3.1 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

	L	P
Periods/week	5	3

RATIONALE

For a diploma holder in electrical and electronics engineering, it becomes imperative to know the fundamentals of the subject in order to grasp the knowledge of the field. This subject will provide acquaintance with various terms knowledge of fundamental concepts of electricity, magnetism and various principles related to it.

DETAILED CONTENTS

1. (a) Application and Advantages of Electrical Energy (04 Periods)
   - Different forms of energy
   - Advantages of electrical energy
   - Uses of electrical energy

   (b) Basic Electrical Elements and Quantities
   - Basic concept of resistance, capacitance, inductance, charge, current, voltage, power, energy and their units
   - Conversion of units of work, power and energy from one form to another

2. DC Circuits and their applications (12 Periods)

   2.1 Ohm's law, resistances in series and parallel

   2.2 Kirchhoff's laws and their applications in solving electrical network problems

   2.3 Network theorems such as Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Superposition theorem

3. Batteries and their applications (15 Periods)

   3.1 Basic idea about primary and secondary cells

   3.2 Working principle and construction of Lead acid, Nickel Cadmium and Silver Oxide Cells

   3.3 Capacity and efficiency of lead acid battery

   3.4 Charging methods used for lead acid accumulator

   3.5 Care and maintenance of a lead acid battery

   3.6 Grouping of cells in series and parallel (simple numerical problems)

   3.7 Testing of lead Acid battery for fully charged conditions and their specifications

   3.8 Idea about batteries used in UPS

4. Magnetism and Electromagnetism with their Applications: (08 Periods)

4.1 Introduction to electromagnetism, Magnetic field around a straight current carrying conductor and a solenoid and methods to find its direction, force between two parallel current carrying conductors.

4.2 Force on a conductor placed in the magnetic field

4.3 Magnetic circuits

4.4 Concept of Hysteresis characteristic and hysteresis loss.

5. Electromagnetic Induction: (10 Periods)

5.1 Faraday's Laws of electromagnetic induction

5.2 Lenz's law

5.3 Fleming's Right and Left Hand Rule

5.4 Principle of self and mutual induction

5.5 Principle of self and mutually induced e.m.f.

5.6 Inductances in series and parallel

5.7 Energy stored in a magnetic field

5.8 Concept of eddy currents, eddy current loss

6. AC Fundamentals (06 Periods)

6.1 Concept of a.c. generation (single phase and three phase)

6.2 Difference between a.c. and d.c.

6.3 Concept of alternating current and voltage, equation of instantaneous values, average value, r.m.s. value, form factor, power factor etc. of periodic waveforms.

6.4 Concept of phasor and phase difference

6.5 Representation of alternating sinusoidal quantities by vectors

6.6 Phasor algebra (addition, subtraction, multiplication and division of complex quantities)

7. AC Circuits (15 Periods)

7.1 AC through pure resistance, inductance and capacitance

7.2 Alternating voltage applied to RL, RC and RLC series and parallel circuits (impedance triangle, phasor diagram and their solutions)

7.3 Concept of susceptance, conductance and admittance

7.5 J,notation and its application in solving problems in ac circuits

7.6 Power in pure resistance, inductance, capacitance and series RL, RC, RLC circuits

7.7 Active and reactive components of current and their significance

7.8 Power factor and its practical significance

8. Poly,Phase Systems (10 Periods)

8.1 Advantages of 3 phase over single phase system

8.2 Star and delta connections (derive relationship between phase and line voltages, phase and line currents in star delta connections

8.3 Power in 3 phase circuits and measurement by wattmeter methods
8.4 Measurement of power and power factor of a 3,phase load by two wattmeter method using balanced/unbalanced load.

LIST OF PRACTICALS

1. To Determination of voltage,current relationship in a dc circuit under specific physical conditions and to draw conclusions (to verify ohm's law)
2. Filament lamp
   - Measure the resistance of a cold lamp filament with the help of calculations.
   - Measure the current drawn by the lamp at different voltages from zero to 220 volts and the resistance of lamp at different voltages, plot a graph between current and voltage
3. (a) To verify that $R_t = R_1+R_2+\ldots$ where R_1, R_2 etc. are resistances connected in series

