COMPUTER ENGINEERING
(For Punjab State)

> # VARIOUS SUBJECTS
> # IN
> # SECOND YEAR

THIRD SEMESTER

3.1   DIGITAL ELECTRONICS
[Common in Computer Engg., I.T., ECE and Electronics (µP)]

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RATIONALE

This syllabus has been designed to make the students know about the fundamental principles of digital electronics and gain familiarity with the available IC chips. This subject aims to give a background in the broad field of digital systems design and microprocessors.

DETAILED CONTENTS

1.   Introduction   (02 hrs)

   a)   Distinction between analog and digital signal.
   b)   Applications and advantages of digital signals.

2.   Number System   (04 hrs)

   a)   Binary, octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa.
   b)   Binary addition, subtraction, multiplication and division including binary points. 1's and 2's complement method of addition/subtraction, sign magnitude method of representation, floating point representation

3.   Codes and Parity   (04 hrs)

   a)   Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code.

   b)   Concept of parity, single and double parity and error detection

   c)   Alpha numeric codes: ASCII and EBCDIC.

4.   Logic Gates and Families   (07 hrs)

   a)   Concept of negative and positive logic

   b)   Definition, symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates.
   (c) Logic family classification:

      - Definition of SSI, MSI, LSI, VLSI

      - TTL and C MOS families and their sub classification

      - Characteristics of TTL and C MOS digital gates. Delay, speed, noise margin, logic levels, power dissipation, fan-in, power supply requirement and comparison between TTL and C MOS families

5.   Logic Simplification   (06 hrs)

   a)   Postulates of Boolean algebra, De Morgan's Theorems. Various identities. Formulation of truth table and Boolean equation for simple problem. Implementation of Boolean (logic) equation with gates

   b)   Karnaugh map (upto 4 variables) and simple application in developing combinational logic circuits

6.   Arithmetic circuits   (06 hrs)

   a)   Half adder and Full adder circuit, design and implementation.
   b)   Half and Full subtracter circuit, design and implementation.
   c)   4 bit adder/subtracter.
   d)   Adder and Subtractor IC (7484)

7.   Decoders, Multiplexeres and De Multiplexeres   (06 hrs)

   a)   Four bit decoder circuits for 7 segment display and decoder/driver ICs.
   b)   Multiplexers and De-Multiplexers
   c)   Basic functions and block diagram of MUX and DEMUX. Different types and ICs

8.   Latches and flip flops   (06 hrs)

   a)   Concept and types of latch with their working and applications
   b)   Operation using waveforms and truth tables of RS, T, D, Master/Slave JK flip flops.
   c)   Difference between a latch and a flip flop
   d)   Flip flop ICs

9.   Counters   (8 hrs)

   a)   Introduction to Asynchronous and Synchronous counters
   b)   Binary counters
   c)   Divide by N ripple counters, Decade counter.
   d)   Pre settable and programmable counters
   e)   Up/down counter
   f)   Ring counter with timing diagram
   g)   Counter ICs

10.   Shift Register   (07 hrs)

   Introduction and basic concepts including shift left and shift right.

   a)   Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.
   b)   Universal shift register
   c)   Buffer register, Tristate Buffer register
   d)   IC 7495

11.	A/D and D/A Converters	(08 hrs)

 a)	Working principle of A/D and D/A converters
 b)	Brief idea about different techniques A/D conversion and study of :
  - Stair step Ramp A/D converter
  - Dual Slope A/D converter
  - Successive Approximation A/D Converter

 c)	Detail study of :
  - Binary Weighted D/A converter
  - R/2R ladder D/A converter
 d)	Performance characteristics of A/D and D/A converter.
 e)	Applications of A/D and D/A converter.

LIST OF PRACTICALS

1.	Verification and interpretation of truth tables for AND, OR, NOT NAND, NOR and Exclusive OR (EXOR) and Exclusive NOR(EXNOR) gates

2.	-	Realisation of logic functions with the help of NAND or NOR gates

	-	Design of a NOR gate latch and verification of its operation

3.	To design a half adder using XOR and NAND gates and verification of its operation
	Construction of a full adder circuit using XOR and NAND gates and verify its operation

4.	4 bit adder, 2's complement subtractor circuit using an 4 bit adder IC and an XOR IC and
	verify the operation of the circuit.

