



# SPPU B.E./B.Tech CSE Sem 3 syllabus

## Discrete Mathematics

### 210241: Discrete Mathematics

#### Credit 04

#### Unit I Set Theory and Logic

Introduction and significance of Discrete Mathematics, Sets- Naïve Set Theory (Cantor's Set Theory), Axiomatic Set Theory, Set Operations, Cardinality of set, Principle of inclusion and exclusion. Types of Sets - Bounded and Unbounded Sets, Diagonalization Argument, Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets, Power set, Propositional Logic- logic, Propositional Equivalences, Application of Propositional Logic- Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction

#Exemplar/Case Studies Know about the great philosophers- Georg Cantor, RichardM Dedekind and Aristotle

Mapping of Course Outcomes for Unit I CO1, CO3

#### Unit II Relations and Functions

Relations and their Properties, n-ary relations and their applications, Representing relations , Closures of relations, Equivalence relations, Partial orderings, Partitions, Hasse diagram, Lattices, Chains and Anti-Chains, Transitive closure and Warshall's algorithm. Functions- Surjective, Injective and Bijective functions, Identity function, Partial function, Invertible function, Constant function, Inverse functions and Compositions of functions, The Pigeonhole Principle.

#Exemplar/Case Studies Know about the great philosophers-Dirichlet  
Mapping of Course Outcomes for Unit II CO2

#### Unit III Counting Principles

The Basics of Counting, rule of Sum and Product, Permutations and

Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Algorithms for generating Permutations and Combinations.

#Exemplar/Case Studies Study Sudoku solving algorithms and algorithm for generation of new SUDOKU. Study Hand-shake Puzzle and algorithm to solve it

Mapping of Course Outcomes for Unit III

### **Unit IV Graph Theory**

Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, the handshaking lemma, Single source shortest path- Dijkstra's Algorithm, Planar Graphs, Graph Colouring.

#Exemplar/Case Studies Three utility problem, Web Graph, Google map

Mapping of Course Outcomes for Unit IV CO4

### **Unit V Trees**

Introduction, properties of trees, Binary search tree, tree traversal, decision tree, prefix codes and Huffman coding, cut sets, Spanning Trees and Minimum Spanning Tree, Kruskal's and Prim's algorithms, The Max flow- Min Cut Theorem (Transport network).

#Exemplar/Case Studies Algebraic Expression tree, Tic-tac-toe game tree

Mapping of Course Outcomes for Unit V CO4, CO5

### **Unit VI Algebraic Structures and Coding Theory**

The structure of algebra, Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism and Normal Subgroups, and Congruence relations, Rings, Integral Domains and Fields, Coding theory, Polynomial Rings and polynomial Codes, Galois Theory -Field Theory and Group Theory.

#Exemplar/Case Studies Cryptography used in world war II

Mapping of Course Outcomes for Unit VI CO6

## **Learning Resources**

### **Text Books:**

1. C. L. Liu, —Elements of Discrete Mathematics||, TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, --“Discrete Mathematics”, 3rd Ed, Oxford University Press, ISBN 0 -19-850717-8.

## **Reference Books:**

1. Bernard Kolman, Robert C. Busby and Sharon Ross, —Discrete Mathematical Structures||, Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
2. Narsingh Deo, “Graph with application to Engineering and Computer Science”, Prentice Hall of India, 1990, 0 - 87692 - 145 - 4.
3. Eric Gossett, “Discrete Mathematical Structures with Proofs”, Wiley India Ltd, ISBN:978-81-265-2758-8.
4. Sriram P & Steven S., “Computational Discrete Mathematics”, Cambridge University Press, ISBN 13: 978-0-521-73311-3.
5. Kenneth H. Rosen, —Discrete Mathematics and its Applications||, Tata McGraw-Hill, ISBN 978-0-07-288008-3

## **Fundamentals of Data Structures**

### **210242: Fundamentals of Data Structures**

#### **Credit 03**

#### **Unit I Introduction to Algorithm and Data Structures**

Introduction: From Problem to Data Structure (Problem, Logic, Algorithm, and Data Structure).

Data Structures: Data, Information, Knowledge, and Data structure, Abstract Data Types (ADT), Data Structure Classification (Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures)

Algorithms: Problem Solving, Introduction to algorithm, Characteristics of algorithm, Algorithm design tools: Pseudo-code and flowchart

Complexity of algorithm: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and

Omega, Finding complexity using step count method, Analysis of programming constructs-Linear, Quadratic, Cubic, Logarithmic.