   (b) To verify $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_m}$

   Where R_1, R_2 etc. are resistances connected in parallel
4. To Verify the Kirchhoff's current and voltage laws applied to DC circuits
   a) To construct a circuit arrangement consisting of resistances in series, parallel combination
   b) Identification of node points in the circuit
   c) To see that algebraic sum of currents at node point is zero
   d) To see that algebraic sum of emfs and voltage drops in a closed loop is zero
5. To observe the a.c. and d.c. wave shapes on CRO.
6. To find ratio of inductance values of a coil having air /iron core respectively and to see the effect of introduction of a magnetic core on coil inductance
7. To construct an RL and RC circuit and to measure
   a) Impedance of the circuit
   b) Phase angle between voltage and current
   c) Construct impedance triangle
8. Measurement of power and power factor of a single phase RLC circuit. To calculate KVA and KVAR
9. Measurement of power and power factor of a 3,phase circuit by using 2, wattmeter method using induction motor as a load and to calculate KVA and KVAR
10. Testing a battery for its charged condition i.e. testing of gravity

Note: The results should be verified analytically also.

INSTRUCTIONAL STRATEGY

Basic electrical engineering being a fundamental subject need to be handled very carefully and in

a manner such that students develop clear understanding of principles and concepts and develop skill in their application in solving related problems. Teacher may lay emphasis on laboratory experiments and give lot of tutorial work to students in order to given them an opportunity in mastering the basics in solving related problems.

RECOMMENDED BOOKS

1. Fundamentals of Electrical Engineering by Sahdev, Uneek Publication, Jalandhar
2. Basic Electrical Engineering by P S Dhogal, Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. Electrical Science by V K Mehta, S Chand and Co., New Delhi
4. Electrical Engineering by DR Arora, Ishan Publications, Ambala
5. Electrical Technology by J B Gupta, SK Kataria and Sons, New Delhi
6. Electrical Technology by B L Theraja, S Chand & Co., New Delhi
7. Electrical Science by S. Chandhni, R Chakrabarti and PK Chattopadhyay. Narosa Publishing House Pvt. Ltd., New Delhi
8. Basic Electrical Engineering by Mool Singh, Galgotia Publication Pvt. Ltd., New Delhi
9. Principles of Electrical Engineering by B R Gupta, S Chand & Co., New Delhi
10. Handbook of Electrical Engineering by S L Bhatia, Khanna Publishers, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	04	05
2	12	15
3	15	15
4	08	10
5	10	15
6	06	05
7	15	20
8	10	15
Total	**80**	**100**

3.2 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

	L	P
Periods/week	4	2

RATIONALE

A diploma holder in Electrical and Electronics Engineering will be involved in maintenance, repair and production of electrical equipment and systems. In addition, he may be required to procure, inspect and test electrical and electronic engineering materials. Knowledge of various types of materials will be needed in order to execute the above mentioned functions. He may also have to decide for an alternative when a particular material is either not readily available in the market or its cost becomes prohibitive.

DETAILED CONTENTS

1. Classification (03 Periods)
   Classification of materials into conducting, semi conducting and insulating materials through a brief reference to their atomic structure and energy bands

2. Conducting Materials and their applications (12Periods)
   - 2.1 Introduction
   - 2.2 Resistance and factors affecting it such as alloying and temperature etc
   - 2.3 Classification of conducting material as low resistivity and high resistivity materials,
     Low resistance materials
     a. Copper, General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard,drawn and annealed copper, corrosion, contact resistance.
     b. Aluminium , General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solderability, contact resistance.
     c. Steel , General properties as conductor: Resistivity, corrosion, temperature coefficient, density, mechanical properties, solderability
     Introduction to bundle conductors and its applications
     Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), and their practical applications with reasons
   - 2.4 Applications of special metals e.g. Silver, Gold, Platinum etc.
   - 2.5 High resistivity materials and their applications e.g., Manganin, Constantin, Nichrome, Mercury, Platinum, Carbon, Tungsten, Tantalum
   - 2.6 Superconductors and their applications

3. Semi,conducting Materials and their applications (05 Periods)

   Semi Conducting material such as Germanium, Silicon, Carbon,their atomic structure/application/against , pure and impure semi conductors and their use for making electronic devices. Material used for special purpose semiconductor, diode, contacts, power transistor, substrate, integrated circuits and power handling devices.

