Annexure II

Sem-II

Syllabus of B.Tech. -MAC

Department of Engineering Mathematics and Computing

Object Oriented Programming & Methodology
Subject Code: 25241201

Course Objectives

- To study about the concept of object-oriented programming.
- To create C++ programs that leverage the object-oriented features.
- To apply object-oriented techniques to solve real world problems.

Unit I:

Object Oriented Paradigm, Features of OOPs: Encapsulation, Class and Object, Inheritance, Reusability, Polymorphism, Abstraction etc, Comparison with Procedural Oriented Programming & Object-Oriented Programming, Function Overloading, Default Augments, References, Inline Functions.

Unit II:

Classes & Objects: Specification of Class, Visibility Modes: Private, Public, Protected, Defining Member Functions, Creating of Objects, Static Data Member, Static Member Function, Array of Objects, Object as Arguments, Friend Function and Class, Member Function, Member Initializer List, Constructors and Destructors, Deference between Class and Structure.

Unit III:

Dynamic Allocations: New, Delete, Malloc and Free, Dynamic Allocation of Objects, Array of Objects, Mutable Data Members, Self-Referential Class, Shallow and Deep Copying, This Pointer, Proxy Classes.
Operator Overloading: Overloading Unary and Binary Operators, **Type Casting:** Implicit, Explicit, Dynamic, Static, Reinterpret, Conversion Between Objects of Various Classes.

Unit IV:

Inheritance: Introduction to Code Reuse, Visibility Modes, Types of Inheritance, Ambiguity in Inheritance, Virtual Base Classes, Constructors in Derived Classes. **Polymorphism:** Dynamic and Static Binding, Pure Virtual Function, Abstract and Concrete Classes, Virtual Destructors, Containership: Nesting of Classes.

Unit V:

Exception Handling: Try, Catch and Throw, Streams and File: Basic Concept and Class Hierarchy, Templates: Function Template, Class Template, Template Specialization, Default Type Arguments and Templates, Namespaces and their uses.

Recommended Books

1. C++ How to Program: H M Deitel and P J Deitel, Prentice Hall,1998.
2. Object Oriented Programming in Turbo C++: Robert Lafore, The WAITE Group Press, 1994.
3. Programming with C++: D Ravichandran, T.M.H, 2003.
4. Object oriented Programming with C++: E Balagurusamy, Tata McGraw-Hill, 2001.
5. The Complete Reference in C++: Herbert Schildt, TMH, 2002.
6. Object Oriented Analysis & Design: G. Booch, Addison Wesley, 2006.
7. Principles of Object-Oriented Analysis and Design: James Martin, Prentice Hall, 1992.

Course Outcomes

After completion of this course, the students would be able to:

CO1. Tell procedural and object-oriented paradigm with concepts of classes, functions, data and objects.
CO2. Explain dynamic memory management techniques using constructors, destructors, etc.
CO3. Build C++ classes using appropriate features of object-oriented programming.
CO4. Apply object orient programming concepts for real world problem.
CO5. Analyze the utilization of inheritance and polymorphism in the solution of problems.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	2	1	1	1	1	2	1	1	3	1
CO2	3	3	2	1	2	1	1	1	1	2	1	1	3	1
CO3	3	3	3	1	3	1	1	1	1	2	1	1	3	1
CO4	3	3	3	1	3	1	1	1	1	2	1	1	3	1
CO5	3	3	3	1	3	1	1	1	1	2	1	1	3	2

1 - Slightly; 2 - Moderately; 3 – Substantially

Department of Engineering Mathematics and Computing

Data Structures
Subject Code: 25241202

COURSE OBJECTIVES

- To be familiar with the use of data structures as the foundational base for computer solutions to problems.
- To understand various techniques of searching and sorting.
- To understand basic concepts about stacks, queues, lists, trees and graphs.

Unit I:
Introduction to Data Structures: Algorithms & their Characteristics, Asymptotic Notations, Arrays and its Representations, Index to Address Translation, **Link List:** Introduction, Implementation of Linked List, Operations, Circular Link List, Doubly Linked List, Polynomial Manipulation using Linked List.

Unit II:
Stacks: Concepts and Implementation of Stacks, Operations on Stack, Conversion of Infix to Postfix Notation, Evaluation of Postfix Expression, Recursion.
Queues: Concepts and Implementation, Operations on Queues, Dequeue, Priority Queues, Circular Queues and Application.