Algorithmic Strategies- Introduction to algorithm design strategies- Divide and Conquer, and Greedy strategy.

#Exemplar/Case Studies Multiplication technique by the mathematician Carl Friedrich Gauss and Karatsuba algorithm for fast multiplication.

Mapping of Course Outcomes for Unit I CO3, CO5, CO6

## **Unit II Linear Data Structure Using Sequential Organization**

Concept of Sequential Organization, Overview of Array, Array as an Abstract Data Type, Operations on Array, Merging of two arrays, Storage Representation and their Address Calculation: Row major and Column Major, Multidimensional Arrays: Two-dimensional arrays, n-dimensional arrays. Concept of Ordered List, Single Variable Polynomial: Representation using arrays, Polynomial as array of structure, Polynomial addition, Polynomial multiplication. Sparse Matrix: Sparse matrix representation using array, Sparse matrix addition, Transpose of sparse matrix- Simple and Fast Transpose, Time and Space tradeoff.

#Exemplar/Case Studies Study use of sparse matrix in Social Networks and Maps. Study how Economists use polynomials to model economic growth patterns, how medical researchers use them to describe the behaviour of Covid-19 virus.

Mapping of Course Outcomes for Unit II CO1, CO2, CO3

## **Unit III Searching and Sorting**

**Searching:** Search Techniques-Sequential Search/Linear Search, Variant of Sequential Search- Sentinel Search, Binary Search, Fibonacci Search, and Indexed Sequential Search.

**Sorting:** Types of Sorting-Internal and External Sorting, General Sort Concepts-Sort Order, Stability, Efficiency, and Number of Passes, Comparison Based Sorting Methods-Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell Sort, Non-comparison Based Sorting Methods-Radix Sort, Counting Sort, and Bucket Sort, Comparison of All Sorting Methods and their complexities.

#Exemplar/Case Studies Use of Fibonacci search in non-uniform access memory storage and in Optimization of Unimodal Functions. Timsort as a hybrid stable sorting algorithm

Mapping of Course Outcomes for Unit III CO1, CO3, CO4

## **Unit IV Linked List**

Introduction to Static and Dynamic Memory Allocation, Linked List: Introduction, of Linked Lists, Realization of linked list using dynamic memory management,

operations, Linked List as ADT, Types of Linked List: singly linked, linear and Circular Linked Lists, Doubly Linked List, Doubly Circular Linked List, Primitive Operations on Linked List-Create, Traverse, Search, Insert, Delete, Sort, Concatenate. Polynomial Manipulations-Polynomial addition. Generalized Linked List (GLL) concept, Representation of Polynomial using GLL.  
#Exemplar/Case Studies Garbage Collection  
Mapping of Course Outcomes for Unit IV CO1, CO2, CO5

### **Unit V Stack**

Basic concept, stack Abstract Data Type, Representation of Stacks Using Sequential Organization, stack operations, Multiple Stacks, Applications of Stack- Expression Evaluation and Conversion, Polish notation and expression conversion, Need for prefix and postfix expressions, Postfix expression evaluation, Linked Stack and Operations. Recursion- concept, variants of recursion- direct, indirect, tail and tree, Backtracking algorithmic strategy, use of stack in backtracking.  
#Exemplar/Case Studies Android- multiple tasks/multiple activities and back-stack, Tower of Hanoi, 4 Queens problem.

Mapping of Course Outcomes for Unit V CO1, CO2, CO5, CO6

### **Unit VI Queue**

Basic concept, Queue as Abstract Data Type, Representation of Queue using Sequential organization, Queue Operations, Circular Queue and its advantages, Multi-queues, Linked Queue and Operations. Deque-Basic concept, types (Input restricted and Output restricted), Priority Queue- Basic concept, types(Ascending and Descending).  
#Exemplar/Case Studies Priority queue in bandwidth management  
Mapping of Course Outcomes for Unit VI CO1, CO2, CO5, CO6

### **Learning Resources**

#### **Text Books:**

1. Horowitz and Sahani—Fundamentals of Data Structures in C++, University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926.

2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley Publication, ISBN: 978-1-118-29027-9

### **Reference Books:**

1. Brassard & Bratley —Fundamentals of Algorithmic Prentice Hall India/Pearson Education, ISBN 13-9788120311312.

2. Allen Downey, Jeffery Elkner, Chris Meyers-How to think like a Computer Scientist: Learning with Python, Dreamtech Press, ISBN:9789351198147.