4. Insulating materials; General Properties and their applications (12 Periods)

4.1 Electrical Properties

Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant

4.2 Physical Properties

Hygroscopicity, tensile and compressive strengths, abrasive resistance, brittleness

4.3 Thermal Properties

Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro,thermal breakdown in solid dielectrics

4.4 Chemical Properties

Solubility, chemical resistance, weatherability

4.5 Mechanical properties, mechanical structure, tensile structure

5. Insulating Materials and their applications (13Periods)

5.1 Plastics

a. Definition and classification

b. Thermosetting materials:

Phenol,formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and melamine , formaldehyde), epoxy resins , their important properties

c. Procedure of preparation of plastic (PVC)

d. Thermo,plastic materials:

Polyvinyl chloride (PVC), polyethelene, silicons, their important properties

5.2 Natural insulating materials, properties and their applications

a. Mica and Mica products
b. Asbestos and asbestos products
c. Ceramic materials (porcelain and steatite)
d. Glass and glass products
e. Cotton
f. Silk
g. Paper (dry and impregnated)
h. Rubber, Bitumen

i. Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
j. Enamels for winding wires
k. Glass fibre sleeves

5.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF6; their properties and applications

6. Magnetic Materials (11 Periods)

6.1 Introduction , ferromagnetic materials, permeability, B,H curve, magnetic saturation, hysteresis loop including coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magnetostriction effect, method of reduction of eddy current loss and hysteresis loss

6.2 Soft Magnetic Materials

a) Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines
b) Cold rolled grain oriented steels for transformer, Non,oriented steels for rotating machine
c) Nickel,iron alloys
d) Soft Ferrites

6.3 Hard magnetic materials , Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications

7. Special Materials (04 Periods)

Thermocouple, bimetals, leads soldering and fuses material, mention their applications

8. Introduction of various engineering materials necessary for fabrication of electrical Machines (04 Periods)

LIST OF PRACTICALS

1. A market survey of different Electrical and Electronics materials available in market will be conducted by students. They will submit a report, which will include names, types, specifications, identification, testing of components, manufacturing details and related cost.
2. Case study/data manuals of different wires/cables/fuses/sockets etc.. A report will be submitted by the students.

INSTRUCTIONAL STRATEGY

The teacher should bring different materials, electronic components and devices in the class while taking lectures and explain and make students familiar with them. Also he may give emphasis on practical applications of these devices and components in the field. In addition, the students should be given exercises on identification of materials used in various electronic gadgets etc. and be encouraged to do practical work independently and confidently.

RECOMMENDED BOOKS

Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi

Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi

Electrical Engineering Materials by Sahdev, Uneek International Publications

Electronic Components and Materials by SM Dhir, Tata Mc Graw Hill, New Delhi

Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi

Electrical and Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi

Electrical and Electronics Engineering Materials DR Arora, Ishan Publications, Ambala City

Electrical Engineering Materials by Rakesh Dogra, SK Kataria and Sons, NEW Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Period)	Marks Allocation (%)
1	03	05
2	12	20
3	05	05
4	12	20
5	13	25
6	11	15
7	04	05
8	04	05
Total	**64**	**100**

3.3 ELECTRONIC DEVICES AND CIRCUIT

	L	P
Periods/Weeks	**5**	**3**

RATIONALE

At present, electronic gadgets are being extensively used in various manufacturing processes in industries, power system operations, communication systems, computers etc. Even for an electrical diploma holder, it is absolutely necessary to have a basic understanding of electronic components, their function and applications. This understanding should facilitate in operation and maintenance equipment, which are electronically controlled.
The course is design to meet with the objectives of:

- To make the students to build a solid foundation about science & technology of the basic electronic elements, circuits and devices, namely , junction theory, electrons, holes, diodes and transistors.
- To make the students to study the characteristics and hence functions & performance parameters of basic electronics devices.
- To provide a clear foundation of making different circuits using different combinations of different diodes and transistors.
- To understand the measurement parameters and criteria of circuits likes rectifiers, bias circuits, amplifiers.

DETAILED CONTENTS

1 Semi,conductor Theory: (10 periods)

1.1 Introduction: Structure of matter. Energy band structure of insulators, conductors and semiconductors. Concept of Doping, intrinsic and extrinsic semiconductors. Conduction in solids. Pure and doped semiconductor. Concept of Electron and hole mobility. Fermi Dirac distribution and energy band diagram, Fermi levels in extrinsic semiconductor, effect of temperature on intrinsic and extrinsic semiconductors; Hall Effect

2 PN Diode and its Applications (16 periods)

2.1 Mechanism of current flow in PN junction, drift and diffusion currents, depletion layer, potential barrier, effect of forward and reverse biasing in a PN junction. Diode equation, Temperature effects , DC and AC Resistance. Diode equivalent circuit , Transition and Diffusion Capacitance. Breakdown mechanism.

