
1.2 Determination of excitation
1.3 Determination of the relationship between the voltage and load current of an alternator, keeping excitation and speed constant
1.4 Determination of the regulation and efficiency of alternator from the open circuit and short circuit test
1.4 Parallel operation of polyphase alternators and load sharing
1.5 Determination of the effect of variation of excitation on performance of a synchronous motor

1. Induction Machines:
1.1 Determination of efficiency by (a) no load test and blocked rotor test on an induction motor (b) direct loading of an induction motor (refer ISI Code/BIS code)
1.2 Determination of effect of rotor resistance on torque speed curve of an induction motor

2. FKW Motors:
2.1 To tell the effect of a capacitor on the starting and running of a single-phase induction motor.
2.2 Reversing the direction of rotation of ceiling fan

RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, New Delhi

2. Electrical Machines by SK Sahdev, Unique International Publications, Jalandhar

3. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi

4. Electrical Engineering by JB Gupta, SK Kataria & sons, New Delhi

5.2 POWER – 1 (Generation, Transmission and Distribution of Electrical Power)

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RATIONALE

The majority of the polytechnic passouts have to perform various activities in the State Electricity Boards in the field of Generation, Transmission and Distribution of Electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in power stations, transmission and distribution networks in addition to administrative jobs to public relations,

They should also be made aware of recent developments, current practices in the electricity departments, corporations and boards to keep them abreast with modern techniques in Generation, Transmission and Distribution of Electrical Power.

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. Transmission Systems (24 hrs)

   2.1 Layout of transmission system, selection of voltage for H.T and L.T lines, advantages of high voltage for Transmission both AC and DC
   2.2 Comparison of different system: AC versus DC for power transmission, conductor material and sizes from table
   2.3 Constructional features of transmission lines: Types of supports, types of insulators, Selection of insulators, conductors, earth wire and their accessories, Transposition and strig efficiency of lines
   2.4 Mechanical features of line: Importance of sag, calculation of sag, effects of wind and ice and related problems; Indian electricity rules pertaining to clearance
   2.5 Electrical features of line: Calculation of resistance, inductance and capacitance without derivation in a.c. transmission line, voltage regulation concept of corona. Effects of corona and remedial measures

3. Distribution System (10 hrs)

   3.1 Lay out of HT and LT distribution system, constructional feature of distribution lines and their erection. LT feeders and service mains; Simple problems on AC radial distribution system, determination of size of conductor
   3.2 Construction of LT and HT power cables advantages/disadvantages

3.3 Preparation of estimates for LT and HT overhead distribution lines.
3.4 Calculation of line losses in distribution system

4. Substations: (8 hrs)

4.1 Brief idea about substations; out door grid sub-station 220/132 KV, 66/33 KV outdoor substations, pole mounted substations and indoor substation
4.2 Layout of 33/11 KV distribution substation and various auxiliaries and equipment associated with it
4.3 Preparation of estimates for 11 KV/0.4 KV substations (pole mounted)

5. Faults: (4 hrs)

5.1 Common type of faults in both overhead and underground systems

6. Power Factor: (4 hrs)

6.1 Concept of power factor
6.2 Reasons and disadvantages of low power factor
6.3 Methods for improvement of power factor using capacitor banks

7. Various Types of Tariffs: (3 hrs)

7.1 Tariffs
7.2 Block rate, flat rate, maximum demand and two part tariffs
7.3 Simple problems

8. Field Visits

RECOMMENDED BOOKS

1. Electrical Power System and Analysis by CL Wadhwa, 3rd edition, New Age International Publishers, New Delhi
2. Substation Design and Equipment by Satnam and PV Gupta, Dhanpat Rai & Sons, New Delhi
3. Electrical Power –I by SK Sahdev, Unique International Publications, Jalandhar
4. Electrical Power System by VK Mehta, S Chand & CO., New Delhi
5. Electrical Power System by JB Gupta, Kataria and Sons, New Delhi
6. Sub-Station Design by Satnam, Dhanpat Rai and Co., New Delhi
7. Electrical Power Distribution System by AS Pabla, Tata McGraw Hill, New Delhi

5.3 INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES

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RATIONALE

Industrial electronics plays a very vital role in the field of control engineering specifically in the modern industries as they mostly use electronic controls which are more efficient, effective and precise as compare to the conventional method. The old magnetic and electrical control schemes have all become obsolete. Electrical diploma holder many times has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control electronics is must for them in order to supervise the work efficiently and effectively. Looking in to usefulness and importance to the subject this has been incorporated in the curriculum.

