Faculty of Engineering

Syllabus

S.E. (Information Technology) 2015 Course

(With effect from Academic Year 2016 - 17)

SAVITRIBAI PHULE PUNE UNIVERSITY

THE SYLLABUS IS PREPARED BY:

B.O.S. in Information Technology, SavitribaiPhule Pune University

PROGRAM EDUCATIONAL OBJECTIVES

The students of Information Technology course after passing out will

1. Possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges.
2. Possess knowledge and skills in the field of Computer Science and Information Technology for analyzing, designing and implementing complex engineering problems of any domain with innovative approaches.
3. Possess an attitude and aptitude for research, entrepreneurship and higher studies in the field of Computer Science and Information Technology.
4. Have commitment to ethical practices, societal contributions through communities and life-long learning.
5. Possess better communication, presentation, time management and team work skills leading to responsible & competent professionals and will be able to address challenges in the field of IT at global level.

PROGRAM OUTCOMES

The students in the Information Technology course will attain:

1. an ability to apply knowledge of mathematics, computing, science, engineering and technology;

2. an ability to define a problem and provide a systematic solution with the help of conducting experiments, analyzing the problem and interpreting the data;

3. an ability to design, implement, and evaluate a software or a software/hardware system, component, or process to meet desired needs within realistic constraints;

4. an ability to identify, formulate, and provide systematic solutions to complex engineering/Technology problems;

5. an ability to use the techniques, skills, and modern engineering technology tools, standard processes necessary for practice as a IT professional;

6. an ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems with necessary constraints and assumptions;

7. an ability to analyze and provide solution for the local and global impact of information technology on individuals, organizations and society;

8. an ability to understand professional, ethical, legal, security and social issues and responsibilities;

9. an ability to function effectively as an individual or as a team member to accomplish a desired goal(s);

10. an ability to engage in life-long learning and continuing professional development to cope up with fast changes in the technologies/tools with the help of electives, professional organizations and extra-curricular activities;

11. an ability to communicate effectively in engineering community at large by means of effective presentations, report writing, paper publications, demonstrations;

12. an ability to understand engineering, management, financial aspects, performance, optimizations and time complexity necessary for professional practice;

13. an ability to apply design and development principles in the construction of software systems of varying complexity.

S.E. (Information Technology) 2015 Course to be implemented from June 2016

SEMESTER – I

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits
		Lecture	Tutorial	Practical	Theory Paper	Theory Online	TW	PR	OR		
214441	Discrete Structures	4	--	--	50	50	--	--	--	100	4
214442	Computer Organization & Architecture	4	--	--	50	50				100	4
214443	Digital Electronics and Logic Design	4	--	--	50	50	--	--	--	100	4
214444	Fundamentals of Data Structures	4	--	--	50	50	--	--	--	100	4
214445	Problem Solving and Object Oriented programming	4	--	--	50	50	--	--	--	100	4
214446	Digital Laboratory	--	--	2	--	--	25	50	--	75	1
214447	Programming Laboratory	--	--	4	--	--	25	50	--	75	2
214448	Object Oriented programming Lab.	--	--	2	--	--	25	50		75	1
214449	Communication Skills	--	--	2	--		25	--	--	25	1
	Audit Course	--	--	--	--	--	--	--	--	Grade	
	Total	**20**	**--**	**10**	**250**	**250**	**100**	**150**	**--**	**750**	**25**
	Total of Part-I	**30 Hours**			**750**						

SEMESTER – II

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits
		Lecture	Tutorial	Practical	Theory Paper	Theory Online	TW	PR	OR		
207003	Engineering Mathematics -III	4	1	--	50	50	25	--	--	125	5
214450	Computer Graphics	3	-	--	50	50	--	--	--	100	3
214451	Processor Architecture and Interfacing	4	-	-	50	50	--	--	--	100	4
214452	Data Structures & Files	4	-	-	50	50	--	--	--	100	4
214453	Foundations of Communication and Computer Network	4	-	-	50	50	--	--	--	100	4
214454	Processor Interfacing Laboratory	--	--	4	--	--	25	50	--	75	2
214455	Data Structure and Files Laboratory	--	--	4	--	--	25	50	--	75	2
214456	Computer Graphics Laboratory	--	--	2	--	--	25	50	--	75	1
	Audit Course	--	--	--	--	--	--	--	--	Grade	
	Total	**19**	**01**	**10**	**250**	**250**	**100**	**150**	**--**	**750**	**25**
	Total of Part-II	**30 Hours**			**750**						

TW: Term Work   **PR: Practical**   **OR: Oral**

SEMESTER - I

214441 : DISCRETE STRUCTURES

Teaching Scheme:	**Credit**	**Examination Scheme:**
Lectures: 4 Hours/Week	04	In-Semester (Online): 50 Marks
		End-Semester: 50 Marks

Prerequisites: Basic Mathematics

Course Objectives :
1. Learn the use of set, proof techniques and determine logical possibilities in a given situation.
2. Learn relations, functions among various entities in real world.
3. Learn to apply relations and functions in real life.
4. Learn to formulate problem mathematically using graph theory and trees.

Course Outcomes :
By the end of the course, students should be able to
1. Use set, relation and function to formulate a problem and solve it
2. Use graph theory and trees to formulate the problems and solve them
3. Use mathematical propositions and proof techniques to check the truthfulness of a real life situation.

Course Contents

UNIT - I   PERMUTATIONA, COMBINATIONS & DISCRETE PROBABILITY   6 Hours
Permutations and Combinations: rule of sum and product, Permutations, Combinations, Algorithms for generation of Permutations and Combinations. Discrete Probability, Conditional Probability, Bayes' Theorem, Information and Mutual Information.

UNIT - II   SETS AND PROPOSITIONS   6 Hours
Sets, Combinations of sets, Venn Diagrams, Finite and Infinite sets, Uncountable infinite sets, Principle of inclusion and exclusion, multisets. Propositions, Conditional Propositions, Logical Connectivity, Propositional calculus, Universal and Existential Quantifiers, Normal forms, methods of proofs, Mathematical Induction

UNIT - III   RELATIONS AND FUNCTIONS   6 Hours
Properties of Binary Relations, Closure of relations, Warshall's algorithm, Equivalence Relations and partitions, Partial ordering relations and lattices, Chains and Anti chains.
Recurrence Relations
Recurrence Relation, Linear Recurrence Relations With constant Coefficients, Homogeneous Solutions, Total solutions, solutions by the method of generating functions
Functions
Functions, Composition of functions, Invertible functions, Pigeonhole Principle, Discrete Numeric functions and Generating functions, Job scheduling Problem.

UNIT IV   GRAPH THEORY   6 Hours
Basic terminology, representation of graph in computer memory, multi graphs and weighted graphs, Subgraph, Isomorphic graph, Complete, regular and bipartite graphs, operation on graph, paths and circuits, Hamiltonian and Euler paths and circuits, shortest path in weighted graph(Dijkstra's algorithm), factors of a graph, planer graph and Travelling salesman problem, Graph coloring.

UNIT - V   TREES   6 Hours
Trees, rooted trees, path length in rooted trees, prefix codes and optimal prefix codes, binary search trees, tree traversals, spanning trees, Fundamental circuits and cut set, minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree, The Max flow –Min cut theorem (transport network).

UNIT – VI   GROUPS AND RINGS   6 Hours
Algebraic Systems, Groups, Semi Groups, Monoid, Subgroups, Permutation Groups, Codes and Group codes, Isomorphism and Automorphisms, Homomorphism and Normal Subgroups, Ring, Integral Domain, Field, Ring Homomorphism, Polynomial Rings and Cyclic Codes

Text Books
1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7[th]edition, McGraw-Hill, ISBN0-07-289905-0
2. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", 4th Edition, McGraw-Hill

Reference Books
1. N. Biggs,"Discrete Mathematics", 2nd Edition, Oxford University Press
2. Singh, "Discrete Mathematical Structures", Wiley, ISBN-9788126527908
3. Eric Gossett, "Discrete Mathematics with Proof", Wiley, 2nd Edition, ISBN-9788126527588
4. Edgar G. Goodaire, Michael M. Parmenter, Discrete Mathematics with Graph Theory, Pearson Education, 3[rd]Edition, ISBN-13: 978-0131679955
5. Richard Johnsonbaugh, "Discrete Mathematics" 7th Edition, Person Education, ISBN : 9332535183

214442 : COMPUTER ORGANIZATION &ARCHITECTURE

Teaching Scheme: **Credits**   **Examination Scheme:**
Lectures: 4 Hours/Week   04   In-Semester (Online): 50 Marks
                                                           End-Semester: 50 Marks

Prerequisites : Fundamental of Programming Languages

Course Objectives :
1. To understand the structure, function & characteristics of computer systems.
2. To understand the design of the various functional units of digital computers.
3. To understand instruction level parallelism & parallel organization of multi-processor & multi core systems

Course Outcomes :
On completion of the course, learner will be able to–
1. Solve problems based on computer arithmetic.
2. Explain processor structure & its functions.
3. Obtain knowledge about micro-programming of a processor.
4. Understand concepts related to memory & IO organization.
5. Acquire knowledge about instruction level parallelism & parallel organization of multi-processors & multi core systems.

Course Contents

UNIT – I   COMPUTER EVOLUTION, PERFORMANCE MEASUREMENT & ARITHMETIC   8 Hours
A Brief History of Computers, Von Neumann Architecture, Harvard Architecture.
Computer Performance Measurement – Benchmarks (SPEC) for Evaluation, Metrics such as CPU Time, Throughput, etc., Aspects & Factors affecting Computer Performance, Comparing Computer Performances, Marketing Metrics – MIPS & MFLOPS, Speedup & Amdahl's Law
Booths Algorithm For Signed Multiplication & it's Hardware Implementation, Restoring And Non Restoring Division Algorithms & it's Hardware Implementation

UNIT – II   THE CENTRAL PROCESSING UNIT   8 Hours
Arithmetic & Logic Unit.
Instruction Sets: - Machine Instruction Characteristics, Types of Operands and Types of Operations, Addressing Modes, Instruction Formats, Instruction Types
Processor Structure and Function - Processor Organization, Register Organization, The Instruction Cycle and Instruction Pipelining.
RISC: Instruction Execution Characteristics, RISC Vs CISC, RISC Architecture - MIPS.

UNIT – III   THE CONTROL UNIT   8 Hours
Instruction Cycle & Micro Operations, Functional Requirements & Operations of the Control Unit, Block Schematic & Control Signals, Single Bus Processor Organization, Control Signal example with Micro Operations and Register Transfer.
Control Unit Design Methods - Hardwired Control – State Table Method, Design example - Multiplier CU.
Micro-Programmed Control - Basic Concepts, Microinstructions & Formats, Control Memory, Micro-

Programmed Control Unit Schematic, Microinstruction Sequencing - Design Considerations, Sequencing Techniques, Address Generation, Microinstruction Execution - A Taxonomy of Microinstructions, Microinstruction Encoding.

