CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. (Comp. Sci.) Mathematics (2023 Pattern)

Name of the Programme	**:** B.Sc. (Comp. Sci.)
Program Code	**:** USCOS
Class	**:** S.Y.B.Sc. (Comp. Sci.)
Semester	**:** IV
Course Type	**:** Minor
Course Name	**:** Numerical Analysis
Course Code	**:** COS-261-MN(B)
No. of Teaching Hours	**:** 30
No. of Credits	**:** 2

Course Objectives:

1. To define and explain concepts like degree, isolated vertex, pendent vertex, and null graph.
2. To understand graph isomorphism and its significance.
3. To understand the impact of these operations on the properties of graphs.
4. To apply matrices to represent graph structures.
5. To understand applications of chromatic numbers in graph colouring.
6. To explore the significance and solutions to this problem.
7. To 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 1: Algebraic and Transcendental Equations	**04**
1.1 Errors	
1.2 Algebraic and Transcendental Equations	
1.3 False Position Method/Regula Falsi Method	
1.4 Newton-Raphson's Method	
Unit 2: Calculus of Finite Differences and Interpolation	**10**
2.1 Differences	
2.2 Properties of Operators	
2.3 Relation between Operators	
2.4 Newton's Gregory Formula for forward Difference Interpolation	
2.5 Newton's Gregory Formula for Backward Difference Interpolation	
2.6 Lagrange's Interpolation Formula	
Unit 3: Numerical Integration	**08**
3.1 General Quadrature Formula	
3.2 Trapezoidal Rule	
3.3 Simpson's one-third Rule	
3.4 Simpson's three-eight Rule	
Unit 4: Numerical Solution of Ordinary Differential Equation	**08**
4.1 Euler's Method	
4.2 Euler's Modified Method	
4.3 Runge-Kutta's Second-order Method	
4.4 Runge-Kutta's Fourth order Method	

Text Books:

1. S.S. Sastry, *Introductory Methods of Numerical Analysis*, Prentice Hall of India (3rd Edition),1999.

Reference Books:

1. H.C. Saxena, *Finite differences and Numerical Analysis*, S. Chand and Company.
2. K.E. Atkinson, *An Introduction to Numerical Analysis*, Wiley Publications.
3. Balguruswamy, *Numerical Analysis*.
4. A. K. Jaiswal and Anju Khandelwal, *A Textbook of Computer Based Numerical and Statistical Techniques*, New Age International Publishers.

CO-PO Mapping

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

Programme Outcomes	Course Outcomes						
	CO1	CO2	CO3	CO4	CO5	CO6	CO7
PO1	2	2	2	2	2	2	2
PO2	2	2	2	2	2	2	2
PO3	1	1	1	1	1	1	1
PO4	2	2	2	2	2	2	2
PO5	2	2	2	2	2	2	2
PO6	2	2	2	2	2	2	2
PO7	2	2	2	2	2	2	2
PO8	2	2	2	2	2	2	2
PO9	2	2	2	2	2	2	2
PO10							
PO11	1	1	1	1	1	1	1
PO12	1	1	1	1	1	1	1
PO13							

Justification for the mapping

PO1 (Comprehensive Knowledge and Understanding): Moderate relation (2) for all COs as they contribute to a comprehensive understanding of graph theory.
PO2 (Practical, Professional, and Procedural Knowledge): Moderate relation (2) for all COs as they involve practical knowledge and skills in graph theory.
PO3 (Entrepreneurial Mindset and Knowledge): Weak relation (1) for all COs as they do not directly relate to entrepreneurial mindset or knowledge.
PO4 (Specialized Skills and Competencies): Moderate relation (2) for all COs as they contribute to specialized skills in graph theory.
PO5 (Capacity for Application, Problem-Solving, and Analytical Reasoning): Moderate relation (2) for all COs as they involve application, problem-solving, and analytical reasoning in graph theory.
PO6 (Communication Skills and Collaboration): Moderate relation (2) for all COs as they involve communication and collaboration in graph theory.
PO7 (Research-related Skills): Moderate relation (2) for all COs as they contribute to research skills in graph theory.
PO8 (Learning How to Learn Skills): Moderate relation (2) for all COs as they involve learning skills in graph theory.
PO9 (Digital and Technological Skills): Moderate relation (2) for all COs as they involve digital and technological skills in graph theory.
PO11 (Value Inculcation and Environmental Awareness): Weak relation (1) for all COs as they do not directly relate to value inculcation or environmental awareness.
PO12 (Autonomy, Responsibility, and Accountability): Weak relation (1) for all COs as they do not directly relate to autonomy, responsibility, or accountability.

