

### 3.1 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

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#### RATIONALE

A diploma holder in Electrical 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: (3 Hrs)  
 Classification of materials into conducting, semi conducting and insulating materials based on (a) atomic structure and (b) energy bands
2. Conducting Materials (12 Hrs)
  - 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:
    - a) To study the following properties of Copper, Aluminium and Steel:  
Resistivity, temperature coefficient, density, mechanical properties of hard-drawn and annealed metal, corrosion, contact resistance. Application in the field of electrical engineering.
    - b) Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), and their practical applications with reasons for the same
  - 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 and tungsten, Tantalum
  - 2.6 Introduction to bundle conductors and its applications.
  - 2.7 Superconductors and their applications
3. Semi-conducting Materials (2 Hrs)  
 Germanium (Ge), Silicon (Si) and Carbon (C) - their atomic structure, types of semiconductors and their applications
4. Insulating materials - General Properties: (12 Hrs)
  - 4.1 Electrical Properties:  
 Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage), dielectric constant
  - 4.2 Physical Properties:

Hygroscopicity, tensile and compressive strength, 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: (16 Hrs)

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 and applications

c. Procedure for preparation of plastic (PVC)

d. Thermo-plastic materials:

Polyvinyl chloride (PVC), polythene, silicon, their important properties and applications

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 oil

j) Enamels for winding wires

k) Glass fibre sleeves

5.3 Gaseous insulating materials; Air, Hydrogen, Nitrogen, SF<sub>6</sub> their properties and applications

6. Magnetic Materials: (11 Hrs)
- 6.1 Introduction – Types of magnetic 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:
- Alloyed steels with silicon: High silicon alloy steel for transformers, low silicon alloy steel for electric rotating machines
  - Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine
  - Nickel-iron alloys
  - Soft Ferrites
  - Applications of the above (a – d)
- 6.3 Hard magnetic materials
- Tungsten steel, chrome steel, cobalt steel
  - Hard ferrites
  - Applications of the above (a – b)
7. Special Materials (4 hrs)  
Thermocouple, bimetals, lead soldering and fuses materials, applications
8. Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc (4 hrs)

### **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

6. Electrical and Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi
7. Electrical and Electronics Engineering Materials DR Arora, Ishan Publications, Ambala City
8. Electrical Engineering Materials by Rakesh Dogra, SK Kataria and Sons, NEW Delhi

**SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPERSETTER**

<b>Sr. No</b>	<b>Topic</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allocation (%)</b>
1	Classification	03	5
2	Conducting Materials	12	20
3	Review of Semi-conducting Materials	02	5
4	Insulating materials; General Properties:	12	20
5	Insulating Materials and their Applications	16	25
6	Magnetic Materials:	11	15
7	Special Materials	04	5
8	Introduction of various Engineering Materials	04	5
	<b>Total</b>	<b>64</b>	<b>100</b>

## 3.2 ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS

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### RATIONALE

Diploma holders in Electrical Engineering have to work on various jobs in the field as well as in testing laboratories and on control panels, where they perform the duties of installation, operation, maintenance and testing by measuring instruments. Persons working on control panels in power plants, substations and in industries, will come across the use of various types of instruments and have to take measurements. Instruments used to read and observe the general electrical quantities like current, voltage, power, energy, frequency, resistance etc and their wave shapes, have been incorporated in this subject. So the technician will understand the construction and use of various types of electrical instruments.

### DETAILED CONTENTS

1. Introduction to Electrical Measuring Instruments: (06 hrs)
  - 1.1 Concept of measurement and measuring instruments
  - 1.2 Types of electrical measuring instruments – indicating, integrating and recording type instruments
  - 1.3 Essentials of indicating instruments – deflecting, controlling and damping torque
2. Ammeters and Voltmeters (Moving coil and moving iron type): (12 hrs)
  - 2.1 Concept of ammeters and voltmeters and difference between them
  - 2.2 Extension of range of voltmeters and ammeter
  - 2.3 Construction and working principles of moving Iron and moving coil instruments
  - 2.4 Merits and demerits, sources of error and application of these instruments
3. Wattmeters (Dynamometer Type) (4 hrs)
 

