CBCS Syllabus as per NEP 2020 for F.Y.B.Sc.(Comp.Sci.) Mathematics
(2024 Pattern)

Name of the Programme : B.Sc. (Comp.Sci.) Mathematics
Program Code : USCS
Class : F.Y.B.Sc. (Comp.Sci.)
Semester : I
Course Type : Theory
Course Name : Discrete Mathematics
Course Code : COSMT-101-GEN
No. of Teaching Hours : 30
No. of Credits : 2

Course Objective:

1. Understand the fundamentals of propositional logic and be able to apply propositional equivalence to simplify logical expression.
2. Develop critical thinking skills and the ability to build logical arguments effectively.
3. Grasp the concept of ordered pairs and understand how to calculate the Cartesian Product of sets.
4. Understand the concept of transitive closure and be able to apply Warshall's Algorithm to find it.
5. Be able to represent Boolean functions in various forms, such as minterms, maxterms, disjunctive normal form, and conjunctive normal form.
6. Understand the concept of recurrence relations and their importance in mathematics and computer science.
7. Develop the ability to find the total solution for recurrence relations using initial conditions.

Course Outcomes:

CO1: Students will demonstrate a thorough understanding of propositional logic, including the ability to apply propositional equivalences to simplify logical expressions.

CO2: Student will be proficient in using predicates and quantifiers to formalize mathematical statements and apply them to various domains.

CO3: Student will classify and apply different types of relations, including equivalence relations and partial ordering relations.

CO4: Student will master the representation of relations using digraphs and matrices and understand the composition of relations.

CO5: Students will gain a solid understanding of lattices, including completed, bounded and distributive lattices.

CO6: Students will have the skills to form and solve linear recurrence relations with constant coefficients.

CO7: Students will be capable of finding homogeneous and particular solutions for recurrence relations.

Topics and Learning Points

Teaching Hours

Unit 01: Logic **7**

1.1 Revision: Propositional Logic, Propositional Equivalences
1.2 Predicates and Quantifiers: Predicate, n-place Predicate or n-ary Predicate, Quantification and Quantifiers, Universal Quantifier, Existential Quantifier, Quantifiers with restricted domains, Logical Equivalences involving Quantifiers.
1.3 Rules of Inference: Argument in propositional Logic, Validity Argument (Direct and Indirect methods), Rules of Inference for Propositional Logic, Building Arguments.

Unit 02: Relation and Digraph **8**

2.1 Ordered pairs, Cartesian Product of sets
2.2 Relation, types of relation, equivalence relation, Partial Ordering relations.
2.3 Digraphs of relations ,matrix representation and composition of relations
2.4 Transitive Closure and Warshall's Algorithm

Unit 03: Lattices and Boolean Algebra **6**

3.1 Lattices, Complemented Lattice, Bounded Lattice and Distributive Lattice.
3.2 Boolean Functions: Introduction, Boolean Variable, Boolean Function of degree n, Boolean identities, Definition of Boolean Algebra.
3.3 Representation of Boolean Functions: Minterm, Maxterm, Disjunctive normal form, Conjunctive normal form.

Unit 04: Recurrence Relations **9**

4.1 Recurrence Relations: Introduction, Formation
4.2 Linear Recurrence Relations with constant coefficients
4.3 Homogeneous solutions.
4.4 Particular solutions
4.5 Total solutions

Text Book : Kenneth Rosen, Discrete Mathematics and its applications, McGraw Hill Education Pvt. Ltd. (7^{th} Edition).
Unit 1: Section 1.1to 1.5
Unit 4: Section 8.2

Text Book : Bernard Kolman, Robert Busby, Sharon Culter Ross, Nadeem-ur-Rehman, Discrete Mathematics Structure, Pearson Education, 5^{th} Edition.
Unit 2: Section 4.2, 4.4, 4.5, 4.8
Unit 3: Section 7.3 to 7.6

Reference Books:

1. C. L. Liu., Elements of Discrete Mathematics, Tata McGraw Hill.

Mapping of Program Outcomes with Course Outcomes

Class: F.Y.B.Sc. (Comp.Sci.) (Sem I) **Subject**: Mathematics

Course Name: Discrete Mathematics **Course Code**: COSMT-101-GEN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Programme Outcomes	Course Programme Outcomes (COs)						
	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
PO 1	3	3	3	3	3	3	3
PO 2	2	2	3	3	2	3	3
PO 3	1	1	1	1	1	1	1
PO 4	3	3	3	3	3	3	3
PO 5	3	3	3	3	3	3	3
PO 6	1	1	1	1	1	1	1
PO 7	2	2	2	2	2	2	2
PO8	2	2	2	2	2	2	2
PO9	1	2	1	1	1	2	2
PO10	1	1	1	1	1	1	1
PO11	1	1	1	1	1	1	1
PO12	2	2	2	2	2	2	2
PO13	1	1	1	1	1	1	1

Justification for the mapping

PO1 (Comprehensive Knowledge and Understanding):
Each CO contributes significantly to the theoretical and practical understanding of mathematical and logical concepts, directly aligning with comprehensive knowledge.

PO2 (Practical, Professional, and Procedural Knowledge):
COs related to the application of logical equivalences, predicates, relations, and recurrence relations enhance practical and procedural skills.

PO3 (Entrepreneurial Mindset and Knowledge):
These COs have a minimal direct impact on entrepreneurship but contribute foundational analytical skills.

PO4 (Specialized Skills and Competencies):
The mastery of logical, relational, and mathematical concepts provided by each CO is critical for specialized skills in fields like computer science and engineering.

PO5 (Capacity for Application, Problem-Solving, and Analytical Reasoning):
Each CO is deeply embedded in problem-solving and analytical reasoning skills through various mathematical and logical methods.

PO6 (Communication Skills and Collaboration):
These COs do not significantly focus on communication and collaboration skills, thus a lower weightage.

PO7 (Research-related Skills):
Developing a thorough understanding and ability to apply mathematical and logical principles fosters research skills.

PO8 (Learning How to Learn Skills):
The COs encourage continuous learning and application of advanced mathematical concepts.

PO9 (Digital and Technological Skills):
Understanding and applying logical and mathematical concepts moderately contribute to technological skills.

PO10 (Multicultural Competence, Inclusive Spirit, and Empathy):
These COs have a minimal direct influence on multicultural competence and empathy.

PO11 (Value Inculcation and Environmental Awareness):
These COs minimally impact values and environmental awareness.

PO12 (Autonomy, Responsibility, and Accountability):
Understanding complex concepts in logic and mathematics fosters autonomous learning and responsibility.

PO13 (Community Engagement and Service):
These COs have minimal direct relevance to community engagement and service.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc.(Comp.Sci.) Mathematics
(2024 Pattern)

Name of the Programme : B.Sc. (Comp.Sci.) Mathematics
Program Code : USCS
Class : F.Y.B.Sc. (Comp.Sci.)
Semester : I
Course Type : Practical
Course Name : Discrete Mathematics practical using maxima software.
Course Code : COSMT-102-GEN
No. of Teaching Hours : 60
No. of Credits : 2

A) Course Objective:

1. Develop a Strong Foundation in Propositional Logic and Equivalences.
2. Student will able to formalize mathematical statements using predicates and quantifiers, and to apply these concepts in various domains, enhancing their mathematical reasoning and problem-solving skills.
3. Apply Rules of Inference for Logical Argumentation.
4. Students will able to define and classify different types of relations, represent relations using digraphs and matrices, and apply algorithms to compute transitive closures, thus enhancing their understanding of relational structures and their applications.
5. Student will able to understand lattices and Boolean algebra, including the construction and visualization of various types of lattices, and the manipulation of Boolean functions and identities, which are fundamental in many areas of computer science and mathematics.
6. Student will able to solve Recurrence Relations and Analyze Their Solutions.
7. Student will able to integrate Theoretical Knowledge with Practical Applications Using Maxima Software.