5.	To design a NOR Gate Latch and verification of its operation

6	Verification of truth table for positive edge triggered, negative edge triggered, level triggered IC flip-flops (At least one IC each of D latch , D flip-flop, JK flip-flops).

7.	Verification of truth table for encoder and decoder ICs, Mux and DeMux

8.	To design a 4 bit SISO, SIPO, PISO, PIPO shift registers using JK/D flip flops and verification of their operation.

9.	To design a 4 bit ring counter and verify its operation.

10.	Asynchronous Counter ICs

	Verification of truth table for any one universal shift register IC

	Use of IC 7490 or equivalent TTL (a) divide by 2 (b) divide by 10 Counter
	OR
	Use of IC 7493 or equivalent TTL (a) divide by 2 (b) divide by 8 (c) divide by 16 counter

Note: Above experiments may preferably be done on Bread Boards.

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), A/D, D/A Converters and other topics. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. Programming exercises other than the tested in circulation may be given to the students.

RECOMMENDED BOOKS

1. Digital Electronics and Applications by Malvino Leach, Tata McGraw Hill Education Pvt Ltd, New Delhi

2. Digital Logic Designs by Morris Mano, Prentice Hall of India, New Delhi

3. Digital Electronics by Soumitra Kumar Mandal, Tata McGraw Hill Education Pvt Ltd,

4. Digital Electronics by V K Sangar , Raj Publishers, Jalandhar

5. Digital Electronics by Tokheim, Tata McGraw Hill Education Pvt Ltd,

6. Digital Fundamentals by Thomas Floyds, Universal Book Stall

7. Digital Electronics by RP Jain, Tata McGraw Hill Education Pvt Ltd, New Delhi

8. Digital Electronics by KS Jamwal, Dhanpat Rai and Co., New Delhi

9. Digital Electronics by Rajiv Sapra, Ishan Publication, Ambala

10. Digital Electronics by BR Gupta, Dhanpat Rai & Co., New Delhi

11. Digital Systems: Principles and Applications by RJ Tocci, Prentice Hall of India, New Delhi

12. Digital Electronics by Rajaraman V., Prentice Hall of India, New Delhi

13. Fundamentals of Digital Electronics by Naresh Gupta, Jain Brothers, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1.	Introduction	2	5
2.	Number System	4	5
3.	Codes and Parity	4	5
4.	Logic Gates and Families	7	15
5.	Logic Simplification	6	10
6.	Arithmetic Circuits	6	10
7.	Decoders, Multiplexers and Demultiplexers	6	10
8.	Latches and Flip flops	6	10
9	Counters	8	10
10.	Shift Registers	7	10
11.	A/D and D/A Converter	8	10
	Total	**64**	**100**

3.2   COMPUTER PROGRAMMING USING 'C'
(Common in Computer Engineering and Information Technology)

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RATIONALE

Computers play a vital role in present day life, more so, in the professional life of technician engineers. People working in the field of computer industry, use computers in solving problems more easily and effectively. In order to enable the students use the computers effectively in problem solving, this course offers the modern programming language C along with exposition to various applications of computers. The knowledge of C language will be reinforced by the practical exercises.

DETAILED CONTENTS

1. Algorithm and Programming Development   (06 Hrs)

    Steps in development of a program, Flow charts, Algorithm development, Program Debugging

2. Program Structure   (06 Hrs)

    I/o statements, assign statements. Constants, variables and data types, Operators and Expressions, Standards and Formatted, Use of Header & Library files

3. Control Structures   (10 Hrs)

    Introduction, Decision making with IF – statement, IF – Else and Nested IF, While and do-while, for loop, Break and switch statements

4. Functions   (08 Hrs)

    Introduction to functions, Global and Local Variables, Function Declaration, Standard functions, Parameters and Parameter Passing, Call – by value/reference, Recursion

5. Arrays   (06 Hrs)

    Introduction to Arrays, Array Declaration and Initialization, Single and Multidimensional Array. Arrays of characters

6. Pointers   (08 Hrs)

    Introduction to Pointers, Address operator and pointers, Declaring and Initializing pointers, Assignment through pointers, Pointers and Arrays