Unit III:
Trees: Types, Terminology, Binary Tree -Representations, Traversal, Conversion of General Tree to Binary Tree, Binary Search Tree, Threaded Binary Tree and Height Balanced Tree.

Unit IV:
Graphs: Background, Graph Theory Terminologies, Representation of Graphs- Sequential & Linked Representation, Path Matrix, Graph Traversals- BFS, DFS, Spanning Trees, Applications of Graph.

Unit V:
Searching & Sorting: Linear Search, Binary Search, Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Radix Sort and Heap Sort, Comparison Between Sorting Techniques, Hashing and Collision Resolution Techniques.

Recommended Books

1. Data Structures, Algorithms and Applications in C++, Sartaj Sahni, 2nd Edition.
2. An Introduction to Data Structures with Applications, Jean-Paul Tremblay, Mcgraw hill.
3. Data Structures & Algorithms, Aho, Hopcroft & Ullman, Original Edition, Pearson Publication.

Course Outcomes

After completion of this course, the students would be able to:
CO1. Explain the working of linear/Non-Linear data structures.
CO2. Apply the appropriate data structure to solve specific problems.
CO3. Analyze the performance of various data structures & their applications.
CO4. Demonstrate the representation and traversal techniques of graphs and their applications.
CO5. Design the optimal algorithmic solutions for various problems.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1	1	1	1	1	1	2	1	1	2	1
CO2	3	3	3	3	3	1	1	1	1	2	1	1	3	1
CO3	1	1	3	1	1	1	1	1	1	2	1	1	1	3
CO4	3	3	1	2	2	1	1	1	1	2	1	1	3	1
CO5	3	3	3	3	1	1	1	1	1	2	1	1	3	1

1 - Slightly; 2 - Moderately; 3 – Substantially

Department of Engineering Mathematics and Computing

Numerical Techniques
(Subject Code: 25241203)

Course Objective

- To perceive the Error of computation
- To enumerate the concept of interpolation, extrapolation, numerical differential, and integration
- To understand numerical solution of ordinary differential equation
- To explore the finite difference methods

Unit 1:

Problem solving on computer, Algorithms and flow charts, Introduction to numerical computing, approximations and errors in numerical computations. Useful rules for estimating Errors, Truncation and round off errors, propagation of errors, Error in the Approximation of function, Error in Approximation

Bisection method, Regula Falsi method, Iteration method, Newton Raphson method, Secant method, convergence of iterative methods.

Unit 2:

Matrix algebra, Solution of simultaneous linear algebraic equations: Gauss elimination, Gauss Jordan method, LU decomposition, Jacobi method, Gauss Seidel method, SOR method, Ill and well condition of equations, Condition of a system and stability issues., Finite Differences, forward, backward and central operators, Shifting operators, Averaging Operators, Differences of a polynomial, Factorial Notation, Relation between operators.

Unit 3:

Newton's forward and backward interpolation formula, Lagrange interpolation formula, Divided differences and Newton's divided difference formula, Inverse Interpolation, Numerical differentiation, Numerical integration: Newton-Cotes integration formulas, Trapezoidal, Simpson's rules (1/3 & 3/8) and Weddle rules.

Unit 4:

Taylor series method, Picard's method, Euler's method, Modified Euler's method, RungeKutta methods fourth order. Multistep methods: Milne's Predictor corrector method, Numerical solution of the simultaneous linear differential equation, Second order differential equation.

Unit 5:

Classification of partial differential equation, Finite difference method, Numerical solution of Partial Differential equations, five-point formula, Laplace and Poisson equation.

Course Outcomes

After completing this course, the students will be able to:

CO's	Description of CO's
CO1	Identify the concepts Algebraic & Transcendental Equations
CO2	Acquire the knowledge of difference operators
CO3	Illustrate numerical integration and differentiation
CO4	Evaluate the problems of ordinary differential equation employing numerical techniques
CO5	Test the Partial differential equations by finite difference method

Recommended Books:

1. B. S. Grewal: Higher Engineering Mathematics, Khanna Publisher, 43rd Edition, 2015.
2. B.V. Ramanna: Higher Engineering Mathematics, McGraw Hill,1st Edition, 2017.
3. S.S. Sastry: Introductory Methods of Numerical Analysis, PHI Learning Private Limited, 4th edition, 2007.
4. J. H. Mathews and K. D. Fink: Numerical Methods using MATLAB, PHI, 4th edition, 2007.
5. C.F. Gerald and P.O. Wheatley: Applied Numerical Analysis, Pearson Education, 6th edition, 2006.
6. H. K. Dass: Advance Engineering Mathematics, S. Chand& Company, Publisher, 2018.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	1	1	1	1	1	3	3	3
CO2	3	2	3	3	3	2	1	1	1	1	1	3	3	3
CO3	3	3	3	3	3	2	1	1	1	1	1	3	3	3
CO4	3	3	3	3	3	2	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	2	2	1	1	1	1	3	3	3