Construction, working principle, merits and demerits of dynamometer type wattmeter, sources of error
4. Energy meter (Induction type): (6 hrs)
 

Construction, working principle, merits and demerits of single-phase and three-phase energy meters

  - 4.1 Errors and their compensation
  - 4.2 Simple numerical problems
  - 4.3 Construction and working principle of maximum demand indicators
5. Miscellaneous Measuring Instruments: (12 hrs)

- 5.1 Construction, working principle and application of Meggar, Earth tester, Multimeter, Frequency meter (dynamometer type) single phase power factor meter (Electrodynamometer type). Working principle of synchroscope and phase sequence indicator, tong tester (Clamp-on meter)
- 5.2 Instrument Transformers: Construction, working and applications
- CT
  - PT and their ratio and phase angle error
6. Electronic Instruments: (6 hrs)
- Cathode Ray Oscilloscope: Block diagram, working principle of CRO and its various controls. Applications of CRO.
  - Digital multi-meter (only block diagram) and Applications
7. LCR meters. (4 hrs)
- Study of LCR meter and its applications
8. Power Measurements in 3-phase circuits by (6 hrs)
- 2 wattmeter method in balanced and unbalanced circuits and simple problems
  - Three wattmeter method
- Measurement of Non-electrical Quantities (Introduction only) (4 hrs)
- Basic concept of pressure measurement, flow measurement, level measurement, displacement measurement using transducers
- Measurement of Temperature (4 hrs)
- Different types of thermometers, thermocouple, resistance temperature detector and their construction, principle and working.

## LIST OF PRACTICALS

- Use of analog and digital multimeter for measurement of voltage, current (a.c/d.c) and resistance
- To calibrate 1-phase energy meter by direct loading method.
- To measure the value of earth resistance using earth tester.
- To measure power, power factor in a single-phase circuit, using wattmeter and power factor meter and to verify results with calculations.
- Measurement of power and power factor of a three-phase balanced load by two wattmeter method.
- Measurement of voltage and frequency of a sinusoidal signal using CRO and draw wave shape of signal.
- Measurement of power in a 3 phase circuit using CT, PT and 3-phase wattmeter.
- Use of LCR meter for measuring inductance, capacitance and resistance.
- To record all electrical quantities from the meters installed in the institution premises.
- To measure Energy at different Loads using Single phase Digital Energy meter.

## INSTRUCTIONAL STRATEGY

After making the students 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 to 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 Instruments by AK Sawhney and PL Bhatia; Dhanpat Rai and Sons, New Delhi
4. Electric Instruments by D. Cooper
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi
6. Electronics Instrumentation by Umesh Sinha, Satya Publication, New Delhi
7. Basic Electrical Measurements by Melville B. Staut.
8. Electrical Measurement and Measuring Instruments by JB Gupta, SK Kataria and Sons, New Delhi
9. Electrical Measurement and Measuring Instruments by ML Anand, SK Kataria and Sons, New Delhi

## SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction to Electrical Measuring Instruments	06	10
2	Ammeters and Voltmeters	12	20
3	Watt Meter	04	5
4	Energy Meter	06	10
5	Miscellaneous Measuring Instruments:	12	20
6	Electronic Instruments:	06	10
7	LCR Meters	04	5
8	Power Measurements in 3-phase circuits	06	10
9	Measurement of Non-electrical quantities	04	5
10	Measurement of Temperature	04	5
	<b>Total</b>	<b>64</b>	<b>100</b>

### 3.3 ELECTRONICS - I

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#### RATIONALE

At present, electronics 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.

In this course, topics like semi-conductor physics, semi-conductor Diodes, Bipolar transistors, rectifiers, single stage and multistage amplifiers and field effect transistors have been included.