7. Structures and Unions   (08 Hrs)

    Declaration of structures, Accessing structure members, Structure Initialization, Arrays of structures, Unions

8.   Strings   (06 Hrs)

Introduction, Declaring and Initializing string variables, Reading and writing strings, String handling functions, Array of strings

9.   Files   (06 Hrs)

Introduction, File reading/writing in different modes, File manipulation using standard function types

LIST OF PRACTICALS

1. Programming exercises on executing and editing a C program.
2. Programming exercises on defining variables and assigning values to variables.
3. Programming exercises on arithmetic and relational operators.
4. Programming exercises on arithmetic expressions and their evaluation
5. Programming exercises on formatting input/output using printf and scanf
6. Programming exercises using if statement.
7. Programming exercises using if – Else.
8. Programming exercises on switch statement.
9. Programming exercises on do – while statements.
10. Programming exercises on for – statement.
11. Programs on one-dimensional array.
12. Programs on two-dimensional array.
13. (i)   Programs for putting two strings together.
    (ii)   Programs for comparing two strings.
14. Simple programs using structures.
15. Simple programs using pointers.
16. Simple programs for reading from a file and writing into a file.

INSTRUCTIONAL STRATEGY

The subject is totally practical based. Students should be given clear idea about the basic concepts of programming. In practical session student should be asked to draw flow chart write algorithm and then write program for the algorithm and run on computer. It is required that students should maintain records (files with printouts).

RECOMMENDED BOOKS

1. Programming in ANSI C by E Balaguruswami, , Tata McGraw Hill Education Pvt Ltd , New Delhi
2. Application Programming in C by RS Salaria, Khanna Book Publishing Co(P) Ltd. New Delhi
3. Programming in C by Gottfried, Schaum Series, , Tata McGraw Hill Education Pvt Ltd , New Delhi
4. Exploring C by Yashwant Kanetkar – BPB Publications, New Delhi
5. Programming in C by Stefin G. Coachin
6. Programming in C by R Subburaj, Vikas Publishing House Pvt. Ltd., Jangpura, New Delhi
7. Elements of C by M.H. Lewin, Khanna Publishers, New Delhi
8. Programming in C by Stephen G Kochan
9. Programming in C by BP Mahapatra, Khanna Publishers, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted (%)
1	Algorithm and Programming Development	6	10
2	Program Structure	6	10
3	Control Structure	10	15
4	Functions	8	10
5	Arrays	6	10
6	pointers	8	15
7	Structures and Unions	8	10
8	Strings	6	10
9	Files	6	10
	Total	**64**	**100**

3.3   SYSTEM ANALYSIS AND DESIGN
(Common in Computer Engineering and Information Technology)

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RATIONALE

The system analysis and design is backbone of Application software development. After studying the subject the students will be able to develop and design the system according to given requirements. It involves various steps in analysis and design of the system. It includes the knowledge of preparing a project systematically. It is important to know about various aspects of system analysis and design so that the students will be able to understand the responsibilities while designing and implementing the project.

DETAILED CONTENTS

1.   Introduction   (04 hrs)

Concept of system. Types of systems, Open and Closed, Static and Dynamic with examples

2.   Overview of System Analysis and Design   (08 hrs)

Systems Development life cycle, brief Introduction to feasibility, design implementation and testing and maintenance

3.   Preliminary Investigations   (08 hrs)

Project selection, scope definition and preliminary investigation

4.   Feasibility Study   (08 hrs)

Technical and economic and operational feasibility, cost and benefit analysis

5.   Requirement Specifications and Analysis   (08 hrs)

Fact finding techniques, data flow diagrams, data dictionaries, decision trees and tables.

6.   Detailed Design   (05 hrs)

Module specification, file design, data base design

7.   Testing and Quality Assurance   (07 hrs)

Maintenance, unit and integration testing techniques, design objectives, quality factors such as reliability etc.

INSTRUCTIONAL STRATEGY

The system analysis and design is a theoretical subject, so after completing the syllabus of system analysis and design the teacher will ask group of students to select a small project. The students will apply system analysis and design in preparation of the project.

