

**SECOND SEMESTER 2022-2023**

# Course Handout Part II

16-01-2023

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

*Course No. : MATH F243*

*Course Title : Graphs & Networks*

*Instructor-in-charge : A. Michael Alphonse*

*Instructors :* A. Michael Alphonse, Faiz Imam, Hirendra Kumar Garai

**Scope and Objective of the Course:** The applications of graph theory are ranging from social sciences to electrical engineering and computer science to management. Every graph theoretic model is supported by a strong mathematical scheme. The objective of the course is, in addition to apply the graph theoretic model to different applications; students can develop a strong concept on the logical foundations, and can develop of a standard mathematical formulation for different real life problems.

**Textbooks:**

1. Gary Chartrand & Ping Zhang: Introduction to Graph Theory, Mcgraw-hill, Indian Edition 2006.

**Reference books**

1. E. G. Goodaire & M. M. Parmenter : Discrete Mathematics with graph theory, 3rd edition, Pearson, 2002.
2. Narsingh Deo: Graph theory with applications to engineering & computer science, PHI 1974.
3. G. Agnarsson and R. Greenlaw: Graph Theory Modeling, Applications and Algorithms, Pearson, 2007.

**Course Plan:**

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| --- | --- | --- | --- |
| **Lecture No.** | **Learners objective** | **Topics to be covered** | **Chapter in the Text Book** |
| 1-4 | To introduce the concept of graph and its representation. Distinguish between multigraphs and digraphs. | Graphs and Graph Models, Connected Graphs, Classes of graphs, Multigraphs and Digraphs. | Chapter  1.1-1.4 |
| 5-8 | Understanding the graphs through the degree of the vertices, order and Size. Relationship between the graphs and matrices. | Degree of a vertex, Regular graphs, Degree Sequence, Graphs and Matrices, Irregular graphs. | Chapter2.1-2.5 |
| 9-12 | Understanding when two graphs are equal | Isomorphic Graphs, Definition of isomorphism, Isomorphism as a relation | Chapter3.1-3.3 |
| 13-16 | Studying a specific class of graphs called Trees and their uses in Optimization | Bridges, Trees, equivalent definitions, spanning tree, Minimal spanning tree, Prim’s & Kruskal Algorithm Binary trees, Distance between spanning tree, eccentricity, Centre(s), diameter of tree & connected graph. | Chapter  4.1-4.4 |
| 17-20 | How spanning tree is connected with concept of special type of cut set & circuit in a connected graph | Cut vertices, Blocks, Connectivity, Menger’s Theorem | Chapter  5.1-5.4 |
| 21-23 | To appreciate the difference between edge traversal & vertex traversal | Eulerian Graphs, Hamiltonian Graphs, Hamiltonian walk and numbers | Chapter  6.1-6.3 |
| 24-26 | To determine the matching number, covering number. | Matchings, Factorization | Chapter  8.1-8.2 |
| 27-30 | To study the Planar Graphs, Surface Graphs and their Properties | Planar Graphs, Euler identity, Detection of planarity, Embedded graphs on surface. Graph Minors | Chapter  9.1-9.3 |
| 31-34 | To study the Graph coloring Problems and their applications | The four color problem, vertex coloring, edge coloring, chromatic number, chromatic partitioning | Chapter  10.1-10.3 |
| 35-36 | To study the Digraphs | Directed graph, Euler digraph,  Strongly connected & weakly connected digraphs, | Chapter  7.1 |
| 37- 40 | Directed weighted network, relevance of maximum flow | Network flow, Max Flow- Min Cut theorem, Fulkerson Algorithm for Maximum flow, Shortest path problem & Dijkstara Algorithm. | Chapters in R1 :  15.1, 15.2 and  10.4.1-10.4.3 |

**Evaluation Scheme:**

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| **Evaluation Component** | **Duration** | **Weightage** | **Date & Time** | **Nature of Component** |
| Mid-semester Examination | 90 Minutes | 30% | 14/03 9.30 - 11.00AM | Open book |
| Quiz 1 |  | 7% | Details will be announced in the class | Closed book |
| Quiz 2 |  | 7% |
| Assignment 1 |  | 6% | Open Book |
| Assignment 2 |  | 5% |
| Comprehensive Examination | 3 Hours | 45% | 10/05 FN | Closed Book |

**Total Marks: 100**

**Chamber Consultation Hour:** To be announced in the class.

**Notices:** All notices about the course will be put up in the CMS Notice Board.

**Make-up Policy:** Make up will be granted only in genuine cases. Permission must be taken in advance.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**INSTRUCTOR-IN-CHARGE**