3. R. Gillberg, B. Forouzn —Data Structures: A Pseudo code approach with C, Cenage Learning, ISBN: 9788131503140.

4. M. Weiss—Data Structures and Algorithm Analysis in C++, 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0.

## **Object Oriented Programming**

### **210243: Object Oriented Programming**

#### **Credit 03**

#### **Unit I Fundamentals of Object Oriented Programming**

Introduction to procedural, modular, generic and object-oriented programming techniques, limitations of procedural programming, Need of object-oriented programming, OOP Paradigms, Fundamentals of object-oriented programming: Namespaces, objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism.

Benefits of OOP, C++ as object oriented programming language.

**C++ Programming-** C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, Access specifiers, separating interface from implementation.

**Functions-** Function, function prototype, accessing function and utility function, Constructors and destructor, Types of constructor ,Objects and Memory requirements, Static members: variable and

functions, inline function, friend function.

#Exemplar/Case Studies Story of C++ invention by Bjarne Stroustrup

Mapping of Course Outcomes for Unit I CO1

## **Unit II Inheritance and Pointers**

**Inheritance-** Base Class and derived Class, protected members, relationship between base Class and

derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class

Hierarchies, Public and Private Inheritance, Types of Inheritance, Ambiguity in Multiple Inheritance,

Virtual Base Class, Abstract class, Friend Class , Nested Class.

**Pointers:** declaring and initializing pointers, indirection Operators, Memory Management: new and

delete, Pointers to Objects, this pointer, Pointers Vs Arrays, accessing Arrays using pointers, Arrays of

Pointers, Function pointers, Pointers to Pointers, Pointers to Derived classes, Passing pointers to

functions, Return pointers from functions, Null pointer, void pointer.

#Exemplar/Case Studies Know about Firefox and Thunderbird as popular softwares developed using C++

Mapping of Course Outcomes for Unit II CO2, CO3, CO4

## **Unit III Polymorphism**

Polymorphism- Introduction to Polymorphism, Early and late binding, Types of Polymorphism:

Operator Overloading- concept of overloading, operator overloading, Overloading Unary Operators,

Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of

Operator Overloading and Conversion, Keywords explicit and mutable.

Function overloading

Run Time Polymorphism- Pointers to Base class, virtual function and its significance in C++, pure

virtual function and virtual table, virtual destructor, abstract base class.

#Exemplar/Case Studies Study about use of C++ SDKs wrappers for Java and .Net.

Mapping of Course Outcomes for Unit III CO2, CO3, CO4

## **Unit IV Files and Streams**

Data hierarchy, Stream and files, Stream Classes, Stream Errors, Disk

File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output

#Exemplar/Case Studies Study features used for Microsoft Office, Internet Explorer and Visual Studio that are written in Visual C++

Mapping of Course Outcomes for Unit IV CO2, CO3, CO4

## **Unit V Exception Handling & Templates**

Exception Handling- Fundamentals, other error handling techniques, simple exception handling-

Divide by Zero, Multiple catching, re-throwing an exception, exception specifications, user defined exceptions, processing unexpected exceptions, constructor, destructor and exception handling,

exception and inheritance.

Templates- , The Power of Templates, Function template, overloading Function templates, and class

template, class template and Nontype parameters, template and friends Generic Functions, The typename and export keywords.

#Exemplar/Case Studies Study about use of exception handling in Symbian Operating System (discontinued mobile operating system) that was developed using C++.

Mapping of Course Outcomes for Unit V CO2, CO3, CO4

## **Unit VI Standard Template Library (STL)**

Introduction to STL, STL Components, Containers- Sequence container and associative containers,

container adapters, Application of Container classes: vector, list, Algorithms- basic searching and

sorting algorithms, min-max algorithm, set operations, heap sort, Iterators- input, output, forward,

bidirectional and random access. Object Oriented Programming – a road map to future

#Exemplar/Case Studies Study MySQL open source C++ code available at GitHub.