RECOMMENDED BOOKS

1) Structured System Analysis and Design by ISRD Group, Tata McGraw Hill Education Pvt Ltd, New Delhi
2) System Analysis and Design by Awad, Galgotia Publications, New Delhi
3) System Analysis and Design Vol. I & II by Lee, Galgotia Publications
4) System Analysis and Design with Case Tools by Len Fertuck WCB Publications 1992
5) Introducing System Analysis by Skidmore, BPB Publication, New Delhi
6) Introducing System Design by Skidmore, BPB Publication, New Delhi
7) System Analysis and Design by Jefery L Whitten, Tata McGraw Hill Education Pvt Ltd, New Delhi
8) System Analysis and Design by Perry Edward
9) Analysis and design of Information System by V Rajaraman, Prentice Hall of India, New Delhi
10) Practical System Design by Daniels, Galgotia Publications, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted (%)
1	Introduction	04	10
2	Overview of System Analysis and Design	08	15
3	Preliminary Investigations	08	15
4	Feasibility Study	08	15
5	Requirement Specifications and Analysis	08	15
6	Detailed Design	05	15
7	Testing and Quality Assurance	07	15
	Total	**64**	**100**

3.4 RELATIONAL DATABASE MANAGEMENT SYSTEM (RDBMS)
(Common in Computer Engineering and Information Technology)

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RATIONALE

Database and database systems have become an essential component of everyday life in modern society. This course will acquaint the students with the knowledge of fundamental concepts of DBMS and its application in different areas, storage, manipulation and retrieval of data using query languages. Oracle/My SQL/SQL Server can be use as package to explain concepts.

DETAILED CONTENTS

1.   Introduction   (06 hrs)

Database Systems; Database and its purpose, Characteristics of the database approach, Advantages and disadvantages of database systems. Classification of DBMS Users; Actors on the scene, Database Administrators, Database Designers, End Users, System Analysts and Application Programmers, Workers behind the scene (DBMS system designers and implementers, tool developers, operator and maintenance   personnel)

2.   Database System Concepts and Architecture   (06 hrs)

Data models, schemas, instances, data base state. DBMS Architecture; The External level, The conceptual level, The internal level, Mappings. Data Independence; Logical data Independence, Physical data Independence. Database Languages and Interfaces; DBMS Language, DBMS Interfaces. Classification of Database Management Systems

3.   Data Modeling using E.R. Model (Entity Relationship Model)   (10 hrs)

Data Models Classification; File based or primitive models, traditional data models, semantic data models. Entities and Attributes, Entity types and Entity sets, Key attribute and domain of attributes, Relationship among entities

4.   Relational Model: (06 hrs)

Relational Model Concepts: Domain, Attributes, Tuples and Relations. Relational constraints and relational database schemes; Domain constraints, Key constraints and constraints on Null. Relational databases and relational database schemes, Entity integrity, referential integrity and foreign key

5.   Normalization

(06 hrs)

Non-loss decomposition and functional dependencies, First, Second and Third normal forms, Boyce/Codd normal form

6.   Database Access and Security   (06 hrs)

Database security, process controls, database protection, 2-phase command protocols, 2-phase working protocols, grant and revoke

7.   MYSQL/SQL (Structured Query Language)   (16 hrs)

SQL * Plus. DDL (Data Definition Languages): Creating Tables, Creating a table with data from another table, Inserting values into a table, updating columns of aTable, Deleting Rows, Dropping a Table. DML (Data Manipulation Language): Database Security and Privileges, Grant and Revoke Command, Maintaing Database Objects, Commit and Rollback, various types of select commands, various types of join.

8.   PL/SQL: (08 hrs)

Introduction to PL/SQL, Advantage of PL/SQL, PL/SQL Block Structure, PL/SQL Architecture, Fundamentals of PL/SQL, PL/SQL Data types, Variables and constants, scope of variables, Assignment & expression, operators, operator precedence.

LIST OF PRACTICALS FOR RDBMS USING ORACLE:-

1.   Exercises on creation and modification of structure of tables.
2.   Exercises on inserting and deleting values from tables.
3.   Exercises on quering the table (using select command).
4.   Exercises on using various types of joins.
5.   Exercises on using functions provided by database package.
6.   Exercises on commands like Grant, Revoke, Commit and Rollback etc.
7.   Introductory exercises on PL/SQL.
8.   Design of database for any application using oracle.

