

### 3.1 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

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#### RATIONALE

A diploma holder will be involved in maintenance, repair and production of different types of 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 through a brief reference to their atomic structure and 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, Low resistance materials
    - a) Copper:  
 General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard-drawn and annealed copper, corrosion, contact resistance. Application in the field of electrical engineering.
    - b) Aluminium:  
 General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solderability, contact resistance. Applications in the field of electrical engineering.
    - c) Steel:  
 General properties as conductor: Resistivity, corrosion, temperature coefficient, density, mechanical properties, solderability. Applications in the field of electrical engineering.
    - d) Introduction to bundle conductors and its applications.  
 Low resistivity copper alloys: brass, bronze (cadmium and beryllium), their practical applications with reasons for the same

- 2.4 Applications of special metals e.g. Silver, Gold, and Platinum
- 2.5 High resistivity materials and their applications e.g, manganin, constantan, nichrome, mercury, platinum, carbon and tungsten
- 2.6 Superconductors and their applications
3. Review of Semi-conducting Materials (2 Hrs)
- Semi-conductors and their properties, materials used for electronic components like resistors, capacitors, diodes, transistors and inductors etc.
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, weather ability
- 4.5 Mechanical Properties:  
Mechanical structure, tensile strength
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 Malamine-formaldehyde), epoxy resins - their important properties and applications
- c) Thermo-plastic materials:  
Polyvinyl Chloride (PVC), polyethelene, silicones, 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) porcelain
- f) Cotton
- g) Silk
- h) Jute
- i) Paper (dry and impregnated)
- j) Rubber, Bitumen
- k) Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
- l) Enamels for winding wires
- m) Glass fibre sleeves

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

## 6. Magnetic Materials: (11 Hrs)

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.

### 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 (4 hrs)

Thermocouple, bimetals, leads soldering and fuse's material. Mention their applications

## 8. Various Engineering Materials (4 hrs)

Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc

## INSTRUCTIONAL STRATEGY

The teacher should bring different materials, electronic components and devices in the class during lectures and make students familiar with them. Emphasis be given 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

1. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi
2. Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi
3. Electrical Engineering Materials by Sahdev, Unique International Publications
4. Electronic Components and Materials by SM Dhir, Tata Mc Graw Hill, New Delhi
5. 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

Topc	Time Allotted (Hrs)	Marks Allocation (%)
1	3	5
2	12	20
3	2	5
4	12	20
5	16	25
6	11	15
7	4	5
8	4	5
<b>Total</b>	<b>64</b>	<b>100</b>

## 3.2 SCIENCE OF FIRE TECHNOLOGY

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### RATIONALE

As a process, fire can take many forms, all of which involve chemical reaction between combustible species and oxygen from the air properly our industrial and domestic needs, but unchecked, can cause untold material damage and human suffering. Such an approach requires a detailed understanding of the behaviour of fire from an engineering point of view. The study of Science of Fire Technology is an essential to the Fire Engineer.

### DETAILED CONTENTS

1. Introduction (8 hrs)  
 Definition, factor responsible to fire, classification of fire, different types of smoke, method of extinction, possible causes of fire, spontaneous, ignition, stages of fire, triangle of fire.
2. Combustion (10 hrs)  
 Physics and Chemistry for Combustion – combustion related properties of matter, mechanism of extinction- effects of combustion, spontaneous combustion, hazardous material
3. Electricity (16 hrs)  
 Electricity - types, sources, generation methods, conductors, insulators, distribution and special hazard of transformers - sub stations, cables, junction boxes, wiring system, switches-switch gears etc. static electricity, electrical hazards shock and protection, fire fighting techniques for live installation.
4. Shock and Protection (08 hrs)  
 Shock and Protection - Demonstration of static charges, generation of electricity, short circuit, heating effect of current, earth leakage, fuse, MCB, various type of wiring transformers, switch gears and lamps, how to extinguish electrical fire.
5. Fire Fighting Techniques for Live Hazard (10 hrs)  
 Cutting off power supply in any fire involving current. Non conducting extinguishing agents like: CO<sub>2</sub>, DCP, dry sand and asbestos.
6. Special Hazards (12 hrs)  
 Methods of internal and external storage of hazardous substances which are flammable, toxic, corrosive, radioactive or a combination of such hazards. Precaution to be taken in handling and storage. The correct medical treatment to be applied their reaction to fire fighting of following substances.