B) Course Outcomes:

CO1: Students will demonstrate a thorough understanding of propositional logic and propositional equivalences, including the ability to simplify logical expressions using Maxima software.
CO2: Students will be proficient in using predicates and quantifiers to formalize mathematical statements and simplify them using Maxima software.
CO3: Students will validate arguments by applying rules of inference in propositional logic, using Maxima software to verify their validity.
CO4: Students will classify and apply different types of relations, including equivalence relations and partial ordering relations, and represent these relations using digraphs and matrices with Maxima software.
CO5: Students will gain a solid understanding of lattices, including complemented, bounded, and distributive lattices, and will use Maxima software to create and visualize these lattices.
CO6: Students will develop the skills to form and solve linear recurrence relations with constant coefficients, using Maxima software to find homogeneous and particular solutions.
CO7: Students will be capable of representing Boolean functions in different forms (minterm, maxterm, DNF, CNF) and verifying Boolean identities using Maxima software.

List of Practical's:

1. Propositional Logic and Equivalences: Use Maxima to input various propositional expressions and simplify them using equivalences.

2. Predicates and Quantifiers: Use Maxima to express different statements with predicates and apply quantifiers, then simplify.

3. Rules of Inference: Use Maxima to validate given arguments by applying rules of inference for propositional logic.

4. Cartesian Product of Sets: Use Maxima to find the Cartesian product of two sets and display ordered pairs.

5. Types of Relations: Use Maxima to define relations and determine their types by checking reflexivity, symmetry, transitivity.

6. Digraphs of Relations and Matrix Representation: Use Maxima to create digraphs and matrix representations for given relations.

7. Transitive Closure and Warshall's Algorithm: Implement Warshall's algorithm in Maxima to compute the transitive closure of a given relation.

8. Lattices: Use Maxima to create and visualize complemented, bounded, and distributive lattices.

9. Boolean Functions and Identities: Use Maxima to define Boolean functions and verify various Boolean identities.

10. Representation of Boolean Functions: Use Maxima to convert Boolean functions to minterm, maxterm, disjunctive normal form (DNF), and conjunctive normal form (CNF).

11. Formation and Solutions of Linear Recurrence Relations: Use Maxima to define and solve linear recurrence relations with given coefficients

12. Homogeneous and Particular Solutions of Recurrence Relations: Use Maxima to find homogeneous and particular solutions for given recurrence relations and combine them to get the total solutions.

Mapping of Program Outcomes with Course Outcomes

Class: F.Y.B.Sc.(Computer Science)(Sem I) **Subject:** Mathematics

Course: Discrete Mathematics Practical using Maxima Software **Course Code:** COSMT-102-GEN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Programme Outcomes	Course Programme Outcomes (COs)						
	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
PO 1	3	3	3	3	3	3	3
PO 2	2	2	2	2	2	2	2
PO 3	1	1	1	1	1	1	1
PO 4	2	2	2	2	2	2	2
PO 5	3	3	3	3	3	3	3
PO 6	1	1	1	1	1	1	1
PO 7	2	2	2	2	2	2	2
PO8	2	2	2	2	2	2	2
PO9	3	3	3	3	3	3	3
PO10	1	1	1	1	1	1	1
PO11	1	1	1	1	1	1	1
PO12	2	2	2	2	2	2	2
PO13	1	1	1	1	1	1	1

Justification for the mapping

PO1 (Comprehensive Knowledge and Understanding):
Strong relation as it requires a thorough understanding of propositional logic and propositional equivalences.

PO2 (Practical, Professional, and Procedural Knowledge):
Moderate relation as it involves using Maxima software for simplification.

PO3 (Entrepreneurial Mind set and Knowledge):
Weak relation as it is primarily theoretical.

PO4 (Specialized Skills and Competencies):
Moderate relation due to specialized knowledge in logic.

PO5 (Capacity for Application, Problem-Solving, and Analytical Reasoning):
Strong relation because it involves simplifying logical expressions.

PO6 (Communication Skills and Collaboration):
Weak relation; less emphasis on communication.

PO7 (Research-related Skills):
Moderate relation,involving use of software for logical analysis.