UNIT – IV   Memory & I/O Organization   8 Hours
Characteristics of Memory Systems, Internal and External Memory Types.

Memory Hierarchy, Principle Of Locality, Cache Memory – Basics, Performance Metrics & Improvements, Organization and Mapping Techniques, Handling Cache Misses & Writes, Replacement Algorithms, Multilevel Caches, Cache Coherence, Snooping & MESI Protocols, Memory Segmentation & Interleaved Memory System.

Virtual Memory: Main Memory Allocation, Virtual to Physical Address Translation, Paging, Page Placement & Location, Page Faults, TLB in Address Translation, Handling TLB Misses & Page Faults.

Input / Output Systems, Programmed I/O, Interrupt Driven I/O, Direct Memory Access (DMA).

UNIT – V   Instruction level Parallelism   8 Hours
MIPS Implementation Overview, Digital Logic for MIPS Implementation, Single Data path for MIPS Architecture, Simple MIPS Implementation with Control Signals.

Overview of Instruction Pipelining, Performance Improvement, MIPS Instruction Set for Pipelining, Pipeline Hazards: Structural, Data – Forwarding & Code Reordering, Control – Branch Prediction, 5 Stage Pipeline with Data path & Control for MIPS Architecture, Graphical Representation of Pipelines, Data Hazards – Forwarding & Stalling for MIPS Pipeline, Control Hazards – Dynamic Branch Prediction & Delayed Branch for MIPS Pipeline. Superscalar Processors.

UNIT - VI   Parallel Organization   8 Hours
Parallel Organization – Multiprocessors, Multicores & Clusters. Flynn's Taxonomy for Multiple Processor Organizations, Closely and Loosely Coupled Multiprocessors Systems, Symmetric Multiprocessor (SMP) Organization, Multithreading – Fine Grained, Coarse Grained & Simultaneous (SMT) Threading, Chip Multiprocessing, Cluster Configuration, UMA, NUMA & CC-NUMA.

Multicore Architectures – Hardware & Software Issues in Multicore Organization, Multicore Organizations, Intel X86 Multicore Organizations – Core Duo & Core i7.

Text Books

1. W. Stallings, "Computer Organization and Architecture: Designing for Performance", 8th Edition, Prentice Hall of India, 2010, ISBN 13: 978-0-13-607373-4
2. D. Patterson, J. Hennessy, "Computer Organization and Design: The Hardware Software Interface", 4th Edition, Morgan Kaufmann, Oct 2013, ISBN 978-0-12-374750-1

Reference Books

1. C. Hamacher, V. Zvonko, S. Zaky, "Computer Organization", 5th edition, McGraw Hill, 2002, ISBN: 007-120411-3
2. M. Usha, T. S. Srikanth, Computer System Architecture and Organization", Wiley, 2014, ISBN: 978-81-265-2284-2
3. A. S. Tanenbaum "Structured Computer Organization", 4th Edition, Prentice Hall of India, 1991 ISBN: 81–203–1553–7.
4. G. George, "Computer Organization: Hardware and Software", 2nd Edition, Prentice Hall of India, 1986.
5. J. Hays, "Computer Architecture and Organization", 2nd Edition, McGraw-Hill, 1988 ISBN 0–07–100479–3

214443 : DIGITAL ELECTRONICS AND LOGIC DESIGN

Teaching Scheme: **Credits**   **Examination Scheme:**
Lectures: 4 Hours/Week   04   In-Semester (Online): 50 Marks
                                                                              End-Semester: 50 Marks

Prerequisites : Basic Electronics Engineering

Course Objectives :
1. To learn and understand basic digital design techniques.
2. To develop design and implementation skills of combinational and sequentiallogic circuits.
3. To introduce digital logic design software such as VHDL Programming.

Course Outcomes :
1. Spectacle an awareness and apply knowledge of number systems, codes, Boolean algebra and use necessary A.C, D.C Loading characteristics as well as functioning while designing with logic gates.
2. Use logic function representation for simplification with K-Maps and analyze as well as design Combinational logic circuits using SSI & MSI chips.
3. Analyze Sequential circuits like Flip-Flops (Truth Table, Excitation table), their conversion & design the applications.
4. Identify the Digital Circuits, Input/Outputs to replace by FPGA
5. Use VHDL programming technique with different modeling styles for any digital circuits.

Course Contents

UNIT – I   NUMBER SYSTEM AND LOGIC FAMILIES   8 Hours
Introduction to digital electronics & Boolean algebra.
Number Systems - Binary, Octal, Hexadecimal and their conversions.
Signed Binary number representation and Arithmetic's: Signed & True Magnitude, 1's complement, 2's complement representation and arithmetic's.
Codes: BCD, Excess-3, Gray code, Binary Code and their conversion.
Switching characteristics of BJT & FET, IC Characteristics.
TTL: Standard TTL characteristics, Operation of TTL NAND gate, Subfamilies, Configurations-Active pull-up, Wired AND, totem pole, open collector.
CMOS: Standard CMOS characteristics, operation of CMOS NAND, Subfamilies, CMOS configurations Wired Logic, Open drain outputs.
Comparison of TTL & CMOS, Interfacing: TTL to CMOS and CMOS to TTL

UNIT – II   COMBINATIONAL LOGIC DESIGN   8 Hours
Logic minimization: Representation of truth-table, SOP form, POS form, Simplification of logical functions, Minimization of SOP and POS forms, don't care Conditions.
Reduction techniques: K-Maps up to 4 variables and Quine - McClusky technique.
CLC design using SSI chips – Code converters, Half- Adder, Full Adder, Half Subtractor, Full Subtractor, n bit Binary adder, Look ahead carry generator.Magnitude comparator using IC 7485.
Introduction to MSI functions & chips - Multiplexers (IC 74151 and IC 74153), Decoder / Demultiplexer (IC 74138), Encoder (IC 74147), Binary adder (IC 7483).

CLC design using MSI chips – BCD & Excess 3 adder & subtractor using IC 7483, Implementation of logic functions using IC 74151,74153& 74138.

UNIT – III   SEQUENTIAL LOGIC   8 Hours

Introduction to sequential circuits. Difference between combinational circuits and sequential circuits, memory element – latch.

Flip- Flops: Design, truth table, excitation table of SR, JK, D, T flip flops. Study of flip flops with asynchronous and synchronous Preset & Clear, Master Slave configuration, conversion from one type to another type of flip flop. Study of flip flop ICs - 7473, 7474, 7476

Application of flip-flops – Bounce elimination switch, Counters- asynchronous, synchronous and modulo counters study of modulus n counter ICs- 7490, 74191 & their applications to implement mod counters.

UNIT – IV   SEQUENTIAL LOGIC DESIGN   8 Hours

Registers- Buffer register, shift register types - SISO, SIPO, PISO & PIPO, applications of shift registers - ring counter, twisted ring counter, study of universal shift register IC – 74194,

Sequence generators using counters & shift register, Pseudo Random Binary Sequence Generator.

Basic design steps-State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, sequence detector using Moore & Mealy model.

UNIT – V   PROGRAMMABLE LOGIC DEVICES AND INTRIDUCTION TO HDL   6 Hours

Algorithmic State Machines- ASM notations, charts (eg- counters, washing machine, lift controller, vending machine), design using multiplexer controller method (eg- counters).

Introduction to PLD's – ROM, PAL, PLA, Design of 4 variable SOP using PLDs, Basic architecture of SPLD and CPLD, Study of CPLD architecture XC9572, Basic architecture of FPGA, CPLD. Design flow (Basic Concept of Simulation and Synthesis)

Introduction to HDL – Necessity, Characteristics & Types.

UNIT - VI   VHDL PROGRAMMING   6 Hours

Introduction to VHDL - Library, Package, Entity, Architecture, Data Objects (Variable, signal & constant), Data Types (scalar, composite array type & predefined data types, Attributes (necessity and use. 'event attribute). **VHDL Modeling styles –** Dataflow, behavioral & structural

VHDL statements - Concurrent Statements (With. Select, When..Else), Sequential Statements (if..else, case)

VHDL design Examples - Multiplexer, binary adder, counter, shift register.

Text Books
1. "Modern Digital Electronics ", R.P. Jain, 3rd Edition, Tata McGraw-Hill, ISBN: 0–07–049492–4
2. "Fundamentals of Digital Logic with VHDL Design", Stephen Brown, ZvonkoVranesic McGraw-Hill, ISBN: 978–0–07–352953–0

Reference Books
1. "Digital Principles", Flyod, Pearson EducationISBN:978-81- 7758-643-6.
2. "Digital Design", M Morris Mano, Prentice Hall, 3rd Edition, ISBN: 0130621218.
3. "Digital Logic applications and Design", John Yarbrough, Thomson Publication
   ISBN: 978-0314066756
4. "Digital Principles and Applications", Malvino, D. Leach, 5th edition, Tata McGraw Hill
5. "VHDL Primer", J.Bhaskar, Pearson Education,3rd Edition, ISBN: 0071226249
6. "Switching and Finite Automata Theory", Kohavi Z., Jha N.K,, Cambridge University Press, India, 2nd Edition, ISBN: 978-0-521-85748-2

214444 : FUNDAMENTAL OF DATA STRUCTURES

Teaching Scheme:	Credits	Examination Scheme:
Lectures: 4 Hours/Week	04	In-Semester (Online): 50 Marks
		End-Semester: 50 Marks

Prerequisites : Fundamental knowledge of 'C' and basics of algorithms

Course Objectives :
1. To learn C language constructs and pointers in depth.
2. To learn algorithm development and analysis of algorithms.
3. To learn linear data structures and their applications
4. To learn different searching and sorting techniques

Course Outcomes :
After successful completion of this course, student will be able to
1. Apply appropriate constructs of C language, coding standards for application development.
2. Use dynamic memory allocation concepts and file handling in various application developments.
3. Perform basic analysis of algorithms with respect to time and space complexity
4. Select appropriate searching and/or sorting techniques in the application development
5. Select and use appropriate data structures for problem solving and programming
6. Use algorithmic foundations for solving problems and programming

Course Contents

UNIT – I   C BASICS   6 Hours
Control structures, arrays, functions and parameter passing Structure and Union, String manipulation, matrix operations.

UNIT – II   POINTERS IN C AND FILE HANDLING   9 Hours
Introduction to Pointers, dynamic memory allocation, pointer to pointer, pointer to single and multidimensional arrays, array of pointers, string and structure manipulation using pointers, pointer to functions. Pointer to file structure and basic operations on file, file handling in C.

UNIT – III   INTRIDUCTION TO DATA STRUCTURES AND ANALYSIS OF ALGORITHMS   5 Hours
Introduction to Data Structures: Concept of data, Data object, Data structure, Abstract Data Types, realization of ADT in 'C'. Concept of Primitive and non-primitive, linear and Non-linear, static and dynamic, persistent and ephemeral data structures.
Analysis of algorithm: frequency count and its importance in analysis of an algorithm, Time complexity & Space complexity of an algorithm, Big 'O', 'Ω' and 'Θ' notations, Best, Worst and Average case analysis of an algorithm.