DETAILED CONTENTS

1. Introduction to SCR (15 hrs)

   1.1. Construction and working principles of an SCR, two transistor analogy circuit and characteristics of SCR
   1.2. SCR specifications and rating
   1.3. Construction, working principles and V-I characteristics of DIAC and TRIAC
   1.4. Basic idea about the selection of heat sinks for SCR and TRIACS
   1.5. Methods of triggering a Thyristor. Study of triggering circuits
   1.6. UJT, its Construction, working principles and VI characteristics, UJT laxation oscillator
   1.7. Commutation of Thyristors
   1.8. Series and paralled operation of Thyristor
   1.9. Applications of SCR and TRIACS such as light intensity control control of DC and universal motor, fan regulator, battery charger etc.

2. Controlled Reactifiers (10 hrs)

   2.1 Single phase half wave controlled rectifier with resistive load and inductive load
   2.2 Single phase half controlled full wave rectifier
   2.3 Fully controlled full wave rectifier bridge
   2.4 Single phase full wave centre lap rectifier
   2.5 Three phase full wave half controlled bridge rectifier
   2.6 Three phase full wave fully controlled bridge rectifier

3. Inverters, choppers, dual converters and cyclo convertors (18 hrs)

   3.1 Inverter-introduction, working principles, voltage and current driven in series and paralled invertors and applications
   3.2 Choppers introduction, types of choppers and their working principles and applications

3.3 Dual Convertors-introduction, types of cyclo-convertors, working principles and applications
3.4 Cyclo-convertors-introduction, types, working principles and applications

4. Thyristor control of electric drives (16 hrs)

4.1 DC drives control
4.2 Half wave drives
4.3 Full wave drives
4.4 Chopper drives
4.5 AC drives control
4.6 Phase control
4.7 Variable frequency a.c. drives
4.8 Constant V/F appreciation
4.9 Voltage controlled inverter drives
4.10 Constant current inverter drives
4.11 Cyclo convertors controlled AC drives
4.12 Slip control AC drives

5 Uninterrupted power supplies (5 hrs)

5.1 UPS, online, stand by, Redundant UPS, DC UPS
5.2 Storage devices, battery charger with UPS

6. Static Control of Machines (12 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.

7. 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. To draw firing characteristics of an SCR
2. To draw firing characteristics of a TRIAC
3. To draw firing characteristics of a DIAC
4. To draw unijunction transistor characteristics

5. Observe the output wave of an UJT relexation oscillator
6. Observe the wave shape across SCR and load of an illumination control circuit
7. Fan speed regulator using TRIAC (fabrication of this circuit)
8. Speed-control of a DC sut motor or universal motor
9. Single phase 1 halt controlled full wave rectifier
10. Single phase controlled rectifier
11. Three phase controlled rectifier
12. Single phase inverter circuit (fabrication of this circuit)
13. Learning programme entry and editing of PLC using Hand held programmer.
14. Learning programme entry and editing on PLC through personal computer which is interfaced to PLC through a software package.
15. 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.
16. Wiring of different types of starters for three phase wound and squirrel cage induction motor.
17. Study of some actual control drawings from industry.
18. Design and modification of control circuit as per required control requirements.