#### DETAILED CONTENTS

1. Introduction (05 hrs)
  - 1.1 Electronic components
  - 1.2 Active and passive components
  - 1.3 Concept of current and voltage sources, constant voltage and current sources, their graphical representation. Conversion of voltage source into current source and vice-versa
  - 1.4 Difference between actual voltage source and constant voltage source
  
2. Semi-conductor Physics (10 hrs)
  - 2.1 Atomic structure, crystalline structure
  - 2.2 Energy band theory of crystals, energy band structure of insulator, semiconductor and conductor, generation and recombination of electron hole pairs. Energy band structure of Silicon and Germanium
  - 2.3 Silicon versus Germanium for mobility and conductivity
  - 2.4 Concept of Doping, intrinsic and extrinsic semiconductors
  - 2.5 Effect of temperature on intrinsic and extrinsic semiconductors
  
3. Semiconductor Diodes (10 hrs)
  - 3.1 PN Junction, 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. Concept of junction capacitance in forward and reverse biased conditions. Breakdown mechanism
  - 3.2 Ideal diode, Semiconductor diode characteristics, static and dynamic resistance
  - 3.3 Use of diode as half wave and full wave rectifiers (centre tapped and bridge type), relation between DC output and AC input voltage, rectifier efficiency
  - 3.4 Concept of ripples, filter circuits – shunt capacitor, series inductor, and pie ( ) filters and their applications
  - 3.5 Diode ratings/specifications



- 3.6 Various types of diodes such as zener diode, varactor diode, schottky diode, light emitting diode, tunnel diode, photo diode; their working characteristics and applications
  - 3.7 Zener diode and its characteristics
  - 3.8 Use of zener diode for voltage stabilization
4. Bi-polar Transistors (07 hrs)
- 4.1 Concept of junction transistor, PNP and NPN transistors, their symbols and mechanism of current flow
  - 4.2 Transistor configurations: common base (CB), common emitter (CE) and common collector (CC), current relation and their input/output characteristics; comparison of the three configurations
5. Transistor Biasing and Stabilization (08 hrs)
- 5.1 Transistor biasing, its need, operating point, effect of temperature on the operating point of a transistor and need of stabilization of operating point.
  - 5.2 Different biasing circuits, limitations, simple problems to calculate operating point in different biasing circuits. Use of Thevenin's theorem to determine operating point
  - 5.3 Concept of h-parameters of a transistor
  - 5.4 Use of data book to know the parameters of a given transistor
6. Single-Stage Transistor Amplifiers (10 hrs)
- 6.1 Single stage transistor amplifier circuit in CE configuration, function of each component
  - 6.2 Working of single stage transistor amplifier, physical and graphical explanation, phase reversal
  - 6.3 Concept of DC and AC load line
  - 6.4 Voltage gain of single stage transistor amplifier using characteristics of the device
  - 6.5 Concept of input and output impedance
  - 6.6 AC equivalent circuit of single stage transistor amplifiers
  - 6.7 Calculation of voltage gain using AC equivalent circuit
  - 6.8 Frequency response of a single stage transistor amplifier
7. Multi-Stage Transistor Amplifiers (07 hrs)
- 7.1 Need of multi-stage transistor amplifiers – different types of couplings, their purpose and applications.
  - 7.2 Knowledge of various terms such as voltage gain, current gain, power gain, frequency response, decibel gain and band width
  - 7.3 RC coupled two-stage amplifiers, circuit details, working, frequency response, applications
  - 7.4 Loading effect in multistage amplifiers
  - 7.5 Elementary idea about direct coupled amplifier, its limitations and applications
  - 7.6 Transformer coupled amplifiers, its frequency response. Effect of co-efficient of coupling on frequency response. Applications of transformer coupled amplifiers

8. Field Effect Transistor (FET) (07 hrs)
- 8.1 Construction, operation, characteristics and applications of a N channel JFET and P channel JFET
  - 8.2 JFET as an amplifier
  - 8.3 Types, construction, operation, characteristics and applications of a MOSFET
  - 8.4 Comparison between BJT, JFET and MOSFET