UNIT – IV   SEARCHING AND SORTING TEHNIQUES   7 Hours
Need of searching and sorting, Concept of internal and external sorting, sort stability. Searching methods: Linear and binary search algorithms their comparison and complexity analysis

Sorting methods: Bubble, selection, insertion, merge, quick, bucket sort and their time and space complexity analysis

UNIT – V   LINEAR DATA STRUCTURES USINF SEQUENTIAL ORGANIZATION   8 Hours

Concept of sequential organization, Concept of Linear data structures, Concept of ordered list, Multidimensional arrays and their storage representation: row major and column major form and address calculation. Representation of sparse matrix using arrays, algorithms for sparse matrix addition, simple and fast transpose, polynomial representation using arrays. Analysis of these algorithms. Introduction to Stack and Queue, and their implementation using sequential organization, use of stack in recursion.

UNIT - VI   LINEAR DATA STRUCTURES USING LINKED ORGANIZATION   8 Hours

Concept of linked organization, singly linked list, doubly linked list, circular linked list. Linked list as an ADT. Representation and manipulations of polynomials using linked lists, comparison of a sequential and linked memory organization, concept of Generalized Linked List, representation polynomial using GLL.

Text Books

1. E. Horowitz, S. Sahani, S. Anderson-Freed "Fundamentals of Data Structures in C", Universities Press, 2008
2. R. Gilberg, B. Forouzan, "Data Structures: A pseudo code approach with C", Cenage Learning, ISBN 9788131503140.
3. YashwantKanetkar, "Let us C" and "Pointers in C" , BPB Publication

Reference Books

1. R S Bichkar, "Programming with C", University Press, ISBN 978-81-7371-771-0
2. Dennis Ritchie, Kernighan, "The C Programming Language", Prentice Hall
3. Treamblay, Sorenson, "An introduction to data structures with applications", Tata McGraw Hill, Second Edition
4. Seymour Lipschutz, "Data structures with C", Schaum's Publication
5. Aaron Tanenbaum, "Data Structures using C", Pearson Education
6. G. A.V, PAI , "Data structures and Algorithms ", McGraw Hill, ISBN -13: 978-0-07-066726-6
7. Venkatesan, "Data Structures, w/cd", Wiley, ISBN-9788126553044
8. Langsam,Augenstein, Tenenbaum ,Data Structures Using C and C++, 2e, Pearson Pub.
9. Kamthane, Introduction to Data Structures in C, Pearson Publistion
10. Kruse ,Data Structures and Program Design in C, ISBN, 9788177584233, Pearson Publications,.

214445 : PROBLEM SOLVING AND OBJECT ORIENTED PROGRAMMING

Teaching Scheme:	Credits	Examination Scheme:
Lectures: 4 Hours/Week	04	In-Semester (Online): 50 Marks End-Semester: 50 Marks

Prerequisites : Principles of Programming Languages, Fundamentals of Data Structures

Course Objectives :
1. Employ a problem-solving strategy to breakdown a complex problem into a series of simpler tasks.
2. Execute problem-solving actions appropriate to completing a variety of sub problems.
3. Apply analytical and logical thinking to extract facts from a problem description and determine how they relate to one another and to the problems to be solved.
4. Design and implement an object oriented solution to solve a real life problem.
5. Develop problem-solving and programming skills using OOP concept.

Course Outcomes :
After studying this subject student should be able to
1. Develop algorithms for solving problems by using modular programming concepts
2. Abstract data and entities from the problem domain, build object models and design software solutions using object-oriented principles and strategies
3. Discover, explore and apply tools and best practices in object-oriented programming.
4. Develop programs that appropriately utilize key object-oriented concepts

Course Contents

UNIT – I   Problem Solving Concepts   6 Hours
General Problem Solving Concepts-Types of problems, problems solving with computers, difficulties with problem solving, Problem Solving Aspects, Problem Solving Concepts for computer- constants and variables, data types, functions, operators, expressions and equations, Programming Concepts – communicating with computers, organizing the problem, using the tools, testing the solution, coding the program, Top down design

UNIT – II   Problem Solving with Logic Structures   6 Hours
Programming Structure - modules and their functions, cohesion & Coupling, Local and global variable, parameters, return values, variable names and data dictionaries, four logic structures. Problem solving with sequential logic structure - The sequential logic structure, solution development. Problem Solving with Decisions – decision logic structure, multiple if/then/else instructions, straight-through logic, positive logic, negative logic, logic conversion, decision tables. Problem solving with loops and case logic structures

UNIT – III   Foundations of Object Oriented Programming   6 Hours
Introduction: Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, Need of object-oriented programming, fundamentals of object-oriented programming: objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism
++ Extensions to C : Variable declarations, global scope, 'const', reference variables, operators in C++(scope resolution, new , delete), dynamic memory allocation, function prototypes, default and constant arguments, 'cin', 'cout', inline functions

Class: Defining a class, data members and member functions, public, private and protected members, inline member functions, static data members, static member functions, constructors, destructors, array of objects, classes, objects and memory, class as ADTs and code reuse

UNIT – IV   Overloading and Inheritance   8 Hours
Function overloading, friend function, friend class
Operator Overloading : Introduction, Need of operator overloading, rules for operator overloading, overloading the unary and binary operators using member function, operator overloading using friend function, overloading relational and logical operators, overloading new, delete and assignment operator, type conversions
Inheritance : Introduction, Need of inheritance, base and derived classes, member access control, types of inheritance, derived class constructor, constructors in multiple inheritance, overriding member functions, ambiguity in multiple inheritance, virtual base class

UNIT – V   Virtual Functions and Templates   7 Hours
Virtual functions : Pointers to objects, 'this' pointer, Pointers to derived class, virtual function, rules for virtual function, pure virtual function, abstract class, virtual destructors, early and late binding, container classes
Templates : Introduction, Function template and class template, overloading function template, member function templates and template arguments, Introduction to Standard Template Library (STL), containers, iterators and algorithms

UNIT - VI   Exception Handling and File I/O   7 Hours
Namespaces: Introduction, Rules of namespaces
Exception Handling: Introduction, Exception handling mechanism: try, catch and throw, Multiple Exceptions, Exceptions with arguments
Managing Console I/O Operations: Introduction, C++ streams, stream classes, unformatted I/O, formatted I/O and I/O manipulators
File I/O: Introduction, Classes for file stream operations, file operations (open, close, read, write, detect end of file), file modes, File pointers and their manipulations, error handling during file operations

Text Books

1. R G Dromey, "How to Solve it by Computer", Pearson Education, 2008, ISBN-13: 978-8131705629.
2. Maureen Spankle, "Problem Solving and Programming Concepts", Pearson, 2011, ISBN-13**:** 978-0132492645.
3. Robert Lafore, "Object-Oriented Programming in C++", SAMS Techmedia.

Reference Books

1. Joyce Farrell, "Programming Logic and Design", Cengage Learning, ISBN-13: 978-1285776712.
2. E. Balaguruswamy, "Object-oriented Programming with C++", Tata McGraw Hill, 5th edition.
3. Herbert Schildt, "C++: The Complete Reference", McGraw-Hill.
4. Shukla, "Object-Oriented Programming in C++, w/cd", Wiley, ISBN-9788126516582.
5. Kogent, "Object Oriented Programming Methodology", Wiley, ISBN-9789351191841.
6. Venugopal, "Mastering C++", McGraw-Hill, ISBN-9781259029943.

214446 : DIGITAL LABORATORY

Teaching Scheme:	**Credits**	**Examination Scheme:**
Practical :2 Hours/Week	01	Term Work : 25 Marks
		Practical : 50 Marks

Prerequisites: Basic Electronics Engineering

Course Objectives :
1. To learn and understand basic digital design techniques.
2. To learn and understand design and construction of combinational and sequential circuits.
3. To introduce digital logic design software such as VHDL Programming.

Course Outcomes :
After completion of this course student will be able to
1. Spectacle an awareness and apply knowledge and concepts and methods of digital system design techniques as hands-on experiments with the use of necessary A.C, D.C Loading characteristics.
2. Use logic function representation for simplification with K-Maps and analyze as well as design Combinational logic circuits using SSI & MSI chips.
3. Analyze Sequential circuits like Flip-Flops (Truth Table, Excitation table) & design the applications like Asynchronous and Synchronous Counters.
4. Design Sequential Logic circuits: Sequence generators, MOD counters with registers/Counters using synchronous /asynchronous counters.
5. Understand the need of skills, techniques and learn state-of-the-art engineering tools through hands-on experimentation on the Xilinx tools for design as well as the basics of VHDL.
6. Understand and implement the design Steps, main programming technique with different modeling styles for any digital circuits with VHDL Programming.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant. The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, data sheets of various ICs, 8051 simulator and references.

Guidelines for Student's Lab Journal

1) The laboratory assignments are to be submitted by student in the form of journal. The Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, circuit diagram, pin configuration, conclusion/analysis).
2) Practical Examination will be based on the term work
3) Candidate is expected to know the theory involved in the experiment
4) The practical examination should be conducted if the journal of the student is completed in all respects and certified by concerned faculty and head of the department
5) All the assignment mentioned in the syllabus must be conducted

Guidelines for Lab /TW Assessment

1) Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for

implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.

2) Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out

3) Appropriate knowledge of usage of necessary simulation software and hardware such as ICs, Registers, digital trainer kits, IC tester should be checked by the faculty member

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Use of open source software is encouraged

The guidelines published by BOS time to time regarding conduction of laboratory assignments and Practical/Oral examination is mandatory.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

Suggested List of Laboratory Assignments

Group A

Combinational Logic Design
1. Design (truth table, K-map) and implementation of 4-bitBCD to Excess-3 and Excess-3 to BCD Code converters.
2. Design (truth table, K-map) and implementation of 4 bit BCD & Excess 3 Adder using IC7483.
3. Implementation of logic functions using multiplexer IC 74153 & decoder IC 74138.

   (Verification, cascading & logic function implementation)

Group B

Sequential Logic Design
1. Design (State diagram, state table & K map) and implementation of 3 bit Up and Down Asynchronous and Synchronous Counter using master slave JK flip-flop IC 7476
2. Design and implementation of Module 'n' counter with IC7490 and IC 74191.
3. Design (State Diagram, State Table, K Map) and implementation of Sequence Generator using Shift Register IC 74194.

Group C

VHDL Programming
 Simulation of
1. 4:1 multiplexer using data flow & structural modeling.
2. Full adder using behavioral & structural modeling.
3. 3 bit controlled up / down synchronous counter with preset & clear

Group D

Design, construct digital logic circuits and analyze their behavior through simulation of any one assignment from either Group A or Group B with simulation software like Digital Works 3.0

Student should submit term work in the form of a journal based on the above assignments (Group A,Band C). Practical examination will be based on the term work. Questions will be asked during the examination to judge the understanding of the practical performed in the examination. Candidate is expected to know the theory involved in the experiment.