BOOKS RECOMMENDED

1. Control of Electrical Machines by S.K. Bhattacharya and Brijinder Singh. Tata Mc Graw Hill, New Delhi
2. Industrial Control Electronics. John Webb, Kevin Greshock, Maxwell, Macmillan International editions.
3. Fundamentals of Power Electronics by S Rama Reddi, Narosa Publishing House Pvt. Ltd, New Delhi
4. Power Electronics, Circuits Devices and Applications by Mohammad H. Rashid
5. Power Electronics by PC Sen
6. Power Electronics by Dr. PS Bhimbra, Khanna Publishers, New Delhi
7. Industrial Electronics & Control by SK Bhattacharya & S Chatterji, New Age international Publications(P) Ltd, New Delhi
8. Power Electronics by SK Sahdev, Unique International Publication, Jalandhar
9. Power Electronics by JC Karhava, King India Publication,
10. Fundamentals of Electrical Devices by Gopal K Dubey, Narosa Publishing House Pvt. Ltd, New Delhi
11. Power Electronics and Controls by Samir K Datta, Prentice Hall of India, New Delhi

5.5 (a) Elective - I
INSTRUMENTATION

L	T	P
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RATIONALE

This subject deals with the various instruments, their construction and working which control the various parameters and operations in any industry. Electrical supervisor employed in maintenance of electrical equipment, machinery is required to diagnose faults, rectify them and test the total system for good performance. Thus there is a need of introducing diploma holders to the basics of Instrumentation.

DETAILED CONTENTS

1. Measurements: (4 hrs)

   Importance of measurement, Basic measuring systems, advantages and limitations of each measuring systems, generalized measurement system, signal conditioning and display devices

2. Transducers: (8 hrs)

   Theory, construction and use of various transducers (resistance, inductance, capacitance, electromagnetic, piezo electric type)

2. Measurement of Displacement and Strain: (10 hrs)

   Displacement Measuring Devices: wire wound potentiometer, LVDT, strain gauges, different strain gauges such as inductance type, resistive type, wire and foil etc. Gauge factor, gauge materials, and their selections, sources of errors and its compensations. Use of electrical strain gauges, strain gauge bridges and amplifiers.

3. Force and Torque Measurement: (10 hrs)

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

4. Pressure Measurement: (8 hrs)

   Bourdon pressure gauges, electrical pressure pick ups and their principle, construction application and use of pressure cells.

5. Flow Measurement: (6 hrs)

   Basic principles of magnetic and ultrasonic flow meters

6. Measurement of Temperature: (10 hrs)

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

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

RECOMMENDED BOOKS

1. Electronic Measurement and Instrumentation by Dr Rajendra Prasad

2. Electrical and Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Co., New Delhi

3. Electronic Instrumentation and Measurement Techniques by WD Cooper, AD Helfrick Prentice Hall of India Pvt. Ltd. New Delhi

5.4(b) Elective-II
NON CONVENTIONAL ENERGY SOURCES

L	T	P
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RATIONALE

Energy is a crucial input in the process of economic, social and industrial development. High energy consumption has traditionally been associated with higher quality of life, which in turn is related to Gross National Project (GNP). Since the conventional energy resources are under depletion, it is high time to tape the non conventional energy sources. The electrical diploma holder will have to face this challenges in future life. Therefore this subject is offered in diploma programme for future benefit.

DETAILED CONTENTS

1. Introduction: (6 hrs)
   Importance of Non conventional sources of energy, Present Scenario, Future Prospects, Economic Criteria

2. Solar Energy: (10 hrs)
   Physical Principal of the conversion of Solar radiation into heat, Photo-voltaic cell, Electricity generation, Solar water heaters, Solar Furnaces, Solar cookers, Solar Stills solar pumping.

3. Hydro Energy: (8 hrs)
   Hydro-electric Power Plants, Mini and Micro hydro-electric power generation. Magneto Hydro Dynamic (MHD) Power Generation.

4. Bio-energy: (8 hrs)
   Bio-mass Conversion Technologies- wet and dry processes. Methods for obtaining energy from Biomass. Power Generation by using gassifiers

5. Wind Energy: (6 hrs)
   Wind Energy Conversion, Wind mills, Electricity generation from wind- Types of wind mills, local control, energy storage

6. Geo-thermal and Tidal Energy: (10 hrs)
   Geo-thermal sources, Ocean thermal electric conversion, open and closed cycles, hybrid cycles. Prime movers for geo-thermal energy conversion. Steam Generation and electricity generation.

7. Chemical Energy Sources: (10 hrs)
   Design and operating principles of a fuel cell, conversion efficiency, work output and emf of fuel cells, applications storage battery characteristics, types, applications, maintenance of batteries.