- a) Fats and waxes
- b) Paints and varnishes
- c) Coal gas and natural gas installation
- d) Petroleum and oil installation
- e) Chemical plants
- f) Liquified petroleum gas installation

### LIST OF PRACTICALS

1. Preparation and demonstration of the properties of various chemicals and basic material under suitable circumstance
  - Practical Fire Fighting
2. Fire Fighting Techniques for Live Installation
  - Demonstration of static charges, generation of electricity, short circuit, heating effect of current, earth leakage, fuse, MCB, various type of wiring, transformers switch gears. How to extinguish fire.

### INSTRUCTIONAL STRATEGY

This is one of the fundamental subjects covering classification of fires, science of combustion, methods of extinction and fire fighting techniques. Teacher should demonstrate by charts, models, video programmes etc. Teacher should emphasize on conceptual clarity of combustion and combustion related properties to enhance the level of understanding of the students about science of fire technology.

### RECOMMENDED BOOKS

1. Elementary of Physics and Electricity- 'Practical of Fireman ship in Volumes' UK.
2. Fire Technology; NFPA Journal.

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	12
2	10	15
3	16	25
4	08	13
5	10	15
6	12	20
<b>Total</b>	<b>64</b>	<b>100</b>

### 3.3 BASIC ELECTRONICS

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#### RATIONALE

At present electronics gadgets are being extensively used in manufacturing process in industries, power system operations, communication systems, computers etc. Even for an electrical diploma holder, it is absolutely necessary to take a basic understanding of electronics components, their function and applications. This understanding should facilitate in operation and maintenance equipments which are electronically controlled.

In this course, topics like electronics components, semi-conductor physics, rectifiers, and amplifiers have been included.

#### DETAILED CONTENTS

1. Introduction (5 hrs)
  - 1.1 Brief history of development of electronics
  - 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 Theory (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. Energy band structure of Silicon and Germanium
  - 2.3 Silicon versus Germanium for mobility and conductivity
  - 2.4 Concept of 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 (7 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 collection (CC), current relation and their input/output characteristics; comparison of the three configurations
  
- 5. Transistor Biasing and Stabilization (8 hrs)
  - 5.1 Transistor biasing, its need, operating point and need of stabilization of operating point.
  - 5.2 Difference between circuits, limitations, simple problems to calculate operating point in different biasing circuits. Use of thevenin theorem to determine operating point
  - 5.3 Effect of temperature on the operating point of a transistor
  - 5.4 Concept of h-parameters of a transistor
  - 5.5 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 (7 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) (7 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 Construction, operation, characteristics and applications of a MOSFET in depletion enhancement mode
- 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  
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 zenor diode and finding its reverse breakdown voltage  
b) Fabrication of a zenor 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 wave shape of a full wave rectifier with (i) shunt capacitor (ii) series induction (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 of a single stage amplifier using CE configuration at different loads
11. To plot frequency response curve of a single stage transistor amplifier using semilog sheet and to measure its band width

12. To measure the voltage gain of a two-stage RC coupled amplifier (a) as individual stages (b) after coupling as multi-stage amplifier (c) to study effect of coupling capacitor on frequency response
13. To plot frequency response curve of a two stage RC coupled amplifier using semi-log sheet and measure the band width
14. To plot V-I characteristics of a FET

### **INSTRUCTIONAL STRATEGY**

This subject gives the knowledge of fundamental concepts of 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**

<b>Topic</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allocation (%)</b>
1	5	10
2	10	15
3	10	15
4	7	10
5	8	15
6	10	15
7	7	10
8	7	10
<b>Total</b>	<b>64</b>	<b>100</b>

### 3.4 FIRE PREVENTION

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#### RATIONALE

The purpose of Fire Prevention Legislations and Codes is not only to provide reasonable protection to life and property from hazards of fire and explosion associated with storages, use, processing or handling of hazardous materials but also set the requirements for installing, testing and maintaining fire suppression, fire detection and fire warning system. The Chief of fire department who is legally responsible for conducting inspection, preventing and correcting the code violations, issuing of fire license, issuing violation notices also conducts hearing and maintains records.