Note - Instructor should take care that datasheets of all the required ICs are available in the laboratory & students are verifying the functionality of ICs being used.

Reference Books
1. R.P. Jain, "Modern Digital Electronics", 3rd Edition,Tata McGraw-Hill, ISBN: 0-07-049492-4
2. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL Design", McGraw-Hill, ISBN: 978-0-07-352953-0
3. John Yarbrough, "Digital Logic applications and Design", Thomson Publication, ISBN: 978-0314066756

214447 : PROGRAMMING LABORATORY

Teaching Scheme:	**Credits**	**Examination Scheme:**
Practical: 4 Hours/Week	02	Term Work: 25 Marks
		Practical : 50 Marks

Prerequisites:
1. Fundamentals of programming languages

Course Objectives :
1. To learn C language constructs and pointers in depth.
2. To learn algorithm development and analysis of algorithms.
3. To learn linear data structures and their applications
4. To learn different searching and sorting techniques

Course Outcomes :
After successful completion of this course, student will be able to
1. Apply appropriate constructs of C language, coding standards for application development.
2. Use dynamic memory allocation concepts and file handling in various application developments.
3. Perform basic analysis of algorithms with respect to time and space complexity
4. Select appropriate searching and/or sorting techniques in the application development
5. Select and use appropriate data structures for problem solving and programming
6. Use algorithmic foundations for solving problems and programming

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant. The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, algorithm written in pseudo language, sample test cases and references.

Guidelines for Student's Lab Journal

1) The laboratory assignments are to be submitted by student in the form of journal. The Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, algorithms, printouts of the code written using coding standards, sample test cases etc.
2) Practical Examination will be based on the term work
3) Candidate is expected to know the theory involved in the experiment
4) The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department
5) All the assignment mentioned in the syllabus must be conducted

Guidelines for Lab /TW Assessment

1) Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.

2) Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out

3) Appropriate knowledge of usage of software and hardware such as compiler, debugger, coding standards, algorithm to be implemented etc. should be checked by the concerned faculty member(s)

Guidelines for Laboratory Conduction

1) The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

2) The guidelines published by BOS time to time regarding conduction of laboratory assignments and Practical/Oral examination is mandatory.

3) All the assignments should be conducted on multicore hardware and 64-bit open-source software

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

Suggested List of Laboratory Assignments

1. Represent sets using one dimensional arrays and implement functions to perform
   i. Union
   ii. Intersection
   iii. Difference
   iv. Symmetric difference of two sets

2. Represent matrix using two dimensional arrays and perform following operations **with and without pointers**:
   i. Addition
   ii. multiplication
   iii. transpose
   iv. Saddle point

3. Implement following operations on string **with / without pointers (without using library functions)**
   i. Length
   ii. Palindrome

     iii.   String comparison

     iv.   Copy

     v.   Reverse

     vi.   Substring

4. Create a Database using array of structures and perform following operations on it:
   - i. Create Database
   - ii. Display Database
   - iii. Add record
   - iv. Search record
   - v. Modify record
   - vi. Delete record

5. a) Sort the set of strings in ascending order using Bubble sort and descending order by using Selection sort or Insertion sort. (Display pass by pass output)

   b) Search a particular string using binary search **with and without recursion.**

6. Implement sequential file and perform following operations:
   - i. Display
   - ii. Add records
   - iii. Search record
   - iv. Modify record
   - v. Delete record

7. Implement Quick Sort / **Merge Sort** to sort the given list of numbers. Display corresponding list in each pass. (with and without recursion)

8. Accept conventional matrix and convert it into sparse matrix using structure and perform **addition**, simple and fast transpose

9. Implement a singly linked list with following options
   - i. Insertion of a node at any location
   - ii. Deletion of a node from any location
   - iii. display a list
   - iv. Display in reverse
   - v. Reverse the list without using additional data structure.

10. Implement polynomial using CLL and perform
    - i. Addition of Polynomials
    - ii. Multiplication of polynomials and
    - iii. Evaluation of polynomial

11. Implement any database using doubly linked list with following options
    - i. Insert a record
    - ii. delete a record
    - iii. modify a record
    - iv. Display list forward
    - v. Display list backward

12. Implement Generalized Linked List to create and display the book index.

Note:

1. For all programs implementations students are expected to use meaningful identifiers, proper indentation, use of functions, minimal use of global variables and writing time complexity using any one notation is mandatory.
2. Student should submit term work in the form of a journal based on the above assignments.
3. Practical examination will be based on the term work.
4. Questions will be asked during the examination to judge the understanding of the practical performed in the examination.
5. Candidate is expected to know the theory involved in the experiment.
6. Students are expected to implement at least 3 test cases for each assignment.

Note: This list of assignments is indicative. Concerned faculty member may frame different assignments if required maintaining similar difficulty level.

Reference Books
1. E. Horowitz, S. Sahani, S. Anderson-Freed "Fundamentals of Data Structures in C", Universities Press, 2008
2. R. Gilberg, B. Forouzan, "Data Structures: A pseudo code approach with C", Cenage Learning, ISBN 9788131503140.
3. Yashwant Kanetkar, "Let us C" and "Pointers in C" , BPB Publication

214448 : OBJECT ORIENTED PROGRAMMING LABORATORY

Teaching Scheme:	**Credits**	**Examination Scheme:**
Practical :2 Hours/Week	01	Term Work : 25 Marks
		Practical : 50 Marks

Prerequisites : Principles of Programming Languages, Fundamentals of Data Structures

Course Objectives :
1. Employ a problem-solving strategy to breakdown a complex problem into a series of simpler tasks.
2. Execute problem-solving actions appropriate to completing a variety of sub problems.
3. Apply analytical and logical thinking to extract facts from a problem description and determine how they relate to one another and to the problems to be solved.
4. Design and implement an object oriented solution to solve a real life problem.
5. Develop problem-solving and programming skills using OOP concept.

Course Outcomes :
After studying this subject student should be able to
1. Develop and implement algorithms for solving simple problems using modular programming concept.
2. Abstract data and entities from the problem domain, build object models and design software solutions using object-oriented principles and strategies.
3. Discover, explore and apply tools and best practices in object-oriented programming.
4. Develop programs that appropriately utilize key object-oriented concepts
5. Create a data base using files

Guidelines for Instructor's Manual
The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant. The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, algorithm written in pseudo language, sample test cases and references.

Guidelines for Student's Lab Journal
1) The laboratory assignments are to be submitted by student in the form of journal. The Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, algorithms, printouts of the code written using coding standards, sample test cases etc.
2) Practical Examination will be based on the term work submitted by the student in the form of journal
3) Candidate is expected to know the theory involved in the experiment
4) The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department
5) All the assignment mentioned in the syllabus must be conducted

Guidelines for Lab /TW Assessment
1) Examiners will assess the term work based on performance of students considering the

parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.

2) Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out

3) Appropriate knowledge of usage of software and hardware such as compiler, debugger, coding standards, algorithm to be implemented etc. should be checked by the concerned faculty member(s)

Guidelines for Laboratory Conduction

1) The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

2) The guidelines published by BOS time to time regarding conduction of laboratory assignments and Practical/Oral examination is mandatory.

3) All the assignments should be conducted on multicore hardware and 64-bit open-source software

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

Suggested List of Laboratory Assignments

1. Create a class named weather report that holds a daily weather report with data members day_of_month, hightemp, lowtemp,a mount_rain and amount_snow. Use different types of constructors to initialize the objects. Also include a function that prompts the user and sets values for each field so that you can override the default values.
   Write a menu driven program in C++ with options to enter data and generate monthly report that displays average of each attribute.

2. A Book shop maintains the inventory of books that are being sold at the shop. The list includes details such as title, author, publisher, price and available stock.
   Write a program in C++ which will have a class called books with suitable member functions for
   i.   Add
   ii.   Update
   iii.   Search a book
   iv.   Purchase a book (update the stock and display the total cost)
   v.   Record number of successful/unsuccessful transactions (use static data members to keep count of transactions)
   Use new operator in constructors to allocate memory space required.

3. Design a class 'Complex 'with data members for real and imaginary part. Provide default and

parameterized constructors. Write a program to perform arithmetic operations of two complex numbers using operator overloading.
- i. Addition and subtraction using friend functions
- ii. Multiplication and division using member functions

4. Design a base class with name, date of birth, blood group and another base class consisting of the data members such as height and weight. Design one more base class consisting of the insurance policy number and contact address. The derived class contains the data members' telephone numbers and driving license number.
   Write a menu driven program to carry out the following things:
   - i. Build a master table   ii. Display   iii. Insert a new entry
   - iv. Delete entry v. Edit vi. Search for a record

5. Create a base class shape with two double type values and member functions to input the data and compute_area() for calculating area of figure. Derive two classes' triangle and rectangle. Make compute_area() as a virtual function and redefine this function in the derived class to suit their requirements.
   Write a program that accepts dimensions of triangle/rectangle and display calculated area.

6. Write a program in C++ which includes the code for following operations :
   - i. A function to read two double type numbers from keyboard
   - ii. A function to calculate the division of these two numbers
   - iii. A try block to detect and throw an exception if the condition "divide-by-zero" occurs
   - iv. Appropriate catch block to handle the exceptions thrown

7. Write a program in C++ using function/class template to read two matrices of different data types such as integers and floating point values and perform simple arithmetic operations on these matrices separately and display it.

8. Write a program in C++ to implement sequential file for students' database and perform following operations on it
   - i) Create Database
   - ii) Display Database
   - iii) Add a record
   - iv) Delete a record
   - v) Modify a record

9. Create employee bio-data using following classes i) Personal record ii))Professional record iii) Academic record Assume appropriate data members and member function to accept required data & print bio-data. Create bio-data using multiple inheritance using C++

10. Write a C++ program that creates an output file, writes few records into it, closes the file and open it again as an input file and read the information from the file

Note:
While performing the assignments following care should be taken
1. Proper indenting, coding styles, commenting, naming conventions should be followed.
2. Avoid using global variables as far as possible
3. Faculty should prepare a lab manual including standard test cases & should be available for reference to students.

4. Student should submit term work in the form of a journal based on the above assignments.
5. Practical examination will be based on the term work. Questions will be asked during the examination to judge the understanding of the practical performed at the time of examination.
6. Candidate is expected to know the theory involved in the experiment.

Note: This list of assignments is indicative. Concerned faculty member may frame different assignments if required maintaining similar difficulty level.

Reference Books
1. Robert Lafore, "Object-Oriented Programming in C++", SAMS Techmedia.
2. E. Balaguruswamy, "Object-oriented Programming with C++", Tata McGraw Hill, 5th edition.
3. Shukla, "Data Structures using C & C++", Wiley, ISBN-9788126519972.