8. Thermo Electric Power: (6 hrs)

Basic principle, performance analysis of thermo electric power generation, thermoelectric materials and their application.

RECOMMENDED BOOKS :

1. Solar Energy – Principles of thermal collection and Storage SP Sukhatme, Tata McGraw Hill Publication, New Delhi.

2. Solar Energy Utilization; GD Rai ; Khanna Publishers, New Delhi.

3. Reviews of Renewable Energy Sources, Vol. 3, Edited by MS. Sodha, S.S. Mathur, MAS Malik, TC Kandpal ; Wiley Eastern Limited, New Delhi.

4. Renewable Energy Sources and Conversion Technology by NK Bansal,Manfred Kleemann, Michael Meliss, Tata McGraw Hill Publishing Co. Ltd New Delhi.

5. Energy Today and Tomorrow; Maheshwar Dayal; Publications Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi.

6. Energy Technology (non-conventional, renewable and conventional) by S Rao and BB Parulekar, Khanna Publishers, New Delhi

5.4(c) ELECTIVE - I
PC MAINTENANCE AND REPAIR

L	T	P
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RATIONALE

The PC is the tool that defines today 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 advancement in the field of electronics. The PC is the most logical and modern machine and is no more difficult to understand its function. It is very important to learn the various components of 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 (04 hrs)
   - 1.1 Origin of PC
   - 1.2 Hardware and software
   - 1.3 Operating system
   - 1.4 Programming language

2. Hardware Components (16 hrs)
   - 2.1 Motherboard
   - 2.2 Microprocessors and Co-processors
   - 2.3 Memory – ROM, RAM
   - 2.4 Chipsets and support circuits, its function, system control, peripheral control and memory control
   - 2.5 Bus-architecture, function and various buses i.e. ISA, EISA, VESA, PCI
   - 2.6 Moss storage device i.e. hard disk, floppy disk, compact disk
   - 2.7 Input/output devices i.e. keyboard, mouse, display system. Video adopter, audio printers, modems, serial and parallel ports, IEEE 1284, RS-232-C
   - 2.8 General information about computer virus and anti-virus

3. Interfacing Components and Techniques (02 hrs)
   - 3.1 Interface systems and standards
   - 3.2 Programmable peripherals interface (PPI) Chip-8255, 8155
   - 3.3 Pin diagrams and programming

4. Networking Topologies Standards, Cabling and Configuration, IEEE Standards for LANS (02 hrs)

5. Concept of Internet (05 hrs)

5.1 Internet Protocols H.T.T.P.
5.2 Simple Networking Management Protocol (SNMP)
5.3 Domain Name Systems (DNS)
5.4 Security
5.5 Electronic Mail
5.6 World Wide Web
5.7 Concept of ATM Networks

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

5.5 DIGITAL ELECTRONICS AND MICROPROCESSORS

L	T	P
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RATIONALE

Digital electronics has made extremely rapid advances in the last five decades. It has important applications in communication entertainment, instrumentation, control, automation etc. Thus it appears that there is no end to its usefulness in the light and the new world belongs to it. So it is necessary to give the knowledge of digital electronics to the students. Microprocessor is one of the most exciting technological among the semiconductor devices in recent times. It has a tremendous impact on the Industrial processes due to its high reliability and flexibility both at the design and the Implementation stages. The decreasing cost of with increasing facilities act as catalysts in widening their scope of applications.

DETAILED CONTENTS
(Part-A)

1. Number Systems (4 hrs)

   1.1 Decimal, binary, octal and hexa-decimal number systems and their inter-conversion
   1.2 Binary addition, substraction and multiplication
   1.3 1's and 2's complement methods of addition/substraction

2. Gates (3 hrs)

   Definition, symbol and truth tables for inverter, OR, AND, NAND, NOR and X-OR gates

3. Boolean Algebra (5 hrs)

   3.1 Boolean Relations
   3.2 DeMorgan's Law
   3.3 K-Map upto four variables

4. Combinational Circuits (8 hrs)

   4.1 Half adder, Full adder
   4.2 Encoder, Decorder
   4.3 Multiplexer/Demultiplexer
   4.4 Display Devices (LED, LCD and 7-segment display)