INSTRUCTIONAL STRATEGY

Explanation of concepts using real time examples, diagrams etc. For practical sessions books along with CDs or learning materials with specified activities are required. Various exercises and small applications should be given along with theoretical explanation of concepts.

RECOMMENDED BOOKS

1)   Fundamentals of Database Management Systems by Dr Renu Vig and Ekta Walia, - an ISTE, Publication, New Delhi
2)   Database Management Systems by arun K Majumdar and P Bhattacharya, Tata McGraw Hill Education Pvt Ltd, New Delhi
3)   Introduction to DBMS by by ISRD Group, Tata McGraw Hill Education Pvt Ltd, New Delhi
4)   Database Management Systems by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd., New Delhi
5)   An introduction to database systems by Date C.J. Adison Wesley
6)   Fundamentals of Database Systems by Elmasri/Navathe/Adison Wesley

7) An Introduction to Database Systems by Bipin C. Desai, Galgotia Publications Pvt. Ltd., Daryaganj, New Delhi 110 002

8) SQL Unleashed by Hans Ladanyi Techmedia Publications, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted (%)
1	Introduction	06	08
2	Database System Concepts and Architecture	06	12
3	Data Modeling using E.R. Model (Entity Relationship Model)	10	14
4	Relational Model:	06	12
5	Normalisation	06	12
6	Database Access and Security	06	12
7	MYSQL (Structured Query Language)	16	20
8	PL/SQL	08	10
	Total	**64**	**100**

3.5 MULTIMEDIA AND APPLICATIONS
(Common in Computer Engineering and Information Technology)

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RATIONALE

Multimedia is being widely used in web pages, motion pictures and interactive presentations, animation etc. Multimedia has made a significant impact in training/education, business presentations, public information access etc. This course intends to introduce and expose multimedia technology and various factors and features of authoring software. It will also help in making the internet application richer in content and presentation.

DETAILED CONTENTS

1. Introduction   (05 hrs)

    Introduction to multimedia, hypertext, hypergraphics, animation, application in education and training, science and technology, kiosks, business and games

2. Multimedia Hardware   (08 hrs)

    Multimedia PC configuration, features and specifications of sound and video interfaces, OCR, touch-screen, scanners, digital cameras, speakers, printers, plotters, optical disks and drives as CDROM and DVD. multimedia networks

3. Multimedia Software   (12 hrs)

    Image and sound file formats, multimedia file formats, compression, standards and techniques, features of software to read and write such files. Video file formats & compression standards, multimedia operating systems

4. Using Image Processing Tools   (10 hrs)

    Photo-shop workshop, image editing tools, specifying and adjusting colors, using gradient tools, selection and move tools, transforming path drawing and editing tools, using channels, layers, filters and actions

5. Multimedia Authoring Tools   (13 hrs)

    Types of Authoring programmes – Icon based, Time based, Story boarding/scripting and object oriented working in macromedia flash, exploring interface using selection pf PEN tools. Working with drawing and painting tools, applying colour viewing and manipulating time line, animating, processing, guiding layers, importing and editing sound and video clips in flash

LIST OF PRACTICALS

1.   Installation of various multimedia software like Photoshop, Flash, Director or any open source software
2.   Installing and use of various multimedia devices

        -       Scanner

        -       Digital camera, web camera

        -       Mike and speakers

        -       Touch screen

        -       Plotter and printers

        -       DVD

        -       Audio CD and Video CD

3.   Reading and writing of different format on CD/DVD

4.   Transporting audio and video files

5.   Using various features of Flash

6.   Using various features of Photo-shop

7.   Making multimedia presentations combining, Flash, Photo-shop, such as department profile, lesson presentation, games and project presentations

INSTRUCTIONAL STRATEGY

As the subject is practice oriented, more stress should be given to students to do the work practically. The features of software packages Photo-shop, Flash are to be demonstrated in class using LCD projector.