214449 : COMMUNICATION SKILLS

Teaching Scheme:	**Credits**	**Examination Scheme:**
Practical :2 Hours/Week	01	Term Work : 25 Marks

Prerequisites: Basic knowledge of English Language

Course Objectives :
1. Improve students' overall linguistic & communicative competence in English
2. Enhance their pronunciation, vocabulary and LSRW skills
3. Foster their confidence in public speaking and group communication skills

Course Outcomes :
After successful completion of this course, student will be able to
1. Provides an ability to understand, analyze and interpret the essentiality of grammar and its proper usage.
2. Build the students' vocabulary by means of communication via web, direct Communication and indirect communication.
3. Improves Students' Pronunciation skills and understanding between various phonetic sounds during communication.
4. Understanding the various rules and means of written communication.
5. Effective communication with active listening, facing problems while communication and how to overcome it.

Course Contents

Overview

The course has been designed for the students of second year Information Technology for enhancing their linguistic and communicative competence. It attempts to give them exposure to the essential linguistic and communication skills by focusing upon the key areas of immediate significance. Students will also be given a theoretical knowledge through lectures about the fundamental concepts in the English language & communication such as grammar, vocabulary, pronunciation and LSRW skills. At the same time adequate practical exposure to these skills will be provided through laboratory sessions. The course aims at striking a fine balance between theory and practice to ensure the all-round improvement of students in these skills. Students will be able to improve their command over communicative English which will enable them to enhance their academic performance and will contribute to their growth as engineering professionals.

Teaching Methodology in the Language Laboratory
1. Direct Method – Use of English for communication between the teacher and students. Teachers must emphasize on the use of English in the lab. All the instructions and Interactions must be given in English.
2. Theory lectures should also be interactive and the teacher should encourage students' participation in the classroom sessions.
3. Laboratory sessions should be activity based and should be conducted in groups and pairs. Guidelines for conducting laboratory sessions have been given below each activity.

Unit I: ESSENTIAL GRAMMAR AND PHONETICS (5 hrs)

Tenses: Basic forms and use, sentence formation (general & Technical), Common errors, Parts of speech through context, Direct and reported speech structures and voices, stress & intonation, voice modulation, exercises on pronunciation, use of software for exercises on pronunciation.

Activities:-

- The class of students will always have some students with adequate knowledge of basic grammar and rest with no/poor knowledge.
- The basic grammar exercises can be taught by giving students sentences in their mother tongue and telling them to convert it to English thereby covering parts of speech, tenses, voices, etc
- The students with acceptable understanding of grammar can be engaged in some advanced grammar exercises like the ones in 'word power made easy' or any online exercises mentioned in the references below.
- For intonation, voice modulation, videos by decent orators /movie clips can be shown to the students.
- For pronunciation, exercises based on Homonyms, homophones can be conducted.

Unit II: VOCABULARY ENRICHMENT (5 hrs)

Exposure to words from General Service List (GSL) by West, Academic word list (AWL) by Averil Coxhead (2000) and specific technical terms related to the field of Information technology. Phrases, idioms, proverbs, significant abbreviations, formal (business) vocabulary.

Activities:-

- Students should be given 10 idioms, proverbs and phrases each and should be told to form story using them.
- Students can be divided into teams. Each team should be told to find out 10 new words/phrases the meanings of which should be discussed in the lab. This exercise can be repeated in the last 10 minutes of each lab session so as to add to the students' vocabulary.

Unit III: WRITING SKILLS

Letter Writing - Business letters, Application letters, Covering letters, Report Writing -Academic and Business reports, Technical Project writing, Job application letter and Resume writing

Activities:- students should be made to write letters in formal and informal way like letters, resume, technical report writing.

Unit IV: LISTENING SKILLS (5 hrs)

Types of listening, Levels of Listening, Listening Barriers, Listening Ethics, activities to strengthen students' listening skills
Activity:-Chinese whisper
Audio activity:-students should listen to any audio and try to answer question based on that audio.

Unit V: READING SKILLS

Definition, need for reading Skills, techniques for reading, how to develop fluency in Reading.
Lab Activities:
Students can be given some text to read and answer questions related to that text.
Students can be made to read a passage aloud and others can be asked questions based on the passage read.

Unit VI: SPEAKING SKILLS

Difference between talking and Speaking, Attributes /characteristics of public speaking, barriers to effective speaking, Types of speaking: Technical and Non-Technical speaking.

Activities:
- **Prepared speech** (topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.
- **Extempore speech (**students deliver speeches spontaneously for 5 minutes each on a given topic)
- **Story telling** (Each student narrates a fictional or real life story for 5 minutes each)
- **Oral review** (Each student orally presents a review on a story or a book read by them)

2. Power-point Presentations

Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical

3. Formal Group Discussion

Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback.

4. Mock Meetings

In order to enhance students' formal oral communication, mock meetings can be conducted. Teacher should give a topic for the meeting and teach students how a notice and agenda for a meeting is prepared. Students will participate in the meeting assuming the roles assigned by the teacher. After the meeting, teacher should guide students on how minutes of meeting are recorded.

6. Reading and Listening skills

The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be asked questions on the article by the readers. Students will get marks for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills.

7. Pronunciation through software or web-based applications

Teachers should make use of software and web-based applications for giving exercises on pronunciation to students.

8. Vocabulary exercises through web-based applications

Teachers should make use of software and web-based applications for giving exercises on vocabulary to students.

9. Letter, Report & review writing

Each student will write one formal letter, one report and a review on the topics given by the teacher.

10. Grammar exercises through web-based applications

Teachers should make use of software and web-based applications for giving exercises on grammar to students. The term work shall consist of 10 activities carrying 10 marks each. The total marks earned by the students out of 100 will be scaled down to 50. The online exam and term work marks will be further scaled down to 50. Students will have to submit journals or files containing record of each activity performed in laboratory, at the term end.

References
1. Rutherford A. J., " Communication skills for Technical Communication", Pearson Education
2. Meenakshi Raman, Sangeeta Sharma, "Technical Communication – Principles and practice", Oxford
3. Kishna Mohan, "Developing Communications Skills", MacMillan Publishers, 2nd Edition
4. M.S. Rao, " Strategies for improving your business communication", SPD
5. Murphy, " Essential English Grammar", Cambridge
6. Duttet.al, " A course in Communication Skills", Foundation Books
7. Priyadarshani Patnaik, " Group Discussion and Interview Skills", 1st edition, Foundation Books
8. Peter Roach, " English Phonetics and Phonology", 4th Edition, Cambridge

9. Lynch, " listening",, Cambridge
10. Malcom Goodale, " Professional Presentations", Cambridge
11. Ham-Lyons & Heasley, "Writing", 2nd Edition, Cambridge
12. "Idioms and proverbs are fun", Wilco books(author)
13. Whitbeck, " Ethics in Engineering Practice and Research", Cambridge, ISBN-9780521897976
14. Chauhan, "Soft Skills: An Integrated Approach to Maximize", Wiley, ISBN-9788126556397
15. Mishra, "Communication Skills for Engineers", 2e, ISBN – 9788131733844, Pearson

ESL Sites (Web-based applications) for vocabulary learning
1. http://www.nottingham.ac.uk/%7Ealzsh3/acvocab/awlhighlighter.htm
2. http://www.visuwords.com/
3. http://www.vocabulary.com/
4. http://www.uefap.com/vocab/exercise/exercise.htm
5. www.englishvocabularyexercises.co

Guidelines for Student's Lab Journal

1) Student should submit term work in the form of journal which should include handwritten Write-up, printouts of the code written using coding standards, sample test cases, etc.
2) Term Work assessment will be based on the term work
3) The Term of the candidate should be granted if journal of the candidate is completed in all respects and certified by concerned faculty and head of the department
4) All the assignment mentioned in the syllabus must be conducted

Guidelines for Lab /TW Assessment

1) Faculty will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2) Faculty will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out
3) Appropriate knowledge of usage of software and hardware such as Word, Powerpoint, knowledge of different aspects of the communication mentioned in the syllabus etc. should be checked by the concerned faculty member(s)

Guidelines for Laboratory Conduction

1) The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

2) The guidelines published by BOS time to time regarding conduction of laboratory assignments and Term Work assessment are mandatory.

Audit Course1

In addition to credits course, it is recommended that there should be audit course (non-credit course) preferably in each semester from second year. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

(Ref-http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/
UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

List of courses under Audit Course1

Course Code	Audit Course Title
210250:AC1-I	Road Safety
210250:AC1-II	Humanities and Social Sciences
210250:AC1-III	Environmental Studies
210250:AC1-IV	Smart Cities

The detail course contents of above mentioned audit courses are available in Computer Engineering 2015 course syllabus.

Moreover students can opt for any other audit course from the list of Audit Course of any branch of engineering.

SEMESTER - II

207003 : ENGINEERING MATHEMATICS – III (Information Technology + Computer Engineering)

Teaching Scheme:	Credits	Examination Scheme:
Lectures: 4 Hours/Week	05	In-Semester (Online): 50 Marks
Tutorial: 1 Hour/Week		End-Semester: 50 Marks
		Term Work – 25 Marks

Prerequisites :
Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Measures of Central tendency and dispersion, Vector algebra, Algebra of complex numbers.

Course Objectives :
After completing this course, students will have adequate mathematical background, conceptual clarity, computational skills and algorithm design for problem solving related to:
1. Linear differential equations of higher order applicable to Control systems, Computer vision, and Robotics.
2. Transform techniques such as Fourier transform, Z-transform and applications to Image processing.
3. Statistical methods such as correlation, regression analysis and probability theory to analyze data and to make predictions applicable to machine intelligence.
4. Vector calculus necessary to analyze and design complex electrical and electronic devices as appropriate to Computer engineering.
5. Complex functions, conformal mappings and contour integration applicable to Image processing, Digital filters and Computer graphics.

Course Outcomes :
At the end of this course, students will be able to:
1. Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
2. Solve problems related to Fourier transform, Z-Transform and applications to Signal and Image processing.
3. Apply statistical methods like correlation, regression analysis and probability theory for analysis and prediction of a given data as applied to machine intelligence.
4. Perform vector differentiation and integration to analyze the vector fields and apply to compute line, surface and volume integrals.
5. Analyze conformal mappings, transformations and perform contour integration of complex functions required in Image processing, Digital filters and Computer graphics.

Course Contents

UNIT – I   Linear Differential Equations (LDE) and Applications   6 Hours
LDE of nth order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Modeling of Electrical circuits.

UNIT – II   Transforms   6 Hours
Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses,

Discrete Fourier Transform.
Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

UNIT – III   Statistics   6 Hours
Measures of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.

UNIT – IV   Probability and Probability Distributions   6 Hours
Probability, Theorems on Probability, Bayes Theorem, Random variables, Mathematical Expectation, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hypergeometric, Test of Hypothesis: Chi-Square test, t-distribution.

UNIT – V   Vector Calculus   6 Hours
Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal and Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.

UNIT - VI   Complex Variables   6 Hours
Functions of Complex variables, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula, Laurent's series, and Residue theorem.