### LIST OF PRACTICALS

1. a) Identification and testing of electronic components such as resistor, inductor, capacitor, diode, transistor and different types of switches used in Electronic circuits
- b) Measurement of resistances using multimeter and their comparison with colour code values
2. V-I characteristics of a Semiconductor diode and to calculate its static and dynamic resistance
3. a) V-I characteristics of a zener diode and finding its reverse breakdown voltage
- b) Fabrication of a zener diode voltage stabilizer circuit using PCB
4. Observation of input and output wave shapes of a half-wave rectifier and verification of relationship between dc output and ac input voltage
5. Observation of input and output wave shapes of a full wave rectifier and verification and relationship between dc and ac input voltage
6. Observation of input and output wave shapes of a full wave rectifier with (i) shunt capacitor (ii) series inductor (iii)  $\pi$  filter circuits
7. Plotting input and output characteristics of a transistor in CB configuration
8. Plotting input and output characteristics of a transistor in CE configuration
9. Measurement of operating point in case of (i) fixed biased circuit (ii) potential divider biasing circuit and to observe the effect of temperature variation on the operating point.
10. To measure the voltage gain and band width by plotting frequency response curve of a single stage amplifier using CE configuration at different loads
11. 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
12. To plot V-I characteristics of a FET

### 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 etc must be told to students.

### RECOMMENDED BOOKS

1. Basic Electronics and Linear Circuit by NN Bhargava, Kulshreshta and SC Gupta, Tata McGraw Hill Education Pvt Ltd, New Delhi.
2. Electronic Principles by SK Sahdev, Dhanpat Rai & Co., New Delhi

3. Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi
4. Electronic Components and Materials by SM Dhir, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi.
5. Principles of Electronics by SK Bhattacharya and Renu Vig, SK Kataria and Sons, Delhi
6. Electronics Devices and Circuits by Millman and Halkias; McGraw Hill.
7. Principles of Electronics by Albert Paul Malvino; Tata McGraw Hill Education Pvt Ltd, New Delhi.
8. Basic Electronics – Problems and Solutions by Albert Malvino and David J. Bates; Tata McGraw Hill Education Pvt Ltd, New Delhi.
9. Basic Electronics by J.S. Katre, Sandeep Bajaj, Tech. Max. Publications, Pune.
10. Analog Electronics by DR Arora, Ishan Publications, Ambala City.
11. Analog Electronics by JC Karhara, King India Publication, New Delhi
12. Electrical Devices and Circuits by Rama Reddy, Narosa Pulishing House Pvt. Ltd., New Delhi
13. Electronic Devices and Circuits by Dharma Raj Cheruku and Battula Tirumala Krishna: Pearson Education (Singapore) Pvt Ltd., Indian Branch, 482 F.I.E Patparganj, Delhi- 92
14. Basic Electronics by JB Gupta, SK Kataria and Sons, New Delhi
15. Grob's Basic Electronics- A text Lab Manual (Special Indian Edition) by Schultz, Tata McGraw Hill Education Pvt Ltd, New Delhi.

#### **SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER**

<b>Sr. No</b>	<b>Topic</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allocation (%)</b>
1	Introduction	05	10
2	Semi-conductor Physics	10	15
3	Semiconductor Diodes	10	15
4	Bi-polar Transistors	07	10
5	Transistor Biasing and Stabilization	08	15
6	Single-Stage Transistor Amplifiers	10	15
7	Multi-Stage Transistor Amplifiers	07	10
8	Field Effect Transistor	07	10
	<b>Total</b>	<b>64</b>	<b>100</b>

### 3.4 ELECTRICAL ENGINEERING DESIGN AND DRAWING - I

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#### RATIONALE

A polytechnic pass-out in electrical engineering is supposed to have ability to :

- i) Read, understand and interpret engineering drawings
- ii) Communicate and co-relate through sketches and drawings
- iii) Prepare working drawings of panels, transmission and distribution

The contents of this subject has been designed to develop requisite knowledge and skills of electrical drawings in the students of diploma in electrical engineering.

#### DETAILED CONTENTS (To make 16 Sheets)

1. Symbols and Signs Conventions **(2 Sheets)** (6 hrs)  
 Various Electrical Symbols used in Domestic and Industrial Installation and Power System as per BIS.
2. Panels/Distribution Boards **(3 Sheets)** (18 hrs)  
 Design and Drawing of panels/Distribution board using MCBs, ELCB, main switches and change over switches for domestic installation, industrial and commercial installation.
3. Orthographic projections of Simple Electrical Parts **(4 Sheets)** (24 hrs)
  - Kit Kat
  - Bus bar post/ Kit Kat
  - Pin type and shackle type insulator (Pin Type 11kV/66kV)
  - Bobbins of a small transformer / choke
  - Stay insulators/Suspension type insulators
  - Free hand sketching of M.C.B. and E.L.C.B Placed on Distribution Board.
4. Orthographic Projection of Machine Parts **(4 Sheets)** (24 hrs)
  - Rotor of a squirrel cage induction motor
  - Motor body (induction motor) as per IS Specifications (using outside dimensions)
  - Slip rings of 3-phase induction Motor.
  - Stator of 3 phase Induction motor (Sectional View)

