| Course code | Course Name | L-T-P- Credits | Year of Introduction |
|---|---|---|---|
| IT361 | Graph Theory | 3-0-0-3 | 2016 |

**Prerequisite: Nil**

**Course Objectives**

1. To understand and apply the fundamental concepts in graph theory
2. To apply graph theory based tools in solving practical problems
3. To improve the proof writing skills.

**Syllabus**

Simple graphs, Sub graphs, Trees, Cayley's Formula, Connectivity, Euler and Hamiltonian graphs, Matching, Independent sets, Clique, Vertex Colouring, Planar Graphs, Directed Graphs, Network flow and cuts.

**Expected outcome** .

- The students will be able to apply principles and concepts of graph theory in practical situations

**References:**


1. Bondy,J. A. and Murty,U.S.R., 'Graph Theory with Applications', Springer, 2008.
2. Diestel, R. *Graph Theory (Graduate Texts in Mathematics).* New York, NY: Springer-Verlag, 1997. ISBN: 3540261834
3. N. Alon and J. Spenser, "Probabilistic Methods", John Wiley and Sons, 2nd edition, 2000.

Bollobás, B. *Modern Graph Theory (Graduate Texts in Mathematics).* New York, NY: Springer-Verlag, 1998. ISBN: 0387984917.


**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | GRAPHS AND SUBGRAPH - Graphs and Simple Graphs, Graph Isomorphism, The Incidence and Adjacency Matrices, Subgraphs, Vertex Degrees, Paths and Connection, Cycles, Applications – The Shortest Path Problem, Sperner's Lemma . | 5 | 15% |
| | TREES - Cut Edges and Bonds, Cut Vertices, Cayley's Formula, Applications - The Connector Problem | 4 | |
| II | CONNECTIVITY - Blocks, Applications-Construction of Reliable Communication Networks<br>Euler Tours, Hamilton Cycles, Applications-The Chinese Postman Problem, The Travelling Salesman Problem | 5 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | MATCHINGS - Matchings and Coverings in Bipartite Graphs Perfect Matchings, Applications - The Personnel Assignment Problem, The Optimal Assignment Problem. | 4 | 15% |
| | INDEPENDENT SETS AND CLIQUES - Independent Sets, Ramsey's Theorem, TurAn's Theorem, Applications - Schur's Theorem, A Geometry Problem. | 4 | |
| IV | VERTEX COLOURINGS - Chromatic Number, Brooks' Theorem, Hajos' Conjecture, Chromatic Polynomials, Girth and Chromatic Number, Applications - A Storage Problem | 5 | 15% |
| | **SECOND INTERNAL EXAMINATION** | | |
| V | Planar Graphs - Plane and Planar Graphs, Dual Graphs, Euler's Formula, Bridges, Muratowski's Theorem, The Five-Colour Theorem and the Four-Colour Conjecture, Nonharniltonian Planar Graphs, Applications - A Planarity Algorithm | 5 | 20% |

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|---|---|---|---|
| **VI** | DIRECTED GRAPHS - Directed Graphs, Directed Paths, Directed Cycles, Applications - A Job Sequencing Problem, Designing an Efficient Computer Drum, Making a Road System One-way, Ranking the Participants in a Tournament | 4 | 20% |
| | NETWORKS - Flows , Cuts, The Max-Flow Min-Cut Theorem, Applications - Menger's Theorems, Feasible Flows | 4 | |
| END SEMESTER EXAM | | | |



## QUESTION PAPER PATTERN

Maximum Marks: 100 Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

**Part A** shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

**Part B** shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

**Part C** shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

**Note** : Each question can have a maximum of 4 subparts, if needed