Text Books

1. Advanced Engineering Mathematics, 9e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).

Reference Books

1. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
2. Advanced Engineering Mathematics, Wylie C.R. & Barrett L.C. (McGraw-Hill, Inc.)
3. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
4. Applied Mathematics (Volumes I and II) by P. N. Wartikar& J. N. Wartikar (Pune Vidyarthi Griha Prakashan, Pune).
5. Higher Engineering Mathematics by B.V. Ramana, Tata McGraw-Hill

214450 : COMPUTER GRAPHICS

Teaching Scheme:	**Credits**	**Examination Scheme:**
Lectures: 3 Hours/Week	03	In-Semester (Online): 50 Marks
		End-Semester: 50 Marks

Prerequisites:
1. Basic Geometry, Trigonometry, Vectors and Matrices
2. Basics of Data Structures and Algorithms

Course Objectives :
1. To acquaint the learners with the basic concepts of Computer Graphics
2. To learn the various algorithms for generating and rendering graphical figures
3. To get familiar with mathematics behind the graphical transformations
4. To understand and apply various methods and techniques regarding projections, animation, shading, illumination and lighting

Course Outcomes :
On completion of the course, learner will be able to –
1. Apply mathematics and logic to develop Computer programs for elementary graphic operations
2. Develop scientific and strategic approach to solve complex problems in the domain of Computer Graphics
3. Develop the competency to understand the concepts related to Computer Vision and Virtual reality
4. Apply the logic to develop animation and gaming programs

Course Contents

UNIT – I   BASIC CONCEPTS   8 Hours
Introduction to Computer Graphics, Basics of graphics systems, Raster scan & Random scan displays, basic display processor
Display Files: display file structure, algorithms and display file interpreter. Primitive operations on display file
Plotting Primitives: Scan conversions, lines, line segments, vectors, pixels and frame buffers, vector generation
Line drawing Algorithms: DDA, Bresenham
Circle drawing Algorithms: - DDA, Bresenham
Character Generation: Stroke Principle, Starburst Principle, Bit map method,   Introduction to aliasing and anti-aliasing

UNIT – II   POLYGONS AND GRAPHICAL TRANSFORMATIONS   6 Hours
Polygon and its types, inside test, polygon filling methods: Seed fill, Scan Line, Flood fill and Boundary fill
2D Geometric Transformations - translation, scaling, rotation, other transformations such as reflection, shearing, matrix representation and homogeneous coordinate system, Composite transformations

UNIT – III   3D TRANSFORMATIONS AND PROJECTIONS   6 Hours

Translation, scaling, rotation, rotation about X, Y, Z and arbitrary axis reflection about XY, YZ, XZ and arbitrary plane**.**
Projections: Types Parallel - Oblique: Cavalier, Cabinet and orthographic :Isometric, Dimetric**,** Trimetric and Perspective - Vanishing Points as 1 point, 2 point and 3 point

UNIT – IV   SEGMENTS, WINDOWING AND CLIPPING   6 Hours

Segment: Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility
Windowing: Concept of window and viewport, viewing transformations
Line Clipping: Cohen Sutherland Method, Midpoint subdivision method
Polygon Clipping : Sutherland Hodgman method for clipping convex and concave polygons

UNIT – V   SHADING, ANIMATION AND GAMING   6 Hours

Shading: Halftoning, Gouraud and Phong Shading
Computer Animation: Animation sequences, functions & Languages, Key-frame Systems, Motion Specifications.
Gaming platforms: Graphics Memory Pipeline, Block diagram of NVIDIA workstation and i860
Introduction to OpenGL ES

UNIT - VI   CURVES AND FRACTALS   6 Hours

Introduction, Curve generation, Interpolation, interpolating algorithms, interpolating polygons, B-Splines and corners, Bezier curves, Fractals, fractal lines and surfaces
Interactive Graphics & usage of the tools of computer graphics – 3D Studio and Maya

Text Books

1. S. Harrington, "Computer Graphics", 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6.
2. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.

Reference Books

1. J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice", 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.
2. D. Hearn, M. Baker, "Computer Graphics – C Version", 2nd Edition, Pearson Education, 2002, ISBN81 – 7808 – 794 – 4.
3. D. Rogers, J. Adams, "Mathematical Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2002, ISBN 0 – 07 – 048677 – 8.
4. Zhigang Xiang, Roy Plastock, "Computer Graphics", Schaum's Series outlines
5. Shirley, Marschner, "Fundamentals of Computer Graphics", Third Ed, A K Peters SPD
6. F.S. Hill JR, "Computer Graphics Using Open GL", Pearson Education
7. D.P. Mukharjee, Debasish Jana, "Computer Graphics Algorithms and implementation", PHI Learning
8. Samuel R. Buss, "3D Computer Graphics", Cambridge University Press
9. Mario Zechner, Robert Green, "Beginning Android 4 Games Development", Apress, ISBN: 978-81-322-0575-3
10. Maurya, "Computer Graphics with Virtual Reality Systems, 2ed.", Wiley, ISBN-9788126550883
11. Foley, "Computer Graphics: Principles & Practice in C", 2e, ISBN 9788131705056, Pearson Edu.

214451 : PROCESSOR ARCHITECTURE AND INTERFACING

Teaching Scheme:
Lectures: 4 Hours/Week

Credits
04

Examination Scheme:
In-Semester (Online): 50 Marks
End-Semester: 50 Marks

Prerequisites : Computer Organization & Architecture

Course Objectives :
1. To study architecture and features of 80386 microprocessors and 8051 microcontroller
2. To learn design of minimum system using 8051 micro-controller.

Course Outcomes :
After successful completion of this course, student will be able to
1. Learn architectural details of 80386 microprocessor
2. Understand memory management and multitasking of 80386 microprocessor
3. Understand architecture and memory organization of 8051microcontroller
4. Explain timers and interrupts of 8051 microcontroller and its interfacing with I/O devices

Course Contents

**UNIT – I   INTRODUCTION TO ASSEMBLY LANGUAGE PROGRAMMING & 80386   8 Hours
          PROCESSOR**

Introduction to assembly language programming, ALP tools- Assembler, Linker, Loader, Debugger, Emulator, Assembler directives, Far and near procedure, Macros, DOS Internals, DOS Calls.
80386 - Features and Architecture, Register Set, 80386 Real mode segmentation and Address translation, Addressing modes, Instruction set.

UNIT – II   80386 MEMORY MANAGEMENT   8 Hours

Pin Description of 80386, 16/32-bit data transfer mechanism, Pipelined & Non pipelined bus cycles.
Segmentation - support registers and Data structures, Descriptors, Memory management through segmentation, Logical to linear/physical address translation.
Privileged instructions, Protection in segmentation, Inter-privilege level transfer using Call gates and confirming code segment.

**UNIT – III   80386 – PRIVILEGE PROTECTION, MULTITASKING & INTERRUPTS,   8 Hours
          EXCEPTIONS**

Paging - support registers and Data structures, Descriptors, Linear to physical address translation, Page level protection.
Multitasking - Support registers and Data structures, Descriptors, Task switching.
Real and Protected mode Interrupt structure - IVT, IDT, Type of exceptions and Processing.

UNIT – IV   INTRODUCTION TO 8051 MICROCONTROLLER   8 Hours

Difference between microprocessor and microcontroller, 8051 microcontroller - Features, Architecture, Pin Description.
On-Chip data memory and program memory organization - Register set, Register bank and Special Function Registers (SFRs).
Addressing modes, Instruction set. External data memory and program memory organization.

UNIT – V   PORTS, INTERRUPTS & TIMERS/COUNTERS OF 8051   8 Hours

I/O ports programming - Structures, Related SFRs and Configuration.

Interrupt programming - Structure and Response, Related SFRs and Configuration.

Timers/counters programming - Structure, Related SFRs, Operating modes, Delay calculations and Configuration.

Serial port programming - Related SFRs, Operating modes, Baud rate calculation and Configuration.

UNIT - VI   8051 INTERFACING & APPLICATIONS   8 Hours

PPI 8255 – Features, Architecture, Operating modes & Programming.

Interfacing of displays: LED, LCD, Seven segments.

Keyboard Interfacing, Interfacing of ADC and DAC, Interfacing of stepper motor, Interfacing of Sensors (temperature, pressure), External data memory and program memory interfacing, Design of minimum system using 8051 micro-controller for various applications.

Text Books

1. James Turley, "Advanced 80386 Programming Techniques", McGraw Hill Education.
2. M. A. Mazidi, J. G. Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education

Reference Books

1. Walter A. Tribel, Avtar Singh, "The 8088 and 8086 Microprocessors", 4th edition, Prentice Hall of India
2. Ray Duncan, "Advanced MS DOS Programming", 2nd edition, BPB Publications
3. Peter Abel, NiyazNizamuddin, "IBM PC Assembly Language and Programming", Pearson Education
4. Kenneth Ayala ,"The 8051 Micro Controller", 3rd edition, Delmar Cengage Learning
5. I. Scott MacKenzie, Raphael C.-W. Phan, "8051 Microcontroller", 4th edition, Pearson Education
6. Joshi, "Processor Architecture and Interfacing", Wiley, ISBN-9788126545605

214452 : DATA STRUCTURES AND FILES

Teaching Scheme:
Lectures: 4 Hours/Week

Credits
04

Examination Scheme:
In-Semester (Online): 50 Marks
End-Semester: 50 Marks

Prerequisites : Fundamentals of Data Structures, Discrete Structures

Course Objectives :
1. To study data structures and their implementations using OOP (C++) and their applications.
2. To study some advanced data structures such as trees, graphs and tables.
3. To learn different file organizations.

Course Outcomes :
After successful completion of this course, student will be able to
1. Analyze algorithms and to determine algorithm correctness and time efficiency class.
2. Understand different advanced abstract data type (ADT) and data structures and their implementations.
3. Understand different algorithm design techniques (brute -force, divide and conquer, greedy, etc.) and their implementation
4. Apply and implement learned algorithm design techniques and data structures to solve problems.

Course Contents

UNIT – I   STACKS AND QUEUES   8 Hours
Concept of stack, stack as ADT, Implementation of stack using linked organization. Concept of implicit and explicit stack, Applications of stack.
Concept of queues as ADT, Implementation of queue using linked organization. Concept of circular queue, double ended queue and priority queue. Applications of queues.

UNIT – II   TREES   10 Hours
Difference in linear and non-linear data structure, Trees and binary trees-concept and terminology. Expression tree. Conversion of general tree to binary tree. Binary tree as an ADT. Recursive and non-recursive algorithms for binary tree traversals, Binary search trees, Binary search tree as ADT, Applications of trees

UNIT – III   GRAPHS   8 Hours
Graph as an ADT, Representation of graphs using adjacency matrix and adjacency list, Depth First Search and Breadth First Search traversal. Prim's and Kruskal's algorithms for minimum spanning tree, shortest path using Warshall's and Dijkstra's algorithm, topological sorting.