PO8 (Learning How to Learn Skills):
Moderate relation, as it promotes self-learning of software tools.

PO9 (Digital and Technological Skills):
Strong relation due to the use of Maxima software.

PO10 (Multicultural Competence, Inclusive Spirit, and Empathy):
Weak relation, as it is less relevant.
PO11 (Value Inculcation and Environmental Awareness):
Weak relation, as it is less relevant.
PO12 (Autonomy, Responsibility, and Accountability):
Moderate relation, fostering independent work with software.
PO13 (Community Engagement and Service):
Weak relation, as it is less relevant.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc.(Comp.Sci.) Mathematics
(2024 Pattern)

Name of the Programme : B.Sc. (Comp.Sci.) Mathematics
Program Code : USCS
Class : F.Y.B.Sc. (Comp.Sci.)
Semester : II
Course Type : Theory
Course Name : Graph Theory
Course Code : COSMT-151-GEN
No. of Teaching Hours : 30
No. of Credits : 2

Course Objective:

1. Define and explain concepts like degree, isolated vertex, pendent vertex, and null graph.
2. Understand graph isomorphism and its significance.
3. Understand the impact of these operations on the properties of graphs.
4. Apply matrices to represent graph structures.
5. Understand applications of chromatic numbers in graph colouring.
6. Explore the significance and solutions to this problem.
7. Explore real-world scenarios where directed graphs are applicable.

Course Outcomes:

CO1: Student will be able to define and recognize the components of a graph.
CO2: Student will grasp the definitions of degree, isolated vertex, pendent vertex, and null graph, and apply them to analyse graph structures.
CO3: Students will be able to identify isomorphic graphs and sub graphs within a given graph.
CO4: Student will be able to identify and analyse connected graphs, recognizing their importance in real-world applications.
CO5: Student will understand and apply incidence and adjacency matrices to represent graph structures.
CO6: Student will analyse paths and connectedness in directed graphs, applying these concepts to practical situations.
CO7: Student will Understand and apply Euler digraphs and trees with directed edges in various scenarios.

Topics and Learning Points

Teaching Hours

Unit 01: Introduction to Graph **7**

1.4 Graph
1.5 Finite and Infinite Graphs.
1.6 Definitions (Degree, Isolated Vertex, Pendent Vertex and Null Graph)
1.7 Isomorphism
1.8 Subgraphs
1.9 Walks, Paths and Circuits

Unit 02: Connected Graphs and Trees **8**

2.5 Connected Graph
2.6 Euler Graph
2.7 Operation on Graphs
2.8 Hamiltonian Paths
2.9 Trees
2.10 Rooted and Binary Trees
2.11 Spanning Trees

Unit 03: Matrix Representation and Colouring of Graph **8**

3.4 Incidence Matrix
3.5 Adjacency Matrix
3.6 Chromatic Number
3.7 Matching and Covering
3.8 The Four Colour Problem

Unit 04: Directed Graph **7**

4.1 Directed Graph
4.2 Binary relations
4.3 Path and Connectedness
4.4 Euler Digraphs
4.5 Trees with directed edges

Text Book : Narsingh Deo, Graph Theory with Application to Engineering and Computer Science, Dover Publications, INC. New York.

Reference Books:

2. Douglas B. West, Introduction to Graph Theory, Pearson education Pte. Ltd.
3. John Clark and Derek Allan Holton, A First Look at Graph Theory, Allied Publishers.
4. Reinhard Diestel, Graph Theory , Springer Publication.
5. Richard J.Trudeau, Introduction to Graph Theory, Dover Publication.