2.2 Half and full wave rectifiers (centre tapped and bridge type), ripple factor, rectifier efficiency. Clipper and clamper circuit. Basic filter operation. Zener diode and its use

as a voltage stabilizer, varactor diode, Schottky diode, light emitting diode, tunnel diode, photo diode; their working characteristics

3 Bipolar junction transistor and its Applications (18 periods)

3.1 Concept of junction transistor, PNP and NPN transistors, their symbols and mechanism of current flow Transistor configurations: common base (CB), common emitter (CE) and common collector (CC), current relation and their input/output characteristics; comparison of the three configurations.

3.2 DC Biasing: Need, Operating point , different types of biasing, fixed bias, collector to base bias and self,bias and their limitations. Stabilization of transistor, thermal runaway and thermal stability.

4 Transistor as an Amplifier (18 periods)

4.1 Working of single stage transistor amplifier. Frequency response of a single stage transistor amplifier

4.2 Need of multi,stage transistor amplifiers , different types of couplings, their purpose and applications.

4.3 Power amplifiers , Class A, B, AB, C, Push pull & Tuned amplifier.

4.4 Differential amplifier, Common mode & Differential mode gain.

5 Field Effect Transistor its Applications (10 periods)

5.1 Construction, operation, characteristics and applications of an N,channel JFET and P,channel. JFET as an amplifier. Types, construction, operation, characteristics and applications of a MOSFET. Comparison between BJT, JFET and MOSFET.

6 Op,Amp and its Applications (08 periods)

6.1 Characteristics of an ideal operational amplifier and its block diagram, definition of differential voltage gain, CMRR, PSRR, slew rate and input offset Current.

6.2 Operational amplifier as an inverter, scale changer, adder, subtractor, differentiator, integrator, log and anti,log.

INSTRUCTIONAL STRATEGY

This subject gives the knowledge of fundamental concepts of basic electronics. The teacher should give emphasis on understanding of concepts and various term used in the subject. The students be made familiar with diodes, transistors, resistors, capacitors, inductors etc. and electrical measuring instruments etc. Practical exercises will reinforce various concepts. Application of Semiconductor Diodes, Transistors, Field Effect Transistors, Op,Amp etc. must be told to students.

LIST OF PRACTICALS:

1. Identification and testing of electronic components such as resistor, inductor, capacitor, diode, transistor used in Electronic circuits.
2. Measurement of resistances using multimeter and their comparison with colour code values.
3. Plot the V,I characteristics of a Semiconductor diode and calculate its static and dynamic resistance
4. Plot V,l characteristics of a Zener diode and finding its reverse breakdown voltage
5. Observation of input and output wave shapes of a half,wave rectifier and full wave rectifier.
6. Design, implementation and measurement with graphical analysis of input and output of clipping and clampers circuits with p,n junction diode.
7. Plotting input and output characteristics of a transistor in CB and CE configuration
8. To study the effect of coupling capacitor on lower cut off frequency and upper cut off frequency by plotting frequency response curve of a two stage RC coupled amplifier.
9. Plot the V,I characteristics of MOSFET.
10. Study of the Inverting & Non inverting amplifier, adder, subtractor, integrator and differentiator using Op,Amp.

RECOMMENDED BOOKS

1. Jacob Millman & Christos C.Halkias, "Electronic Devices and Circuits" Tata McGraw, Hill,2003.
2. R.L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", PHI Learning Pvt. Ltd, 9th edition, 2008.
3. David A. Bell, "Electronic Devices and Circuits", PHI Learning Private Ltd, 4th edition, 2008.
4. Principles of Electronics by Albert Paul Malvino; Tata McGraw Hill Education Pvt Ltd,New Delhi
5. Basic Electronics , Problems and Solutions by Albert Malvino and David J. Bates; Tata
6. McGraw Hill Education Pvt Ltd, New Delhi
7. Neaman, " Semiconductor Physics & Devices", Tata McGraw Hill, New Delhi,3rd Edition
8. Horowitz & Hill, "The Art of Electronics", Cambridge University Press, Latest Edition
9. R L Smith, Electronics: Circuits & Devices, John Wiley & Sons Ltd
10. Steetmann and Banerjee, "Solid State Electronic devices" Tata McGraw Hill, 6th Edition.