UNIT – IV   TABLES   8 Hours
Symbol Table: Notion of Symbol Table, OBST, Huffman's algorithm, Heap data structure, Min and Max Heap, Heap sort implementation, applications of heap
Hash tables and scattered tables: Basic concepts, hash function, characteristics of good hash function, different key-to-address transformations techniques, synonyms or collisions, collision resolution techniques- linear probing, quadratic probing, rehashing, chaining without replacement and chaining with replacement

UNIT – V   ADVANCE TREES   7 Hours

Concept of threaded binary tree. Preorder and In-order traversals of in-order threaded binary tree, Concept of red and black trees, AVL Trees, B trees, B+ trees, Splay trees

UNIT - VI   FILE ORGANIZATION   7 Hours

External storage devices, File, File types and file organization (sequential, index sequential and Direct access), Primitive operations and implementations for each type and comparison

Text Books

1. R. Gilberg, B. Forouzan, "Data Structures: A pseudo Code Approach with C++", Cengage Learning, ISBN 9788131503140.
2. E. Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi, 1995, ISBN 16782928.

Reference Books

1. Bruno R Preiss, "Data Structures and Algorithms with Object-Oriented Design Patterns in C++", Wiley India Edition
2. G. A.V, PAI , "Data Structures and Algorithms ", McGraw Hill, ISBN -13: 978-0-07-066726-6
3. Y. Langsam, M. Augenstin, A. Tannenbaum, "Data Structures using C and C++", 2nd Edition, Prentice Hall of India, 2002, ISBN-81-203-1177-9.
4. A. Tharp ,"File Organization and Processing", 2008 ,Willey India edition, 9788126518685
5. J. Tremblay, P. Soresan, "An Introduction to Data Structures with Applications", 2nd edition, Tata McGraw Hill International Editions, 1984, ISBN-0-07-462471-7.
6. M. Folk, B. Zoellick, G. Riccardi, "File Structure An Object Oriented Approach with C++", Pearson Education, 2002, ISBN 81 - 7808 - 131 - 8.
7. M. Weiss, "Data Structures and Algorithm Analysis in C++", 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0
8. Goodrich, "Data Structures and Algorithms in C++ ", Wiley, ISBN-9788126512607

214453 : FOUNDATIONS OF COMMUNICATION AND COMPUTER NETWORK

Teaching Scheme:	Credits	Examination Scheme:
Lectures: 4 Hours/Week	04	In-Semester (Online): 50 Marks
		End-Semester: 50 Marks

Prerequisites : Discrete Structures, Engineering Mathematics I and II

Course Objectives :
1. To understand fundamentals of communication systems
2. To acquaint themselves with layered model used computer networks

Course Outcomes :
After successful completion of this course, student will be able to
1. Understand data/signal transmission over communication media
2. Recognize usage of various modulation techniques in communication
3. Analyze various spread spectrum and multiplexing techniques
4. Use concepts of data communication to solve various related problems
5. Understand error correction and detection techniques.
6. Acquaint with transmission media and their standards

Course Contents

UNIT – I   INTRODUCTION TO COMMUNICATION AND NETWORKING   9 Hours
Introduction To Communication Theory: Terminologies, Elements Of Analog Communication System, Baseband signal, Band-pass signal, Need For Modulation, Electromagnetic Spectrum And Typical Applications, Basics Of Signal (Analog And Digital,) Representation And Analysis (Time and frequency)
Introduction To basics of networking: Computer network fundamentals, ISO OSI Model: All Layers, TCP/IP Protocol Suite: All Layers, Addressing (Physical, Logical Port and Other), LAN, WAN And MAN, Network Topologies. Guided Media: Twisted-Pair Cable, Coaxial Cable and Fiber-Optic Cable, Unguided Media: Wireless, Radio Waves, Microwaves And Infrared, Wireless frequency spectrum.
Noise: External Noise, Internal Noise, Noise Calculations, Communication Channel. Discrete and Continuous Channel, Shannon-Hartley Theorem, Channel Capacity, Nyquist and Shanon Theorem, Bandwidth S/N Trade Off

UNIT – II   AMPLITUDE AND ANGLE MODULATION   8 Hours
Amplitude Modulation: Amplitude Modulation Techniques (DSBFC, DSBSC, SSB), Generation Of Amplitude Modulated Signals, Frequency Spectrum.
Angle Modulation Techniques: Theory Of Angle Modulation Techniques, Practical Issues In Frequency Modulation, Generation Of Frequency Modulation, Frequency Spectrum

UNIT – III   PULSE AND DIGITAL MODULATION TECHNIQUES   8 Hours
Pulse Modulation Techniques: Pulse Analog Modulation Techniques, sampling
Pulse Digital Modulation Techniques: PCM, DM, DPCM
Average Information, Entropy, Information Rate. Source coding: Shanon-Fano, Huffman and Limpel-Ziv
Digital-to-digital Conversion: Line Coding, Line Coding Schemes, Block Coding, Scrambling
Digital-to-analog Conversion: Aspects of Digital-to-Analog Conversion, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Quadrature Amplitude Modulation (QAM)
Analog-to-analog Conversion: Amplitude Modulation, Frequency Modulation, Phase Modulation

UNIT – IV   ERROR CONTROL CODING AND DATA LINK CONTROL   8 Hours

Error Detection and Correction:Introduction, Error Detection, Error Correction
Linear Block Codes: hamming code, Hamming Distance, parity check code
Cyclic Codes: CRC (Polynomials), Advantages Of Cyclic Codes, Other Cyclic Codes As Examples: CHECKSUM: One's Complement, Internet Checksum
Framing: fixed-size framing, variable size framing.
Flow control: flow control protocols.
Noiseless channels: simplest protocol, stop-and-wait protocol.
Noisy channels: stop-and-wait automatic repeat request, go-back-n automatic repeat request, Selective repeat automatic repeat request, piggybacking

UNIT – V   MULTIPLEXING AND MULTIPLE ACCESS   6 Hours

Multiplexing: FDM, TDM, Synchronous Time-Division Multiplexing, Statistical Time-Division Multiplexing, WDM, Spread Spectrum: FHSS and DSSS
Random access: ALOHA, CSMA, CSMS/CD and CSMA/ CA
Controlled Access: Reservation, Polling and Token Passing
Channelization: FDMA, TDMA and CDMA

UNIT - VI   PHYSICAL, MAC LAYER STANDARDS AND SWITCHING   6 Hours

LAN hardware: (Switches, routers, hubs, bridges and their types)
IEEE 802.3, Fast Ethernet (MAC Sublayer & Physical Layer), Gigabit Ethernet (MAC Sublayer, Physical Layer) Ten-Gigabit Ethernet, Token ring and token bus standards.
Circuit Switched Networks, Packet (Datagram) Networks, Virtual Circuits, Structure of Circuit and Packet Switches

Text Books

1. George Kennedy, Brendan Davis, srm Prasanna, "Electronic Communication Systems", 5th Edition,ISB N: 9780071077828, MGH Education
2. Behrouz A Forouzan , "Data Communications and Networking", 4th Ed, MGH

Reference Books

1. Simon Haykin and Michael Moher, "Introduction to Analog and Digital Communications" John Wiley & Sons, Inc.
2. Louis E. Frenzel, "Principles Of Electronic Communication Systems (SIE)", 3rd Edition, ISBN: 9780070667556
3. A S Tanenbaum, "Computer Networks", Pearson Education, 4th Edition
4. Roddy & Coolen, "Electronic communications", PHI
5. Kenedy & Davis, " Electronic Communication System", TMH
6. B.P. Lathi, "Modern Digital & Analogue Communication Systems", Ed.-3, Oxford Press.
7. H. Taub And K.L. Shiling, "Principles of Communication System", 3rd Edition, Tata Mcgraw Hill Education Private Limited
8. Irvine, "Data Communications and Networks: An Engineering Approach", Wiley, ISBN-9788126507658.
9. Keshav, "An Engineering Approach to Computer Networking", ISBN-9788131711453, Pearson Education.

214454 : PROCESSOR INTERFACING LABORATORY

Teaching Scheme: **Credits:**
Practical : 4 Hours/Week   02

Examination Scheme:
Term Work : 25 Marks
Practical : 50 Marks

Prerequisites: Processor Architecture and Interfacing, Computer Organization and Architecture

Course Objectives :
1. To learn assembly language programming of 80386 microprocessors and 8051 microcontrollers.
2. To learn interfacing of real world input and output devices to 8051 microcontroller

Course Outcomes :
After successful completion of this course, student will be able to
1. Learn and apply concepts related to assembly language programming
2. Write and execute assembly language program to perform array addition, code conversion, block transfer, sorting and string operations
3. Learn and apply interfacing of real world input and output devices to 8051 microcontroller

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant. The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, algorithm, sample test cases and references etc.

Guidelines for Student's Lab Journal

1) The laboratory assignments are to be submitted by student in the form of journal. The Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, circuit diagram, pin configuration, conclusion/analysis), printouts of the code written using coding standards, sample test cases etc.
2) Practical Examination will be based on the term work submitted by the student in the form of journal
3) Candidate is expected to know the theory involved in the experiment
4) The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department
5) All the assignment mentioned in the syllabus must be conducted

Guidelines for Lab /TW Assessment

1) Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2) Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out
3) Necessary knowledge of usage of software and hardware such as assembler, linker, debugger,

8051 microcontrollers and its interfacing kits should be checked by the concerned faculty member

Guidelines for Laboratory Conduction

1) The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

2) The guidelines published by BOS time to time regarding conduction of laboratory assignments and Practical/Oral examination is mandatory.

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Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

Suggested List of Laboratory Assignments

Group A: Microprocessor Programming

1. Write Assembly Language Program (ALP) to add array of N numbers stored in the memory.

2. Write menu driven ALP to convert 4-digit Hex number into its equivalent BCD number and 5-digit BCD number into its equivalent HEX number. Make your program user friendly to accept the choice from user for
   i. HEX to BCD   ii. BCD to HEX   iii. EXIT.
   Display proper strings to prompt the user while accepting the input and displaying the result. Write near procedures to complete the task.

3. Write ALP to perform following operation on string:
   i.   Find and display length
   ii.   Display reverse
   iii. Check whether string is palindrome or not.

   Display proper strings to prompt the user while accepting the input and displaying the result. Write near procedures to complete the task.

4. Write menu driven ALP to perform string manipulations. The strings to be accepted from the user is to be stored in code segment Module_1 and write FAR PROCEDURES in code segment Module_2 to perform any two of the following string operations:
   i.   Concatenation of two strings.
   ii.   Comparison of two strings.
   iii. Finding Number of occurrences of a sub-string in the given string
   iv.   Finding number of alphabets, digits, special characters, lower & upper case alphabets, words and number of lines from the text.

   Note: Use PUBLIC and EXTERN directives. Create .OBJ files of both the modules and link them to create an .EXE file.

5. Assignment on file operations

   Select any one of the following assignments

   a. Write menu driven program in C using int86, int86x, intdos and intdosx functions for implementing following operations on file.

   i. To delete a file

   ii. To create a directory

   iii. To copy a file

   b. Write 8086 ALP to read command line arguments using Program Segment Prefix (PSP) and simulate "DOS COPY Command". Use file handle function for handling the files. Handle all the errors and display appropriate message if user does not enter proper command line argument.