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Name of the Programme	: B.Sc. (Comp. Sci.)
Program Code	: USCOS
Class	: S.Y.B.Sc. (Comp. Sci.)
Semester	: IV
Course Type	: Minor
Course Name	: Practical based on Numerical Analysis using Scilab
Course Code	: COS-262-MN(B)
No. of Teaching Hours	: 60
No. of Credits	: 2

Course Objectives:

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

Course Outcomes:

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.

Topics and Learning Points

Teaching Hours

List of practical: **60**

1. **Introduction to Scilab**: Installation of the software Scilab, syntax, some important commands on Scilab.
2. **Operations on Matrices**: Matrix construction, Algebraic operations on Matrices, Accessing rows and columns, Determinant and inverse of a matrix, Reduced row echelon form, Rank of a matrix.
3. **Solving systems of linear equations using Scilab.**
4. **Eigenvalues and Eigenvectors using Scilab.**
5. **Polynomial Operations in Scilab and User-defined functions.**
6. **Plotting graphs using Scilab**: 2-D graph, 3-D graph.
7. **Iterations & conditional statements in Scilab:** for statement, while statement, if statement.
8. **Finding roots of an equation using Scilab:** False Position (Regula Falsi) Method.
9. **Finding roots of an equation using Scilab:** Newton-Raphson Method.
10. **Numerical Integration using Scilab:** Trapezoidal Rule, Simpson's 1/3rd Rule, Simpson's 3/8th Rule.
11. **Numerical Differentiation using Scilab:** Euler’s Method.
12. **Numerical Differentiation using Scilab:** Runge-Kutta Method.

CO-PO Mapping

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

Programme Outcomes	Course Outcomes						
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PO2	3	2	2	3	3	3	3
PO3	2	2	2	2	2	2	2
PO4	3	2	2	3	3	3	3
PO5	3	2	2	3	3	3	3
PO6	2	2	2	2	2	2	2
PO7	3	2	2	3	3	3	3
PO8	2	2	2	2	2	2	2
PO9	2	2	2	2	2	2	2
PO10							
PO11							
PO12	2	2	2	2	2	2	2
PO13							

Justification for the mapping

PO1 (Comprehensive Knowledge and Understanding): Moderate relation (2) for all COs as they contribute to the understanding of graph theory and algorithms.
PO2 (Practical, Professional, and Procedural Knowledge): Strong relation (3) for all COs as they involve practical programming skills and knowledge.
PO3 (Entrepreneurial Mindset and Knowledge): Moderate relation (2) for all COs as they contribute to problem-solving skills.
PO4 (Specialized Skills and Competencies): Strong 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 relation (3) for all COs as they require application, problem-solving, and analytical skills.
PO6 (Communication Skills and Collaboration): Moderate relation (2) for all COs as they involve communicating and collaborating in programming tasks.
PO7 (Research-related Skills): Moderate relation (2) for all COs as they involve analyzing and interpreting graph-related data.
PO8 (Learning How to Learn Skills): Moderate relation (2) for all COs as they contribute to learning new programming concepts and algorithms.
PO9 (Digital and Technological Skills): Moderate relation (2) for all COs as they involve programming and using digital tools**.**
PO12 (Autonomy, Responsibility, and Accountability): Moderate relation (2) for all COs as they involve taking responsibility for programming tasks.