1 - Slightly; 2 - Moderately; 3 – Substantially

Department of Engineering Mathematics and Computing

Computer Organization & Architecture
Subject Code: 25241204

Course Objective

- To understand how the computer systems, work and its basic principles.
- To know about ALU operations, fixed point arithmetic and floating-point Arithmetic, instruction set architecture, execution cycle and different types of Control Units.
- To be familiar with the Memory System Design, different types of Memories.
- To understand how the I/O devices are accessed, its principles and concepts of pipelining and Parallel Processing.

Unit I:
Functional Blocks of a Computer: CPU, Memory, Input-Output Unit, Control Unit, Basic Operational Concepts, Von Neumann Architecture.
Data Representation: Signed Number Representation, Fixed- and Floating-Point Representations, Computer Arithmetic– Integer Addition and Subtraction, Ripple Carry Adder, Carry Look-Ahead Adder, Multiplication: Shift and Add, Booth Multiplier.
Unit II:
Introduction to 8086 Architecture, Architecture of a CPU: Register Transfer Language, Register Transfer, Memory Transfer, Instruction Cycle, Addressing Modes, Instruction Set, CISC v/s RISC Architecture, CPU Control Unit Design: Hardwired and Micro-Programmed.
Unit III:
Memory Organization: Memory Hierarchy, Memory Interleaving, Cache Memory, Mapping Functions, Write Policies.
Unit IV:
Peripheral Devices: Characteristics, I/O Device Interface, Data Transfer Modes, I/O Transfers: Program Controlled, Interrupt Driven and DMA, Interrupts and Exceptions.
Unit V:
Pipelining: Basic Concepts of Pipelining, Pipelining Hazards, Parallel Processors: Introduction, Shared Memory Multiprocessors and Cache Coherency.
Recommended Books

1. Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB /McGraw-Hill
2. Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
3. Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Course Outcomes

After completion of this course, the students would be able to:

CO1. Define the basics of computer systems, ALU operations, fixed point arithmetic and floating-point Arithmetic.
CO2. Explain different types of instructions and instruction execution cycle along with types of control units.
CO3. Illustrate the memory system design and different types of memories.
CO4. Explain the access of I/O devices and its principles.
CO5. Discuss the concepts of pipelining and parallel processing.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	2	1	1	1	1	2	1	2	3	1
CO2	3	3	1	1	2	1	1	1	1	2	1	2	3	1
CO3	3	3	1	1	2	1	1	1	1	2	1	2	3	1
CO4	3	3	1	1	2	1	1	1	1	2	1	2	3	1
CO5	3	3	1	1	2	1	1	1	1	2	1	2	3	1

1 - Slightly; 2 - Moderately; 3 – Substantially

Department of Engineering Mathematics and Computing

Linear Algebra
Subject Code: 25241205

Objective of Course

- To understand the concept Matrices and its applications
- To comprehend the various aspect of algebraic structures
- To explore vector space
- To perceive knowledge of linear transformation and their application

Unit1:
Matrix, Rank of Matrix, Echelon form, Normal form of matrix, Solution of simultaneous equation by elementary transformation, Consistency of equation, Eigen values and Eigenvectors, Normalized eigenvector, Cayley Hamilton theorem and its application to finding inverse of matrix.

Unit2:
Introduction of Groups and its properties, Sub-groups, Coset, Lagrange's theorem for finite group, Ring and its properties, Field, Integral domain.

Unit3:
Vector spaces over the field and its properties, sub-spaces, linear dependent vectors and linear independent vectors, linear combination of vectors, linear span of a set of vectors, basis and dimension of a vector space.

Unit4:
Linear transformation, Kernel and range space of linear transformation, Nullity and Rank, Singular and Non-Singular transformation, Matrix representation of a linear transformation.

Unit5:
Inner product spaces, Properties of inner product space, Schwarz's inequality, Triangular inequality, Parallelogram Law, Orthogonality, Pythagoras theorem.