11. Electrical Devices and Circuits by Rama Reddy, Narosa Pulishing House Pvt. Ltd., NewDelhi
12. Basic Electronics by JB Gupta, SK Kataria and Sons, New Delhi
13. Grob's Basic Electronics, A text Lab Manual (Special Indian Edition) by Schultz, Tata
14. McGraw Hill Education Pvt Ltd, New Delhi
15. R.S.Sedha, A Textbook of Applied Electronics", S. Chand, 2008.

SUGGESTED DISTRIBUTION OF MARKS

Topic Time Allotted	**Topic Time Allotted**	**Topic Time Allotted**
1	10	15
2	16	20
3	18	20
4	18	20
5	10	15
6	08	10
TOTAL	80	100

3.4 MICROPROCESSOR AND ITS APPLICATIONS

	L	P
Periods/Weeks	**5**	**3**

RATIONALE

The study of microprocessors in terms of architecture, software and interfacing techniques leads to the understanding of working of CPU in a microcomputer. The development in microprocessors of 32 bit architecture brings them face,to,face with mainframe finding employment in R&D, assembly, repair and maintenance of hardware of microprocessors and computers. Microprocessors find application in process control industry. They also form a part of the electronic switching system between source and destination in long distance telecommunications. Thus the microprocessor is an area of specialization. Students of electronics and related engineering branches often use microprocessors to introduce programmable control in their projects, in industrial training

DETAILED CONTENTS

1 Evaluation and Architecture of a Microprocessor (14 periods)

Typical organization of a microcomputer system and functions of its various blocks. Concept of Bus, bus organization of 8085, Functional block diagram of 8085 and function of each block, Pin details of 8085 and related signals, Demultiplexing of address/data bus generation of read/write control signals, Steps to execute a stored program

2 8085 Programming (16 periods)

Brief idea of machine and assembly languages, Machines and Mnemonic codes, Instruction format and addressing mode. Identification of instructions as to which addressing mode they belong. Concept of Instruction set. Explanation of the instructions of the following groups of instruction set. Data transfer group, Arithmetic Group, Logic Group, Stack, I/O and Machine Control Group. Programming exercises in assembly language with examples

3 Memories and I/O interfacing: (12 periods)

Memory organization, Concept of memory mapping, partitioning of total memory space. Address decoding, concept of I/O mapped I/O and memory mapped I/O. Interfacing of memory mapped I/O devices. Concept of stack and its function. Basic RAM Cell, N X M bit RAM, Expansion of word length and capacity, static and dynamic RAM

4 Instruction Timing and Cycles (08 periods)

Instruction cycle, machine cycle and T,states, Fetch and execute cycle

5 Interrupts (10 periods)

Concept of interrupt, Maskable and non,maskable, Edge triggered and level triggered interrupts, Software interrupt, Restart interrupts and its use, Various hardware interrupts of 8085, Servicing interrupts, extending interrupt system.

6 Data transfer techniques (08 periods)

Concept of programmed I/O operations, synchronous and asynchronous data transfer (hand shaking), Interrupt driven data transfer, DMA, Serial output data, Serial input data.

7 Peripheral devices (12 periods)

8255 PPI and 8253 PIT, 8257 DMA controller, 8279 Programmable KB/Display Interface, 8251 Communication Interface Adapter, 8155/8156

LIST OF PRACTICALS

1. Familiarization of different keys of 8085 microprocessor kit and its memory map
2. Steps to enter, modify data/program and to execute a program on 8085 kit
3. Write and execute the program for addition and substation of two 8 bit numbers
4. Write and execute the program for multiplication and division of two 8 bit numbers
5. Write and execute the program for arranging 10 numbers in ascending/descending order
6. Write and execute the program for 0 to 9 BCD counters (up/down counter according to choice stored in memory)
7. LED display control using 8255 interfacing kit.
8. Interfacing exercise using 8253 programmable interval timer
9. Interfacing exercise using 8279 programmable kit to display the hex code of key pressed
10. Study of 8 bit A/D and D/A interfacing cards in sampling, wave generation, multiplexer, de,multiplexer and counter.