Mapping of Program Outcomes with Course Outcomes

Class: F.Y.B.Sc. (Comp.Sci.) (Sem II) **Subject**: Mathematics

Course Name: Graph Theory **Course Code**: COSMT-151-GEN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Programme Outcomes	Course Programme Outcomes (COs)						
	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
PO 1	2	2	2	2	2	2	2
PO 2	2	2	2	2	2	2	2
PO 3	1	1	1	1	1	1	1
PO 4	2	2	2	2	2	2	2
PO 5	2	2	2	2	2	2	2
PO 6	2	2	2	2	2	2	2
PO 7	2	2	2	2	2	2	2
PO8	2	2	2	2	2	2	2
PO9	2	2	2	2	2	2	2
PO10	1	1	1	1	1	1	1
PO11	1	1	1	1	1	1	1
PO12	1	1	1	1	1	1	1
PO13	1	1	1	1	1	1	1

Justification for the mapping

PO1 (Comprehensive Knowledge and Understanding):
Moderate or partial relation (2) for all COs as they contribute to a comprehensive understanding of graph theory.

PO2 (Practical, Professional, and Procedural Knowledge):
Moderate or partial relation (2) for all COs as they involve practical knowledge and skills in graph theory.

PO3 (Entrepreneurial Mindset and Knowledge):
Weak or low relation (1) for all COs as they do not directly relate to entrepreneurial mindset or knowledge.

PO4 (Specialized Skills and Competencies):
Moderate or partial relation (2) for all COs as they contribute to specialized skills in graph theory.

PO5 (Capacity for Application, Problem-Solving, and Analytical Reasoning):
Moderate or partial relation (2) for all COs as they involve application, problem-solving, and analytical reasoning in graph theory.

PO6 (Communication Skills and Collaboration):
Moderate or partial relation (2) for all COs as they involve communication and collaboration in graph theory.

PO7 (Research-related Skills):
Moderate or partial relation (2) for all COs as they contribute to research skills in graph theory.

PO8 (Learning How to Learn Skills):

Moderate or partial relation (2) for all COs as they involve learning skills in graph theory.

PO9 (Digital and Technological Skills):

Moderate or partial relation (2) for all COs as they involve digital and technological skills in graph theory.

PO10 (Multicultural Competence, Inclusive Spirit, and Empathy):

Weak or low relation (1) for all COs as they do not directly relate to multicultural competence, inclusive spirit, or empathy.

PO11 (Value Inculcation and Environmental Awareness):

Weak or low relation (1) for all COs as they do not directly relate to value inculcation or environmental awareness.

PO12 (Autonomy, Responsibility, and Accountability):

Weak or low relation (1) for all COs as they do not directly relate to autonomy, responsibility, or accountability.

PO13 (Community Engagement and Service):

Weak or low relation (1) for all COs as they do not directly relate to community engagement or service.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc.(Comp.Sci.) Mathematics

(2024 Pattern)

Name of the Programme : B.Sc.(Comp.Sci.) Mathematics
Program Code : USCS
Class : F.Y.B.Sc.(Comp.Sci.)
Semester : II
Course Type : Practical
Course Name : Graph Theory Practical Using C Programming
Course Code : COSMT-152-GEN
No. of Teaching Hours : 60
No. of Credits : 2

A) Course Objectives:

1) Understand and apply algorithms to determine connectivity in graphs.
2) Implement and utilize algorithms for finding shortest paths in connected graphs.
3) Apply tree structures to problem-solving in different contexts
4) Apply matrix representations to solve graph-related problems.
5) Develop C functions for matrix operations relevant to graph representations
6) Apply graph coloring algorithms to different types of graphs.
7) Implement algorithms to find cycles and determine the shortest path in directed graphs.

B) Course Outcome:

CO1: Student will be able to implement algorithms to find shortest paths in connected graphs.
CO2: Student will be able to understand and describe tree structures in the context of graph theory.
CO3: Student will be able to analyze and interpret properties of adjacency matrix and incidence matrix.
CO4: Write C programs for basic graph representation using an adjacency matrix.
CO5: Student will be able to develop C programs for implementing DFS and BFS algorithms for tree traversal.
CO6: Student will be able to implement C functions for matrix operations applicable to graph representations.
CO7: Student will be able to develop C functions to perform operations on directed graphs, including cycle detection and shortest path determination.