Mapping of Course Outcomes for Unit VI CO2, CO3, CO4

## **Learning Resources**



## **Text Books:**

1. E Balagurusamy Object-Oriented Programming with C++.7th edition.McGraw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
2. Robert Lafore, — Object-Oriented Programming in C++ ||, fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089

## **Reference Books:**

1. Herbert Schildt, —C++ The complete reference||, Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805
2. Matt Weisfeld, —The Object-Oriented Thought Process, Third Edition Pearson ISBN-13:075-2063330166
3. Cox Brad, Andrew J. Novobilski, —Object -Oriented Programming: An EvolutionaryApproach||, Second Edition, Addison-Wesley, ISBN:13:978-020-1548341
4. Deitel, “C++ How to Program”, 4th Edition, Pearson Education, ISBN:81-297-0276-2

## **Computer Graphics**

### **210244: Computer Graphics**

### **Credit 03**

### **Unit I Graphics Primitives and Scan Conversion Algorithms**

Introduction, graphics primitives - pixel, resolution, aspect ratio, frame buffer. Display devices, applications of computergraphics.

**Introduction to OpenGL** - OpenGL architecture, primitives and attributes, simple modelling and rendering of two- and three-dimensional geometric objects, GLUT, interaction, events and call-backs

picking.**(Simple Interaction with the Mouse and Keyboard)**

**Scan conversion:** Line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham. Circle drawing algorithms: DDA, Bresenham, and Midpoint.

#Exemplar/Case Studies Study about OpenGL Architecture Review Board (ARB)

Mapping of Course Outcomes for Unit I CO1

### **Unit II Polygon, Windowing and Clipping**

**Polygons:** Introduction to polygon, types: convex, concave and

complex. Inside test.

**Polygon Filling:** flood fill, seed fill, scan line fill.

**Windowing and clipping:** viewing transformations, 2-D clipping: Cohen - Sutherland algorithm line Clipping algorithm, Sutherland Hodgeman Polygon clipping algorithm, Weiler Atherton Polygon Clipping algorithm.

#Exemplar/Case Studies

Mapping of Course Outcomes for Unit II CO2

### **Unit III 2D, 3D Transformations and Projections**

**2-D transformations:** introduction, homogeneous coordinates, 2-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary point.

**3-D transformations:** introduction, 3-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary axis.

**Projections :** Parallel (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric)

and Perspective ( Vanishing Points - 1 point, 2 point and 3 point)

#Exemplar/Case Studies Study use of transformations and projections in education and training softwares.

Mapping of Course Outcomes for Unit III CO3

### **Unit IV Light, Colour, Shading and Hidden Surfaces**

**Colour models:** Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMY.

**Illumination Models:** Ambient Light, Diffuse reflection, Specular Reflection, and the Phong model, Combined diffuse and Specular reflections with multiple light sources, warn model,

**Shading Algorithms:** Halftone, Gauraud and Phong Shading.

**Hidden Surfaces** Introduction, Back face detection and removal, Algorithms: Depth buffer (z), Depth sorts (Painter), Area subdivision (Warnock)

#Exemplar/Case Studies Study any popular graphics designing software

Mapping of Course Outcomes for Unit IV CO4

### **Unit V Curves and Fractals**

**Curves:** Introduction, Interpolation and Approximation, Blending function, B-Spline curve, Bezier

curve,

**Fractals:** Introduction, Classification, Fractal generation: snowflake, Triadic curve, Hilbert curve,

Applications.

#Exemplar/Case Studies Case study on measuring the length of coastline using fractals

Mapping of Course Outcomes for Unit V CO5

## **Unit VI Introduction to Animation and Gaming**

**Segment:** Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility.

**Animation:** Introduction, Conventional and computer based animation, Design of animation sequences, Animation languages, Key- frame, Morphing, Motion specification.

**Gaming:** Introduction, Gaming platform (NVIDIA, i8060), Advances in Gaming.

#Exemplar/Case Studies Study of any open source tool s. a. Unity/Maya/Blender

Mapping of Course Outcomes for Unit VI CO5

### **Text Books:**

1. S. Harrington-Computer Graphics||, 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 - 07 - 100472 - 6.
2. Donald D. Hearn and Baker- Computer Graphics with OpenGL, 4th Edition, ISBN-13: 9780136053583.
1. 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. Rogers, J. Adams, —Mathematical Elements for Computer Graphics||, 2nd Edition, Tata McGrawHill Publication, 2002, ISBN 0 - 07 - 048677 - 8.

## **Digital Electronics and Logic Design**

**210245: Digital Electronics and Logic Design**

## **Credit 03**

### **Unit I Minimization Technique**

Logic Design Minimization Technique -: Minimization of Boolean function using K-map(up to 4 variables) and Quine Mc-Clusky Method, Representation of signed number- sign magnitude representation ,1's complement and 2's complement form (red marked can be removed), Sum of product and Product of sum form, Minimization of SOP and POS using K-map.