INSTRUCTIONAL STRATEGY

The digital systems in microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing). Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. Programming exercises other than the given in the list may be given to the students.

RECOMMENDED BOOKS

1. Microprocessor Architecture, Programming and Applications with 8080/8085 by Ramesh S Gaonker, Willey Eastern Ltd. New Delhi
2. Introduction to Microprocessor by Mathur ,Tata McGraw Hill Education Pvt Ltd , New Delhi
3. Microprocessor and Microcontrollers by Dr B P Singh, Galgotia Publications, New Delhi
4. Microprocessor and Applications by Badri Ram: Tata McGraw Hill Education Pvt Ltd , New Delhi
5. Microprocessor and Microcomputers by Refiquzzaman, Prentice Hall of India Ltd., New Delhi.
6. Digital Logic and Computer Design by Mano, M Morris; Prentice Hall of India, New Delhi
7. Digital Electronics and Applications by Malvino Leach; Publishers McGraw Hill, New Delhi
8. Digital Integrated Electronics by Herbert Taub and DonalsSachilling; Prentice Hall of India Ltd., New Delhi
9. Digital Electronics by Rajaraman; Prentice Hall of India Ltd., New Delhi
10. Digital Electronics and Microprocessor by Rajiv Sapra, Ishan Publication, Ambala

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	14	20
2	16	25
3	12	15
4	08	10
5	10	10
6	08	10
7	12	10
TOTAL	80	100

3.5 ELECTRICAL AND ELECTRONICS MEASURING INSTRUMENTS

	L	P
Periods/Weeks	**5**	**3**

RATIONALE

In the real world of work the technician is required to handle wide variety of instruments while testing, trouble shooting, calibration etc. the study of this subject will help students to gain the knowledge of working principles and operation of different instruments. During practical sessions, he will acquire the requisite skills.

DETAILED CONTENTS

1 Classification and characteristics of instruments (12 periods)

General definition of measurement , functions of measurement system (Indicating, recording and controlling functions) , Applications of measurement systems, classification , absolute and secondary instruments , indicating, recording and integrating instruments, Analog and Digital ,Definition of true value, accuracy , precision, percentage static error and correction , instrument efficiency. Principle of operation , effects used in instruments, Operating forces , deflecting, controlling and damping forces , construction details, moving system , types of supports, balancing , torque weight ratio control systems (spring control and gravity control) , damping systems , Magnets ,pointers and scales.

2 Measurement of voltage, current and resistance (16 periods)

2.1 Types of instruments , Construction, working and derivation of torque equation of moving coil, moving iron, dynamometer type and induction type(shaded pole construction) instruments , extension of instrument ranges , shunt and multiplier (calculation and requirements, Simple Problems), Tong Tester, current transformer and potential transformer (No derivations, working principle only)

2.2 Measurement of low, medium and high resistances , ammeter , voltmeter method , Wheatstone bridge,precision form of Wheatstone bridge , Kelvin double bridge ,Ohmmeter , series and shunt type ohmmeters , high resistance measurement , Megger , direct deflection methods , Earth Resistance measurement.

3 Measurement of power and energy (16 periods)

Types of wattmeter , Construction and operation of dynamometer type wattmeter & LPF wattmeter , 3 phase two element wattmeter , Construction and working of induction type single phase energy meter , friction compensation , creep and prevention , Errors and adjustments in

energy meters, 3 phase energy meter (connection circuit only) , Testing of energy meter with RSS meter , Measurement of power and energy using CT and PT (Circuit only) , Construction and working of single phase dynamometer type power factor meter. Introduction to Digital Energy meter , calibration of Energy meter.

4 Special instruments and Bridges with their applications: (18 periods)

4.1 Cathode Ray Oscilloscope , CRT constructional parts , Electron Gun , Deflection Plate , Fluorescent Screen , Glass envelope , Base , Time Base Generators , block diagram of a general purpose CRO, Basic CRO circuits and controls , vertical deflection system , horizontal deflection system types of sweeps , synchronization , Blanking , Intensity Modulation , positioning control , focus control , intensity control , calibration circuit , astigmatism ,Measurement of Phase and frequency , Applications of CRO. Introduction to Digital Storage Oscilloscope , Dual trace CRO.