Group B: Microcontroller Programming

Assignment 6 and 7. Select any two of the following assignments:

   i. Write 8051 ALP to add n, 8 bits numbers found in internal ram location 40H onwards and store results in R6 and R7.

   ii. Write 8051 ALP to multiply 16 bit number by 8 bit number and store the result in internal memory location.

   iii. Write 8051 ALP for block transfer for internal / external memory.

   iv. Write 8051 ALP for sorting byte array in ascending / descending order.

8. Select any one of the following assignments.

   i. Timer programming: ISR based

   Write ALP to generate 2 KHz square wave using Timer interrupt on any port pin.

   ii. Serial port programming: ISR based

   Connect two 8051 microcontrollers using serial ports. Send FFh and 00H alternatively to receiver. Output received byte to port1, see port1 pin waveform on CRO.

9 & 10. Select any two of the following assignments:

   Write ALP to interface 8051 with:

   i. DAC to generate square, triangular and trapezoidal waveforms.

   ii. ADC to read and display equivalent digital output.

   iii. Stepper motor to rotate motor with different step angles and speeds.

   iv. Sensors (temperature, pressure) to read and display values of the physical parameters sensed.

   v. LCD to display message.

Note: This list of assignments is indicative. Concerned faculty member may frame different assignments if required maintaining similar difficulty level.

Reference Books

1. Peter Abel, Niyaz Nizamuddin, "IBM PC Assembly Language and Programming", Pearson Education
2. Ray Duncan, "Advanced MS DOS Programming", 2nd edition, BPB Publications
3. Intel 8051 Microcontroller manual.

214455 : DATA STRUCTURE AND FILES LABORATORY

Teaching Scheme: **Credits:**
Practical : 4 Hours/Week   02

Examination Scheme:
Term Work : 25 Marks
Practical : 50 Marks

Prerequisites : Fundamentals of Data Structures, Discrete Structures

Course Objectives :
1. To study data structures and their implementations using OOP (C++) and their applications
2. To study some advanced data structures such as trees, graphs and tables
3. To learn different file organizations

Course Outcomes :
After successful completion of this course, student will be able to
1. Apply and implement algorithm to illustrate use of linear data structures such as stack, queue
2. Apply and implement algorithms to create/represent and traverse non-linear data structures such as trees, graphs etc
3. Apply and implement algorithms to create and manipulate database using different file organizations
4. Learn and apply the concept of hashing in database creation and manipulation

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant. The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, algorithm written in pseudo language, sample test cases and references.

Guidelines for Student's Lab Journal

1) The laboratory assignments are to be submitted by student in the form of journal. The Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, algorithms, printouts of the code written using coding standards, sample test cases etc.
2) Practical Examination will be based on the term work submitted by the student in the form of journal
3) Candidate is expected to know the theory involved in the experiment
4) The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department
5) All the assignment mentioned in the syllabus must be conducted

Guidelines for Lab /TW Assessment

1) Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.

2) Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out

3) Appropriate knowledge of usage of software and hardware such as compiler, linker, debugger, coding standards, algorithms to be implemented should be checked by the concerned faculty member(s)

Guidelines for Laboratory Conduction

1) The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

2) The guidelines published by BOS time to time regarding conduction of laboratory assignments and Practical/Oral examination is mandatory

3) All the assignments should be implemented using C++

4) All the assignments should be conducted on multicore hardware and 64-bit open-source software

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

Suggested List of Laboratory Assignments

1. Implement stack as an abstract data type using linked list and use this ADT for conversion of infix expression to postfix, prefix and evaluation of postfix and prefix expression.

2. Implement priority queue as ADT using single linked list for servicing patients in an hospital with priorities as i) Serious (top priority) ii) medium illness (medium priority) iii) General (Least priority).

3. Create Binary tree and perform following operations:
    a. Insert
    b. Display
    c. Depth of a tree
    d. Display leaf-nodes
    e. Create a copy of a tree

4. Construct and expression tree from postfix/prefix expression and perform recursive and non-recursive In-order, pre-order and post-order traversals.

5. Implement binary search tree and perform following operations:
    a. Insert
    b. Delete
    c. Search
    d. Mirror image
    e. Display
    f. Display level wise

6. Consider a friends' network on face book social web site. Model it as a graph to represent each node as a user and a link to represent the fried relationship between them. Store data such as date of birth, number of comments for each user.
   1. Find who is having maximum friends
   2. Find who has post maximum and minimum comments
   3. Find users having birthday in this month.
   Hint: (Use adjacency list representation and perform DFS and BFS traversals)

7. Represent any real world graph using adjacency list /adjacency matrix find minimum spanning tree using Kruskal's algorithm.

8. Represent a given graph using adjacency matrix /adjacency list and find the shortest path using Dijkstra's algorithm (single source all destination).

9. Store data of students with telephone no and name in the structure using hashing function for telephone number and implement chaining with and without replacement.

10. A business house has several offices in different countries; they want to lease phone lines to connect them with each other and the phone company charges different rent to connect different pairs of cities. Business house want to connect all its offices with a minimum total cost. Solve the problem by suggesting appropriate data structures

11. Department maintains a student information. The file contains roll number, name, division and address. Write a program to create a sequential file to store and maintain student data. It should allow the user to add, delete information of student. Display information of particular employee. If record of student does not exist an appropriate message is displayed. If student record is found it should display the student details.

12. Implement direct access file using hashing (chaining without replacement) perform following operations on it
    a. Create Database
    b. Display Database
    c. Add a record
    d. Search a record
    e. Modify a record

Note: This list of assignments is indicative. Concerned faculty member may frame different assignments if required maintaining similar difficulty level.

Reference Books
1. R. Gilberg, B. Forouzan, "Data Structures: A pseudo Code Approach with C++", Cengage Learning, ISBN 9788131503140
2. E. Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi, 1995, ISBN 16782928

214456 : COMPUTER GRAPHICS LABORATORY

Teaching Scheme:	**Credits**	**Examination Scheme:**
Practical : 2 Hours/Week	01	**Term Work** : 25 Marks
		Practical : 50 Marks

Prerequisites:
1. Basic Geometry, Trigonometry, Vectors and Matrices
2. Basics of Data Structures and Algorithms

Course Objectives :
1. To acquaint the learners with the basic concepts of Computer Graphics
2. To learn the various algorithms for generating and rendering graphical figures
3. To get familiar with mathematics behind the graphical transformations
4. To understand and apply various methods and techniques regarding projections, animation, shading, illumination and lighting

Course Outcomes :
On completion of the course, learner will be able to –
1. Apply and implement line drawing and circle drawing algorithms to draw specific shape given in the problem
2. Apply and implement polygon filling algorithm for a given polygon
3. Apply and implement 2-D and 3-D transformation algorithms for given input shape
4. Apply and implement polygon clipping algorithm for given input polygon
5. Apply and implement fractal generation algorithm for a given input
6. Apply and implement animation concepts for generating simple animation without using any animation tool

Guidelines for Instructor's Manual
The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant. The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, algorithm written in pseudo language, sample test cases and references.

Guidelines for Student's Lab Journal
1) The laboratory assignments are to be submitted by student in the form of journal. The Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, algorithms, printouts of the code written using coding standards, sample test cases etc.
2) Practical Examination will be based on the term work submitted by the student in the form of journal
3) Candidate is expected to know the theory involved in the experiment
4) The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department
5) All the assignment mentioned in the syllabus must be conducted

Guidelines for Lab /TW Assessment

1) Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2) Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out
3) Appropriate knowledge of usage of software and hardware such as compiler, linker, debugger, coding standards, algorithms to be implemented should be checked by the concerned faculty member(s)

Guidelines for Laboratory Conduction

5) The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.
6) The guidelines published by BOS time to time regarding conduction of laboratory assignments and Practical/Oral examination is mandatory
7) All the assignments should be conducted on multicore hardware and 64-bit open-source software
8) All the assignments should be conducted preferably using OpenGL or Linux platform
9) **Implement any 4 assignments from group A and any 4 assignments from group B**

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

Suggested List of Laboratory Assignments

Group A

1. A Mandelbrot Set is a set of complex number z that does not diverge under the transformation $x_{n+1} = x_n^2 + z$ with $x_0 = 0$. Where, both x and z represent the complex numbers.
   a)Plot the Mandelbrot set for the threshold |x|= 2.
   b) Plot Julia set choosing z ≠ 0. Use 254 colors for plotting in both cases. Change the threshold to observe different patterns.
2. Draw the polygons by using the mouse. Choose colors by clicking on the designed color pane. Use window port to draw. (Use DDA algorithm for line drawing)
3. Draw inscribed and Circumscribed circles in the triangle as shown as an example below (Use any Circle drawing and Line drawing algorithms)
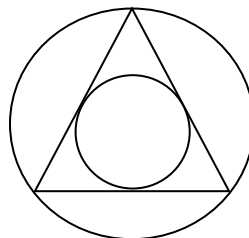
4. Draw the following pattern using any Line drawing algorithms.
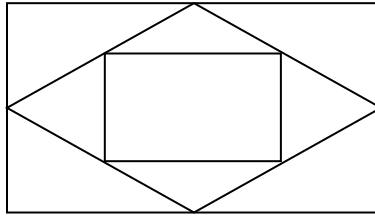
5. Draw a 4X4 chessboard rotated 45˚ with the horizontal axis. Use Bresenham algorithm to draw all the lines. Use seed fill algorithm to fill black squares of the rotated chessboard

Group B

1. Implement Cohen Sutherland Hodgman algorithm to clip any given polygon. Provide the vertices of the polygon to be clipped and pattern of clipping interactively.
2. Implement translation, sheer, rotation and scaling transformations on equilateral triangle and rhombus.
3. Implement Cube rotation about vertical axis passing through its centroid.
4. Generate fractal patterns by using Koch curves.
5. Animation : Implement any one of the following animation assignments,
    - i) Clock with pendulum
    - ii) National Flag hoisting
    - iii) Vehicle/boat locomotion
    - iv) Falling Water drop into the water and generated waves after impact
    - v) Kaleidoscope views generation (at least 3 colorful patterns)

Note: This list of assignments is indicative. Concerned faculty member may frame different assignments if required maintaining similar difficulty level.

Reference Books

1. S. Harrington, "Computer Graphics", 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6.
2. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.

Audit Course2

In addition to credits course, it is recommended that there should be audit course (non-credit course) preferably in each semester from second year. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

(Ref-http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/
UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

• Lectures/ Guest Lectures
• Visits (Social/Field) and reports
• Demonstrations
• Surveys
• Mini Project
• Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

• Written Test
• Demonstrations/ Practical Test
• Presentations
• IPR/Publication
• Report

List of courses under Audit Course2

Course Code	Audit Course Title
210258:AC2-I	Water Management
210258:AC2-II	Intellectual Property Rights and Patents
210258:AC2-III	The Science of Happiness
210258:AC2-IV	Stress Relief: Yoga and Meditation

The detail course contents of above mentioned audit courses are available in Computer Engineering 2015 course.

Moreover students can opt for any other audit course from the list of Audit Course of any branch of engineering.