CO's	Description of CO's
CO1	Determine the solution of matrices
CO2	Find the analytical solution of algebraic structures
CO3	Relate the use of vector space in computation
CO4	Acquire the knowledge of linear transformations
CO5	Illustrate the concept of inner product spaces

Recommended Books:

1. S. Lipschutz and M. Lipson, Linear Algebra (4th Edition), Schaum's Outline series, Mc- Graw Hill. (2009).
2. S. Boyd and L. Vandenberghe, Introduction to Applied Linear Algebra Vectors, Matrices, and Least Squares, University Printing House, Cambridge CB2 8BS, United Kingdom One Liberty Plaza, 20thFloor, New York, NY10006, USA, (2018).
3. E.Kreyszig: Advance Engineering Mathematics, JohnWiley&Sons,10thEdition(2011).
4. R. K. Jain, S. R. K. Iyengar: Advance Engineering Mathematics, Narosa Publishing House Pvt. Ltd, 5th Edition (2016).

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	3	2	1	1	1	1	1	3	3	3
CO2	3	2	3	3	3	2	1	1	1	1	1	2	3	3
CO3	3	2	3	3	3	2	1	1	1	1	1	3	2	3
CO4	3	3	2	3	3	2	2	1	1	1	1	3	3	2
CO5	3	2	3	3	2	2	2	1	1	1	1	3	2	3

1 - Slightly; 2 - Moderately; 3 – Substantially

Department of Engineering Mathematics and Computing

Course Name: Sustainability & Environmental Science
Course Code: 25241211

Course Objectives:

To equip students with a comprehensive understanding of environmental science, pollution control, sustainability, and global frameworks, enabling them to analyze environmental challenges and contribute to sustainable solutions through informed decision-making and responsible practices.

Unit I

Introduction to Environmental Science: definition, importance and its components. Ecosystem and its components. Water cycle, carbon cycle, food chain, energy flow in ecosystem. Current state of environment in India and world; Underlying reasons (root causes) of modern environmental degradation (social, psychological, cultural).

Unit II

Environmental Pollution and Management: air, water, noise, soil, thermal and radioactive. Causes, impacts, pollution control techniques and mitigation strategies. Solid waste management: Principles of waste management, different components of waste management system and introduction to management of hazardous waste like e-waste, plastic waste. Global environmental Issues: Climate change, global warming, ozone layer depletion.

Unit III

Environmental policies and laws in India: Environmental Protection Act, Water Act, Air Act. **Overview of global environmental policies and frameworks**: Kyoto protocol, Montreal protocol, COP summits. Introduction to clean development mechanism, carbon credit, carbon trading.

Unit IV

Sustainability concepts: definition, importance, pillars of sustainability (economic, environmental, and social). Sustainable development. Overview of UN Sustainable Development Goals (SDGs) and their global relevance. Concept of circular economy, resource efficiency, energy conservation, green buildings and sustainable manufacturing.

Unit V

Sustainable Energy solutions: New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy. Introduction to sustainable transportation systems and sustainable water infrastructure.

Course Outcomes:

Upon completion of the course the student will be able to:

CO's	Description of CO's
CO1	**Explain** the fundamental concepts of environmental science, including ecosystems and the causes of environmental degradation
CO2	**Analyze** the sources, causes, and impacts of air, water, and solid waste pollution and propose appropriate mitigation strategies
CO3	**Evaluate** the effectiveness of environmental policies and global frameworks in addressing environmental challenges.
CO4	**Explain** the concepts of sustainability and sustainable development goals.
CO5	**Apply** various solutions for achieving sustainable development.

Reference Book

1. D. K. Asthana, Meera Asthana, A Text Book of Environmental Studies, S Chand & Co., New Delhi.
2. S. K. Dhameja, Environmental Engineering & Management, S K Kataria & Sons, New Delhi
3. C. S. Rao, Environmental Pollution Control Engineering, C.S. Rao, New Age International Publishers
4. A. K. Gupta, Environmental Sustainability and Green Technologies, PHI Learning.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	1	-	-	-	-	1	-	-
CO2	2	2	2	-	-	-	3	-	-	-	-	2	-	-
CO3	-	-	1	-	-	2	2	-	-	-	-	2	-	-
CO4	-	-	-	-	-	-	2	-	-	-	-	2	-	-
CO5	2	2	2	-	-	1	3	-	-	-	-	2	-	-

1 - Slightly; 2 - Moderately; 3 – Substantially