4.2 Study of LCR meter and its applications Digital LCR and Q meter.

4.3 A.C. Bridges (Measurement of impedance) , measurement of inductance, capacitance , Q of coil , Maxwell bridge ,Wien bridge , Hay's bridge , Schering bridge , Anderson bridge , D'Saughty's bridge , errors in A.C. bridge methods and their compensations , detectors , excited field A.C. galvanometer , Vibration galvanometer.

5 Transducers. Their applications and industrial instrumentati (18 periods)

Measurement of strain using Wheatstone bridge , measurement of pressure using inductive transducer , measurement of angular velocity using DC Tachometer generator , Measurement of temperature , Construction and application of Metal Resistance Thermometer , Thermocouple , See,beck effect , basic circuit , Thermistor , construction , types , application Thermistor , Radiation pyrometer , Measurement of flow using electromagnetic flow meter , measurement of thickness using ultrasonic vibrations , measurement of pH value using a pH cell , Measurement of radiation using Geiger Muller tube.

LIST OF PRACTICALS

1) To find the value of unknown resistor using Wheatstone bridge.
2) To find the value of unknown capacitance and inductance using Maxwell's bridge.
3) To find the value of unknown capacitance and inductance using Hay's bridge.
4) To find the value of unknown resistor using Kelvin's bridge.
5) Use of LCR meter for measuring Inductance, capacitance and resitance.
6) To find the value of unknown resistor using Megger
7) Experimental Trainer Kit for Calibration of 1,Phase Energy meter
8) Measurement of frequency using Lissajous method.
9) To study and verify the characteristic of Thermocouple/RTD.
10) To study and verify the characteristic of LVDT

INSTRUCTIONAIL STRATEGY

After making the student's familiar with measuring instruments, they should be made conceptually clear about the constructional features and make them confident in making connection of various measuring instruments. Teacher should demonstrate the application of each measuring instrument in laboratory and encourage students 1o use them independently.

RECOMMENDED BOOKS

1 Electrical Measurements and Measuring Instruments by Golding and Widdis; Wheeler Publishing House, New Delhi
2 Electrical Measurements and Measuring Instruments by SK Sahdev, Unique International Publications. Jalandhar
3 A Course in Electrical Measurement and Measuring lnstruments by AK Sawhney and PL Bhatia; Dhanpat Rai and Sons, New Delhi Electric Instruments by D. Cooper
4 Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi
5 Electronics Instrumentation by Umesh Sinha, Satya Publication, New Delhi
6 Basic Electrical Measurements by Melville B. Staut
7 Electrical Measurement and Measuring Instruments by JB Gupta, SK Kataria and Sons, New Delhi
8 Electrical Measurement and Measuring Instruments by ML Anand, SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	12	12
2	16	20
3	16	20
4	18	25
5	18	23
TOTAL	80	100

3.6 ELECTRICAL WORKSHOP PRACTICE

	L	P
Periods/week ,	0	6

RATIONALE

An electrical and electronics diploma holder will be required to inspect, test and modify the work done by skilled workers working under him. In addition, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively, in addition to conceptual understanding of the method or procedure, he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, fault finding, wiring in electrical appliances and installations.

DETAILED CONTENTS

1. To Study the electrical safety measures as mentioned in the Electricity Rules and shock treatment including first aid

2. Types of wiring and to make different light control circuits in the following types of wiring Casing and capping, (PVC) conduct, baten wiring

3. Study of ISI standard for MCBs and ELCBs Conduct one test on MCB on above basis

4. Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and MCBs Types of wiring and to make different light control circuits in the following types of wiring.

   4.1 Casing and Capping (PVC) wiring
   4.2 Conduit wiring (surface/concealed)

5. Construction of distribution and extension board with two 5A sockets and two 15A sockets, a fuse and indicator with series test lamp provision controlled by their respective switches.

6. Testing of domestic wiring installation using megger.

7. Fault finding and repair of a tube light circuit.

8. To study the pipe/ plate earthing for a small house and 3 phase induction motor. Testing the earthing using earth tester.

9. Connection of single phase and three phase motors through an appropriate starter.

10. Winding/ rewinding of a fan (ceiling and table) and choke.

11. Repair of domestic electric appliances such as electric iron, geyser, fan, heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnace and weighing machine.

Note: Students may be asked to study control circuit of a passenger lift, automatic milling machine, etc. using relays.