RECOMMENDED BOOKS

1.   Principles of Multimedia by Parikh, Tata McGraw Hill Education Pvt Ltd , New Delhi

2.   Multimedia Technologies by Banerji,Tata McGraw Hill Education Pvt Ltd , New Delhi

3.   Multimedia An Introduction by Villam Casanova and Molina; Prentice Hall of India, New Delhi

4.   Multimedia Bible by Win Rosch

5.   Multimedia Making it work by Vaughan, Tay

6.   Photo-shop for Windows Bible by Deke Maclelland IDG Books India Pvt. Ltd., New Delhi

7.   Multimedia Technology and Application by Hillman, Galgotia Publications, New Delhi

8.   Flash 5 Bible by Rein Hardit, IDG Books India Pvt. Ltd.

9.   Flash 5 in easy steps by Vandome IDG Books India Pvt. Ltd.

10.   Fundamentals of Multimedia by Li and Drew, Pearson Publications

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted (%)
1	Introduction	05	15
2	Multimedia Hardware	08	15
3	Multimedia Software	12	20
4	Using Image Processing Tools	10	20
5	Multimedia Authoring Tools	13	30
	Total	**48**	**100**

3.6   COMPUTER WORKSHOP
(Common in Computer Engineering and Information Technology)

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RATIONALE

The course aims at making the students familiar with various parts of computers and how to assemble them, and different types of peripherals desired. In addition, the course will provide the students with necessary knowledge and skills in computer software installation and maintenance to make him diagnose software faults.

DETAILED CONTENTS

Part-A(Hardware)

1.   Familiarization with various components and parts of personal computers, mother board details, hard disk drive, floppy disk drive. CD Rom drive, DVD, keyboard, display devices, various chips (memory chips and CPU); serial and parallel ports, inkjet, USB Ports, Fire wire, Bluetooth, Dot matrix and Laser printers, Modems, connectors and cables

2.   Assembly and Dissembling of PCs : Power supply, linear power supply and switch mode   power supply, trouble shooting of SMPS.

3.   Setting up of basic infrastructure for computers (including power layout, air conditioning, earthing etc.

Part-B(Software)

4.   Installation of various operating systems, LINUX/ windows latest versions. Familiarization of their features with practical demonstrations. Installation and configuration of device drivers. Disk management

5.   Installation of latest version of application software like MS-Office/open office, Adobe Photoshop, Corel Draw, Macromedia Flash etc.

6.   Installation and configuration of latest version of database software like Oracle, MySQL/ SQL Server etc.

7.   Introduction to Virus/Spyware/Worm/Trojan Horse , their detection, prevention and cure.

8.   Installation, uninstallation and use of Antivirus software.

9.   Visit to computer manufacturing industry

INSTRUCTIONAL STRATEGY

As the subject is practice oriented, sufficient exercises on assembling and dissembling of computer system should be given.. Field visits to the places where assembly of computers is taking place will be helpful to the students. Visits to the manufacturing units of CVT or UPS will also be helpful to the students.

RECOMMENDED BOOKS

1)   PC Upgrade and Maintenance Guide by Mark Minasi, BPB Publication
2)   Hardware Bible by Winn Rosch, Techmedia Publications
3)   IBM PC and Clones by B Govinda Rajalu. Tata McGraw Hill Education Pvt Ltd , New Delhi
4)   Electronic Instrumentation and Measurement Techniques by WD Cooper and Adhelfrics. Prentice Hall of India, New Delhi
5)   Common Computer Circuits and Faults Vol. 1 by M. Lotia, BPB Publications, New Delhi
6)   Monitor and Fault Diagnosis Vol. 1 and II. M. Lotia, BPB Publications, New Delhi
7)   Unix System Administration by Unleashed. Tech. Media Publications, New Delhi
8)   Understanding Unix Tech Media Publications, New Delhi
9)   Linux Unleashed Tech Media Publications, New Delhi
10)   Unix Configuration and Installation DPB Publications, New Delhi
11)   Teach Yourself Unix BPB Publications, New Delhi
12)   Study Guide Windows Server and Workstation 4 Tech Media Publications, New Delhi
13)   Complete Guide to Window and Workstation by Peter Norton. Tech Media Publications, New Delhi
14)   Complete Guide to Windows by Peter Norton. Tech. Media Publications, New Delhi
16)   Training Guide for Windows by MCSE, Tech Media Publications, New Delhi