5. Contactor Control Circuits: Schematic and wiring diagram **(3 Sheets)** (24 hrs)
- DOL Starter of 3-phase induction Motor.
  - Forwarding/reversing of 3-phase induction motor
  - Limit switch control of a 3-phase induction motor
  - Sequence operation of two motors using T.D.R.
  - Two speed motor control.
  - Automatic star-delta starter for 3-phase induction motor.

### INSTRUCTIONAL STRATEGY

Teacher should identify/prepare more exercises on the pattern shown above. The teacher should make the students confident in making drawing and layouts of electrical wiring installations and doing estimation and costing. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

### RECOMMENDED BOOKS

1. Electrical Engineering Design and Drawings by Surjeet Singh, Dhanpat Rai and Co, New Delhi
2. Electrical Engineering Design and Drawings by SK Bhattacharya, SK Kataria and Sons, New Delhi
3. Electrical Engineering Design and Drawings by Ubhi & Marwaha, IPH, New Delhi
4. Electrical Design and Drawing by SK Sahdev, Uneek Publications, Jalandhar
5. Electrical Engineering Drawing by Surjit Singh, SK Kataria and Sons, New Delhi

### SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPERSETTER

Sr. No	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Symbols and Signs Conventions	6	10
2	Design and Drawing of panels	18	20
3	Orthographic projections of simple electrical parts	24	20
4	Drawing of Machine Parts	24	25
5	Contactor Control Circuits	24	25
	<b>Total</b>	<b>96</b>	<b>100</b>

### 3.5 COMPUTER PROGRAMMING AND APPLICATIONS

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#### RATIONALE

Computer plays a very vital role in present day life, more so, in the professional life of Diploma engineers. In order to enable the students use the computers effectively in problem solving, this course offers the modern programming language C along with exposure to various engineering applications of computers. The knowledge of C language will be reinforced by the practical exercises and demonstration of application software in the field of Electrical Engineering during the course of study. Introduction to data base management system is also a very significant field with vast employment potential.

#### DETAILED CONTENTS

1. Algorithm and Program Development (4 hrs)
  - Steps in development of a program
  - Flow-charts, algorithm development
  - Introduction to various computer languages
  - Concept of interpreter, compiler, high level language(HLL), machine language (ML) and Assembly Language
  
2. Program Structure (C Programming) (24 hrs)
  - a) History of 'C':  
Data types, input output statements, arithmetic and logical operations, data assignments, precedence and associativity
  - b) I/O statements  
Assignment, Variables, arithmetic operation- their precedence, data types standard I/O function, formulated I/O
  - c) Control Statements  
Logical and relational operators; if-else, while, do- while, for loops, breaks, switch statements
  - d) Functions:  
Function declaration, parameter passing- by value, storage classes (Local, Global and Static variables), standard library functions

e) Arrays:

Single and multi dimensional arrays, character arrays

f) Pointers:

To various data types, pointers in parameters passing, pointers to function

g) Structures:

Definition of a structure, pointer to structure, union and array of structure

h) Strings:

String processing, functions and standard library function

i) Data files

File handling and manipulation, file reading and writing, Binary and ASCII files, file records using standard function type mouse

3. Software Applications in Electrical Engineering (4 hrs)

Computer application overview through various applications software related to Electrical Engineering branch viz: PSIM, PSPICE in Electrical Engineering

### **LIST OF PRACTICALS**

1. Programming exercise on executing a C Programs.
2. Programming exercise on editing a C program.
3. Programming exercise on defining variables and assigning values to variables
4. Programming exercise on arithmetic and relation operators
5. Programming exercise on arithmetic expressions and their evaluation
6. Programming exercise on reading a character
7. Programming exercise on writing a character
8. Programming exercise on formatting input using print
9. Programming exercise on formatting output using scan
10. Programming exercise on simple IF statement
11. Programming exercise on IF... ELSE statement
12. Programming exercise on SWTCH statement
13. Programming exercise on GOTO statement