5. Flip-Flops (6 hrs)

   5.1 J-K Flip-Flop
   5.2 R-S Flip-Flop
   5.3 D-Type Flip-Flop
   5.4 T-Type Flip-Flop
   5.5 Applications of Flip-Flops

6. A/D and D/A Converters (4 hrs)

   6.1 D/A converters (Binary weighted, R-2R D/A Converter)
   6.2 A/D converter (Counter ramp, successive approximation method of A/D Conversion)

7. Semi-conductor Memories (2 hrs)

(PART-B)

1. Microprocessor (20 hrs)

   1.1 Study 8085 microprocessor architecture, pin configuration, bus organisation, registers flags, interrupts
   1.2 Instruction set of 8085 microprocessor, addressing modes, instruction format. Writing some simple assembly language programmes. Use of stacks and sub-routines in programming
   1.3 Interfacing and data transfer between peripheral, I/O and microprocessor
   1.4 Study of peripheral chips – 8255, 8253, 9155
   1.5 Introduction of 16-bit, 32-bit microprocessor, their advantages over 8-bit microprocessor
   1.6 Concept of 8086 and 68000 microprocessors

2. Introduction to Microcontrollers (5 hrs)

   2.1 Different between microprocessor and microcontroller
   2.2 Architecture of 8031 and 8051 varieties of microprocessor

3. Programmable Logic Controller (PLC) (6 hrs)

   3.1 Introduction to PLC
   3.2 Basic configuration of PLC
   3.3 Comparison of logic controller

LIST OF PRACTICALS

1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, X-OR gates
2. Construction of Half Adder using gates
3. Construction of Fulf Adder using gates
4. Verification of operation of a 8-bit D/A Converter
5. Writing assembly language programme using numemoanics and test them on μP Kit (any three)
   i) Addition of two 8-bit numbers
   ii) Substraction of two 8-bit numbers
   iii) MItiplication of two 8-bit numbers

iv) Division of two 8-bit numbers
v) Finding average of N given integer
vi) Finding maximum number out of three given numeric

6. Assembly language programming for different applications on 8051 microprocessor

7. Dadder diagram programming on PLC (any available version of PLC)

RECOMMENDED BOOKS

1. Modern Digital Electronics by RP Jain
2. Digital Principles and Electronics by Malvino & Leach
3. Digital Electronics by RL Rokheine
4. Digital Electronics by SN Ali
5. Microprocessor by Goanker,Wiley Eastern Ltd. New Delhi
6. Digital Electronics by T.L. Foyal
7. Digital Electronics by Jamwal
8. Microprocessors Architecture, Programming and Application with 8085/8080A, RS Gaonkar, Wiley Eastern Ltd. New Delhi
9. Introduction to Microporcessors by Aditya Mathur, TMH Publishing Co., New Delhi

Note: Question paper will be set 50% from Part-A and50% from Part-B.

5.6 MINOR PROJECT WORK

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Minor project work aims at exposing the students to industrial/field practices so as to have an appreciation of size, scale and type of operations; and work culture in the industries. Also the students will be able to comprehend concepts, principles and practices taught in the classroom and their application in solving field/industrial problems.

Depending upon the interests of the students, location of the organization the student may be sent to:

a) Study various operations
b) Study various types of materials being used
c) Learn about various operations/processes
d) Know about various measuring instruments and test equipment
e) Study the plant layout and material handling in an industry
f) Have knowledge about production planning and control in an industry
g) Know about various quality control techniques and safety measures adopted
h) Prepare specifications and
i) Disassembly and assembly of motors, transformers available in the laboratory
j) Checking of wiring in the control panels

For effective planning and implementation of this practical training, it is suggested that polytechnic should:

a) Identify adequate number of industrial/field organizations where students will be sent for visits.

b) Prepare a workbook (which can be used by students) for guiding students to perform definite task during the practical training.

c) Identify teachers who would supervise the students and provide guidance during practical training.

This practical training of 3-4 weeks duration will carry 100 marks. 50 marks will be given by industrial/field supervisors and 50 marks by the teacher supervising this training. The components of evaluation will include the following :

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with workers	15%
d)	Industrial training report	55%