#Exemplar/Case Studies Digital locks using logic gates

Mapping of Course Outcomes for Unit I CO1

### **Unit II Combinational Logic Design**

Code converter -: BCD, Excess-3, Gray code, Binary Code. Half-Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Adder (IC 7483), BCD adder, Look ahead carry generator, Multiplexers (MUX):

MUX (IC 74153, 74151), Cascading multiplexers, Demultiplexers (DEMUX)- Decoder (IC 74138, IC 74154), Implementation of SOP and POS using MUX, DMUX, Comparators (2 bit), Parity generators and Checker.

#Exemplar/Case Studies Combinational Logic Design of BCD to 7-segment display Controller

Mapping of Course Outcomes for Unit II CO1, CO2

### **Unit III Sequential Logic Design**

Flip-Flop: SR, JK,D,T; Preset &Clear, Master Slave JK Flip Flops, Truth Tables and Excitation tables,

Conversion from one type to another type of Flop Flop. Registers: SISO, SIPO, PISO, PIPO, Shift

Registers, Bidirectional Shift Register, Ring Counter , Universal Shift Register Counters: Asynchronous

Counter, Synchronous Counter, BCD Counter, Johnson Counter, Modulus of the counter ( IC

7490),Synchronous Sequential Circuit Design :Models- Moore and Mealy, State diagram and State

Table ,Design Procedure, Sequence Generator and detector.

#Exemplar/Case Studies Electronic Voting Machine (EVM)

Mapping of Course Outcomes for Unit III CO2,CO3

### **Unit IV Algorithmic State Machines and Programmable Logic**

## **Devices**

Algorithmic State Machines: Finite State Machines (FSM) and ASM, ASM charts, notations,

construction of ASM chart and realization for sequential circuits.

PLDs:PLD, ROM as PLD, Programmable Logic Array (PLA),

Programmable Array Logic (PAL), Designing

combinational circuits using PLDs.

#Exemplar/Case Studies Wave form generator using MUX controller method

Mapping of Course Outcomes for Unit IV CO2, CO3, CO4

## **Unit V Logic Families**

Classification of logic families: Unipolar and Bipolar Logic Families, Characteristics of Digital ICs:

Fan-in, Fan-out, Current and voltage parameters, Noise immunity,

Propagation Delay, Power

Dissipation, Figure of Merits, Operating Temperature Range, power supply requirements.

Transistor-Transistor Logic: Operation of TTL NAND Gate (Two input ), TTL with active pull up, TTL

with open collector output, Wired AND Connection, Tristate TTL

Devices, TTL characteristics.

CMOS: CMOS Inverter, CMOS characteristics, CMOS configurations-Wired Logic, Open drain outputs.

#Exemplar/Case Studies To study the various basic gate design using TTL/CMOS logic family

Mapping of Course Outcomes for Unit V CO3

## **Unit VI Introduction to Computer Architecture**

Introduction to Ideal Microprocessor - Data Bus, Address Bus, Control Bus. Microprocessor based

Systems - Basic Operation, Microprocessor operation, Block Diagram of Microprocessor. Functional

Units of Microprocessor - ALU using IC 74181, Basic Arithmetic operations using ALU IC 74181, 4-bit

Multiplier circuit using ALU and shift registers. Memory Organization and Operations, digital circuit

using decoder and registers for memory operations.

#Exemplar/Case Studies Microprocessor based system in Communication/Instrumentation Control

Mapping of Course Outcomes for Unit VI CO2, CO3, CO6

## **Learning Resources**

**Text Books:**

1. Modern Digital Electronics by R.P.Jain, 4th Edition, ISBN 978-0-07-06691-16 Tata McGraw Hill
2. Digital Logic and Computer Design by Moris Mano, Pearson , ISBN 978-93-325-4252-5

**Reference Books:**

1. John Yarbrough, —Digital Logic applications and Design, Cengage Learning, ISBN - 13: 978-81-315-0058-3
2. D. Leach, Malvino, Saha, —Digital Principles and Applications||, Tata McGraw Hill, ISBN - 13:978-0-07-014170-4.
3. Anil Maini, —Digital Electronics: Principles and Integrated Circuits||, Wiley India Ltd, ISBN:978-81-265-1466-3.
4. Norman B & Bradley, —Digital Logic Design Principles, Wiley India Ltd, ISBN:978-81-265-1258-

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