14. Programming exercise on DO-WHILE statement
15. Programming exercise on FOR statement
16. Programming exercise on one dimensional arrays
17. Programming exercise on two dimensional arrays
18. Demonstration of Application software to Electrical Engineering branch such as: MATLAB, PSIM,
19. MULTISIM, PSPICE in Electrical Engineering

### **INSTRUCTIONAL STRATEGY**

This course is a highly practical and self- study oriented courses. The teachers are expected to explain the theoretical part and make the students to execute and debug different programs. The PC needed to have Turbo C.

### **RECOMMENDED BOOKS**

1. Programming in C by Schaum series McGraw Hill
2. Programming in C by Kerning Lan and Richie; Prentice Hall of India, New Delhi
3. Programming in C by Balagurusamy, Tata McGraw Hill, Education Pvt Ltd. New Delhi.
4. Let us C- Yashwant Kanetkar, BPB Publications, New Delhi
5. Vijay Mukhi Series for C and C++
6. Programming in C by R Subburaj, Vikas Publishing House Pvt. Ltd., Jangpura, New Delhi
7. Programming in C by Kris A Jansa, Galgotia Publications Pvt. Ltd., Daryaganj, New Delhi
8. Programming in C by BP Mahapatra, Khanna Publishers, New Delhi
9. Elements of C by MH Lewin, Khanna Publishers, New Delhi
10. The Complete Reference to Visual Basic 6, by Noel Jerke, Tata McGraw Hill, New Delhi
11. Web site [www.Beyondlogic.org](http://www.Beyondlogic.org)
12. Pointers in C by Yashwant Kanetkar, BPB Publishers New Delhi
13. Programming in Applications by Chandershekhar, Uheek Publications, Jalandhar
14. The essentials of Computer Organizing and Architecture by Linda Null and Julia Labur, Narosa Publishing House Pvt. Ltd., New Delhi



**SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER**

<b>Topic No.</b>	<b>Topic</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allocation</b>
1.	Algorithm and Program Development	4	15
2.	Program Structure (C Programming)	24	70
3.	Software Applications	4	15
<b>Total</b>		<b>32</b>	<b>100</b>

### 3.6 ELECTRICAL WORKSHOP PRACTICE

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#### RATIONALE

An electrical 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 (PRACTICAL EXERCISES)

1. Study of electrical safety measures as mentioned in the Electricity Rules and shock treatment including first aid
2. Wire jointing
  - 2.1 Straight married joint
  - 2.2 Technology-joint
  - 2.3 Western union joint
  - 2.4 Britania joint
3. Study of ISI standard for MCBs and Conduct one test on MCB
4. Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and fuses (only internal connection) 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/assembly of Distribution Board and Extension Board  
  
Construction of an extension board with two 5A sockets and one 15A Socket controlled by their respective switches, a fuse and indicator with series test lamp provision.
6. Simple light and Alarm Circuits
  - a) One lamp controlled by two switches (staircase circuit)
  - b) Two lamps controlled by three switches (double staircase circuit)
  - c) Two ordinary bells (for day and night) used at a distant residence
  - d) Bell response circuit using one bell and one relay
  - e) Bell response circuit of an office (for three rooms)
  - f) Traffic light control system for two roads crossing.
7. Fault finding and repair of a tube light circuit

8. Connections of single phase and 3-phase motors, through an appropriate starter and to change their direction of rotation
9. Wiring, testing and fault finding of the following contactor control circuits operating on 3-phase supply:
  - a) Remote control circuits
  - b) Time delay circuits
  - c) Inter locking circuits
  - d) Sequential operation control circuits

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

10. Power cable jointing using epoxy based jointing kits
11. Dismantling/assembly of star-delta and DOL starter
12. Repair and maintenance of domestic electric appliances such as electric iron, geyser, fan, heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnace etc.
13. Dismantling/assembly/maintenance of motor operated appliances such as mixer, blender, drill machine etc.