List of Practical's:

1) **Introduction to Graphs**: Understanding basic graph terminology.
2) **Exploring Connected Graphs**: Identifying connected components determining connectivity and finding shortest paths in connected graphs.
3) **Trees in Graph Theory**: Studying tree structures, properties of trees and applications of trees.
4) **Matrix Representation of Graphs**: Converting graphs into matrix form, exploring properties of adjacency matrix and Incidence matrix.
5) **Coloring of Graphs**: Investing vertex coloring, edge coloring, chromatic number and applications of graph colorings in scheduling and map coloring problems.
6) **Directed Graphs**: Understanding directed graphs and analyzing properties of directed graphs and exploring applications in network and flow problems.

Practical's using C-Programming

7) **Graph representation in C**: Implementing the basic representation of graphs using adjacency matrix in C
8) **Connected Components**: Writing a C- Programs to find display connected components in a graph.
9) **Tree traversal Algorithm**: Implementing Depth First Search (DFS) and Breadth First Search (BFS) algorithms for tree traversal in C.
10) **Matrix Operation for Graphs**: Developing C functions for matrix operations such as addition, multiplication and transposition to manipulate graph representations.
11) **Graph Coloring Algorithm**: Implementing a graph coloring algorithms (i.e. greedy coloring) in C and applying it to various graphs.
12) **Directed Graph Operations**: Creating function in C to perform operations on directed graphs such as finding cycles and determining the shortest path.

Mapping of Program Outcomes with Course Outcomes

Class: F.Y.B.Sc.(Computer Science)(Sem II) **Subject:** Mathematics

Course: Graph Theory Practical Using C Programming **Course Code:** COSMT-152-GEN
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Programme Outcomes	Course Programme Outcomes (COs)						
	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
PO 1	2	2	2	2	2	2	2
PO 2	3	2	2	3	3	3	3
PO 3	2	2	2	2	2	2	2
PO 4	3	2	2	3	3	3	3
PO 5	3	2	2	3	3	3	3
PO 6	2	2	2	2	2	2	2
PO 7	3	2	2	3	3	3	3
PO8	2	2	2	2	2	2	2
PO9	2	2	2	2	2	2	2
PO10	2	2	2	2	2	2	2
PO11	2	2	2	2	2	2	2
PO12	2	2	2	2	2	2	2
PO13	2	2	2	2	2	2	2

Justification for the mapping

PO1 (Comprehensive Knowledge and Understanding):
Moderate or partial relation (2) for all COs as they contribute to the understanding of graph theory and algorithms.

PO2 (Practical, Professional, and Procedural Knowledge):
Strong or direct relation (3) for all COs as they involve practical programming skills and knowledge.

PO3 (Entrepreneurial Mindset and Knowledge):
Moderate or partial relation (2) for all COs as they contribute to problem-solving skills.

PO4 (Specialized Skills and Competencies):
Strong or direct relation (3) for all COs as they involve specialized skills in graph theory and programming.

PO5 (Capacity for Application, Problem-Solving, and Analytical Reasoning):
Strong or direct relation (3) for all COs as they require application, problem-solving, and analytical skills.

PO6 (Communication Skills and Collaboration):
Moderate or partial relation (2) for all COs as they involve communicating and collaborating in programming tasks.

PO7 (Research-related Skills):
Moderate or partial relation (2) for all COs as they involve analyzing and interpreting graph-related data.

PO8 (Learning How to Learn Skills):
Moderate or partial relation (2) for all COs as they contribute to learning new programming concepts and algorithms.
PO9 (Digital and Technological Skills):
Moderate or partial relation (2) for all COs as they involve programming and using digital tools**.**
PO10 (Multicultural Competence, Inclusive Spirit, and Empathy):
Weak or low relation (1) for all COs as they do not directly relate to multicultural competence or inclusive spirit.
PO11 (Value Inculcation and Environmental Awareness):
Weak or low relation (1) for all COs as they do not directly relate to value inculcation or environmental awareness**.**
PO12 (Autonomy, Responsibility, and Accountability):
Moderate or partial relation (2) for all COs as they involve taking responsibility for programming tasks.
PO13 (Community Engagement and Service):
Weak or low relation (1) for all COs as they do not directly relate to community engagement or service.