

## CURRICULUM TRANSACTIONAL STRATEGY

### MMT-E 405: Topics in Graph Theory

**Pre-requisites:** Theory regarding the existence of Graph Theory..

### **COURSE OBJECTIVES**

- To understand how graph theory have been.
- To understand the concept of vertex connectivity and edge connectivity in graphs.
- To develop the under-standing of Geometric duals in Planar Graphs.
- To understand Koenigsberg Seven Bridge Problem.
- To understand the concept of matrices in graphs like Incidence matrix, Adjacency matrix, Cycle matrix etc.
- To understand the concept of digraphs, Euler digraphs and Hamiltonian digraphs.
- To understand the idea of tournaments in digraphs and study some characterizations about tournaments.
- To have an idea of matching in graphs and study some applications of matching in day to day life problems.
- To introduce the idea of coloring in graphs.
- To have an idea of automorphism groups of graphs

### **COURSE OUTLINE**

#### **UNIT I**

- Connectivity in graphs.
- Vertexconnectivityandedgeconnectivity.
- GeometricDualinplanegraphs.
- Eulers formula and its generalization about planar graphs.
- Regular Polyhedras.
- Euler's formula in Plane Graphs.

#### **UNIT II**

- ConnectednessinGraphs.
- Matricesindigraphs.
- Definition Arborescence with examples.
- Tournaments and score sequences in tournaments.

#### **UNIT III**

- Matching and 1- factors.

- Berge's theorem. Hall's theorem.
- 1-factor theorem of Tutte. Antifactor sets.
- Degree factors. f-factor theorem.
- f-factor theorem implies 1-factor theorem. k-factor theorem

#### UNIT IV

- Coloring in graphs.
- Chromatic number of a graph. Brook's theorem
- Vizing's theorem
- Edge-graphs; Whitney's theorem and Beinke's theorem.
- Automorphism groups of graphs.
- Frucht's theorem and Cayley digraphs

## Classroom Transaction

Unit	Topic	Activity	No. of Tutorials	No. of lectures
<b>I</b>	Whitneys Theorem on duality	Assignment	02	01
	Vertex connectivity and edge connectivity	Assignment	02	05
	Regular polyhedras and five regular polyhedras	Assignment and Presentation	01	03
	Euler's formula and its generalization on planer graphs	Assignment	02	02

Unit	Topic	Activity	No. of Tutorials	No. of lectures
<b>II</b>	Incidence matrix, modified incidence matrix, cycle matrix	Assignment	03	06

	and fundamental cut set matrix	and Presentation		
	Relation between modified incidence matrix, fundamental cycle matrix, fundamental cut set matrix	Assignment	02	03
	Laplacian matrix, matrix tree theorem	Assignment	02	03
	Diagraphs, Euler diagraphs and Hamiltonian diagraphs, Arborescence	Assignment	02	02
	Tournaments, Camions theorem, characterization of score sequences			
	Landaus' theorem and Avery's theorem			

Unit	Topic	Activity	No. of Tutorials	No. of lectures
<b>III</b>	Matching, Berge's theorem and Hall's theorem	Assignment	02	02
	1-factors, 1-factor theorem of Tutte	Assignment	01	01
	Anti-factor sets, f-factor theorem	Assignment and Presentation	03	02
	f-factor theorem implies 1-factor theorem, ErdosGallai theorem follows from f-factor theorem	Assignment	04	04
	Degree factors, k-factor theorem	Assignment	01	02

Unit	Topic	Activity	No. of Tutorials	No. of lectures
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<b>IV</b>	Vertex coloring, Brook's theorem	Assignment	01	02
	Edge coloring, Vizing's theorem	Assignment	01	02
	Region coloring, Heaood map coloring theorem	Presentation	03	04
	Edge graphs, Whitney's theorem and Beineke's theorem	Assignment	03	04
	Automorphism groups of graphs , Frucht's theorem	Assignment	01	01
	Cayley diagraphs	Assignment	01	02

### Reference Books:

1. D. B. West, Introduction to graph theory; Prentice Hall,
2. S. Pirzada, An introduction to graph theory; Universities Press, Orient. Blackswan, 2013.
3. R. B. Bapat, Graphs and matrices; Hindustan Book Agency, New Delhi.
4. R. Balakrishnan, K. Ranganathan, A textbook of graph theory, Springer, Verlag, New York.