#### DETAILED CONTENTS

1. Fire Prevention/Protection and Inspection Procedure (12 hrs)  
  
Preparation of check list and follow up procedure and maintenance of mastered register. Fire preventive measures in different buildings, fixed fire fighting installation in different occupancy, inspection as per norms.
2. Building Construction and Structural Protection (20 hrs)  
  
Introduction, fire resistance of elements of structure, behaviour of element of structure in a fire and causes of wall collapse, criteria for assessing the fire properties of building material and element of structures, fire load and grading occupancy and fire load as per NBC occupational hazard and structural fire precautions including means of escape, fire protection in building.
3. Fire Hazards and Special Risk Area of Fire Protection (12 hrs)  
  
Town and other gases work, oil installation and tanks, cross country pipe lines of gas main. Industrial material and dangerous chemical, explosive magazines, oil storage, LPG gas storage, hazardous chemical storage, dangerous chemicals, places of high fire/life risks. Pressurized tunneling, oxygen enriched atmosphere .
4. Fixed Fire Fighting Installations (10 hrs)  
  
Introduction - purpose and principle of installations, type of installations – manual, automatic suppression and their use, care and maintenance used in India and regulations as per National Building Code. Codes of practice prepared by Bureau of Indian Standards(BIS).
5. Air-craft and Rescue (10 hrs)  
  
General introduction of Airport, Airport runways, ATC tower, hangers etc. Airport fire organizations, water resources, special appliances and equipment. Air-craft construction, types, general description, risks associated, crashes and fires, rescue and fire fighting techniques, ejection seat in air force air craft, fire prevention in air craft.

### LIST OF PRACTICALS

1. Arranging visits for demonstration, fire prevention arrangement for magazine oil storage and other highly hazardous places
2. Fixed Fire Fighting Installations: Operation and maintenance visit to multi-storey shopping mall, auditoriums, theaters, hotels, hospitals.
3. Visit to Airport/Aircraft Hangers

### INSTRUCTIONAL STRATEGY

This subject of fire prevention is most important in the fire service. The subject carries all information, Codes, Standards as well as code of practices prepared by ISI. Teacher is required to teach in details all codes, standards to the students as well as the importance of prevention 'Prevention is better than cure'. Teacher must take help of charts and CD while explaining fixed fire fighting installation.

### RECOMMENDED BOOKS

1. Elements of Fire Fighting and Fire Department Operations – IFSTA
2. Fire Prevention – Inspection and Code Enforcement by David Diamantes.

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	20
2	20	30
3	12	20
4	10	15
5	10	15
Total	64	100

### 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 holders. 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 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)
 

History of 'C', data types, input output statements, arithmetic and logical operations, data assignments, precedence and associativity

I/O statements  
Assignment, Variables, arithmetic operation- their precedence, data types standard I/O function, formulated I/O

Control Statements  
Logical and relational operators; if-else, while, do- while, for loops, breaks, switch statements

Functions:  
Function declaration, parameter passing- by value, storage classes (Local, Global and Static variables), standard library functions

Arrays:  
Single and multi dimensional arrays, character arrays

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

**Structures:**

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

**Strings:**

String processing, functions and standard library function

**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 and Electronics Engineering viz: MATLAB, Circuit Maker and Electronic Workbench

**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 SWITCH 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 array
17. Programming exercise on two dimensional array
18. Demonstration of application software related to Electrical and Electronics Engineering such as: MATLAB, ORCAD, Circuit Maker and Electronic Workbench.

## 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. In addition they must demonstrate various application software to students while explaining the capability of particular software.

## RECOMMENDED BOOKS

1. Programming in C by Schaum series McGraw Hill Education Pvt Ltd. New Delhi.
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, Uneek 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

Topic No.	Time Allotted (Hrs)	Marks Allotted(%)
1.	4	15
2.	24	70
3.	4	15
<b>Total</b>	<b>32</b>	<b>100</b>



### 3.6 PHYSICAL TRAINING AND DRILL - I

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Physical fitness is an essential part of “Fire Technology and Safety” curriculum. We may have all facilities, gadgets, equipment but without active involvement of humans, all these things are of no use. Emphasis has been laid on physical training and drill which will be essential for every student from 3<sup>rd</sup> semester onward. There will be one hour drill daily in the morning that too in the field and in proper dress. This, in turn, will develop physical strength, confidence, stamina, and courage to face the challenges of fire hazards.

In addition, fire fighting and field training will also be given which will include:

- Aims of squad drill
- Word of command
- Techniques of instruction
- Attention, stand-at-ease, line and file formation
- Right dress, turning to the left and right
- Quick and double march
- Halting, turning around and saluting
- Hose drill and hydrant drill

A special instructor will be engaged by the polytechnic who will impart the required drill and physical training.