2-Year Master's Program in Mathematics (NEP-2020)
DISCRETE MATHEMATICS

Master's Mathematics (2nd Semester) Total Credits:04
Course Code: MMTHCDM226 (15 hours per credit) Total Marks: 100
Continuous Assessment: Marks 30, Theory: Marks 70 Time Duration: 2½ hrs

Course Learning Outcomes(CLO's): After the completion of this course, students shall be able to:

CLO1. Analyze and classify graphs, and apply concepts of walks, paths, cycles, Eulerian and Hamiltonian properties, and graphical sequence criteria.

CLO2. Examine graph connectivity and tree structures, and apply spanning tree, vertex connectivity, and edge connectivity concepts to solve network problems.

CLO3. Evaluate graph planarity using Euler's formula and Kuratowski's theorem, and interpret related geometric representations.

CLO4. Apply matrix representations of graphs (incidence and adjacency) to analyze properties and compute quantities such as spanning trees.

UNIT -I

Introduction to Graphs: Graphs- types and properties, walks, paths and cycles, bipartite graphs and Konigs theorem, graph operations, distance and eccentricity, Eulerian graphs and Euler's theorem, Konigsberg bridge problem, Hamiltonian graphs, Dirac's theorem, Ore's theorem, Degree sequences, Wang-Kleitman theorem, Havel Hakimi theorem, Hakimi's theorem, Erdos-Gallai theorem, degree sets.

UNIT -II

Trees and Connectivity of graphs: Trees and their properties, rooted trees, binary trees and spanning trees, labelled trees, Cayley's theorem on number of labeled trees, fundamental cycles, generation of trees, Cut vertex and cut edge, their properties, vertex connectivity, edge connectivity. Cut of a graph, Whitney's theorem, Menger's theorem (vertex and edge form).

UNIT -III

Planarity of graphs: Planar graphs, Kuratowski's two graphs, embedding on a sphere, Euler's formula, Kuratowski's theorem, geometric dual, Whitney's theorem on duality, regular polyhedras, theorem on existence of five regular polyhedras, signed graphs, balanced signed graphs, switching, Harary's balance theorem

UNIT -IV

Matrices and digraphs: Incidence matrix A(G), reduced incidence matrix $\boldsymbol{A_f}$, cycle matrix B(G), cut-set matrix C(G), fundamental cycle and cut set matrices $\boldsymbol{B_f}$ and $\boldsymbol{C_f}$, relation between $\boldsymbol{A_f}, \boldsymbol{B_f}$and $\boldsymbol{C_f}$. Adjacency matrix X(G), determination of number of different edge sequences, degree matrix and the matrix tree theorem, Digraphs, connectedness in digraphs, Euler and Hamiltonian digraphs, matrices in digraphs, Camion's theorem, tournaments and score sequences, Landau's theorem.

CLO-PLO Mapping Matrix (Strength version)

CLO ↓ PLO →	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	Average CLOs
MMTHDNT126.1	3	3	2	3	2	3	3	3	**2.75**
MMTHDNT126.2	3	2	3	2	2	2	2	3	**2.37**
MMTHDNT126.3	3	1	3	1	1	2	2	3	**2**
MMTHDNT126.4	3	2	2	2	3	2	1	3	**2.25**
Average PLOs	**3**	**2**	**2.5**	**2**	**2**	**2.25**	**2**	**3**	**2.34**

Recommended Books

1. R. Balakrishnan, K. Ranganathan, A Text Book of Graph Theory, Springer-Verlag, New York.
2. B. Bollobas, Extremal Graph Theory, Springer (2002).
3. F. Harary, Graph Theory, Narosa (2001).
4. Narsingh Deo, Graph Theory with Applications to Eng. and Comp. Sci, PHI. (1979).
5. S. Pirzada, An Introduction to Graph Theory, Universities Press, Orient Blackswan, 2012.
6. D. B. West, Introduction to Graph Theory, Prentice Hall.