Kotebe University of Education
College of Natural and Computational Sciences
Department of Mathematics

Course Syllabus on 'Graph Theory'

Course Code: Math 743

Credit Hours/ ECTS: 3 / 7

Lecture hours: 4

Collaborative Learning hours: 2

Independent learning hours: 5

Length of time to complete the course: 16 weeks

Total number of load hours the student will carry to complete the course: 189 hrs

Pre-requisite Courses: Math 601

Program: M.SC. in Mathematics (Combinatorics Specialization)

Learning Outcomes

On completion of the course successful students will be able to:

- understand the definition of a graph and its various components.
- get familiar to the various terminologies in Graph Theory.
- understand the definition of Matching
- develop skills in modeling and solving various problems using the concept of matching
- understand the definition of connectivity and various properties of connected graphs
- use the concept of connectivity to model problems and solve them
- understand the definition of planarity
- use the concept of planarity and related properties to solve problems.
- understand the definition of coloring and perfect graphs
- use the concept of colouring to model problems and solve them

- understand the definition of Networks and flows
- use various algorithms to solve Network problems
- develop skills in using graphs as modeling tools in various disciplines

Mode of Delivery: This course will be offered in a semester based mode of delivery

Course Contents

1. The Basics
    - 1.1 Graphs
    - 1.2 The Degree of a Vertex
    - 1.3 Matrices and graph Isomorphism
    - 1.4 Paths, Cycles and Trails
    - 1.5 Connections
    - 1.6 Trees and Forests
    - 1.7 Bipartite Graphs
    - 1.8 Contraction and Minors
    - 1.9 Euler Tours
    - 1.11 Other Notions of Graphs
2. TREES
    - 2.1 Properties of Trees
    - 2.2 Distance in trees and graphs
    - 2.3 Spanning Trees
    - 2.4 Enumeration of trees
3. Matching
    - 3.1 Maximum Matchings
    - 3.2 Hall's Matching condition
    - 3.3 Min-Max Theorems
    - 3.4 Independent Sets and Covers
    - 3.5 Maximum Bipartite Matchings
    - 3.6 Matchings In general Graphs
    - 3.7 Tutte's 1-factor Theorem

4. Connectivity
    - 4.1 Blocks
    - 4.2 k-connected graphs and k-edge connected graphs
    - 4.3 2-connected graphs
    - 4.4 The structure of 3-connected Graphs
    - 4.5 Application of Menger's Theorem
    - 4.6 Mader's Theorem
    - 4.7 Edge-disjoint spanning trees.
5. Planar Graphs
    - 5.1 Topological Prerequisites
    - 5.2 Plane Graphs
    - 5.3 Drawings
    - 5.4 Planar Graphs 'Kuratoiski's Theorem
    - 5.5 Algebraic Planarity criteria
    - 5.6 Plane duality.
6. Coloring
    - 6.1 Coloring Maps and Plane Graphs
    - 6.2 Coloring vertices
    - 6.3 Coloring Edges
    - 6.4 List Coloring
    - 6.5 Perfect Graphs
7. Network flow problems
    - 7.1 Shortest Paths, Minimal Spanning Threes
    - 7.2 Minimal Spanning Trees
    - 7.3 Network Flows
    - 7.4 Algorithmic Matching
    - 7.5 The transportation problem

Teaching-Learning Strategy/Methods

Lectures, Tutorial, Group Projects and presentations

Assessment Strategy/Methods

1. Assignment: 20%
2. Tests: 30%
3. Semester Examination: 50%

Course Policy

A student has to

1. Attend at least 80% of the classes
2. Take all continuous assessments
3. Take final examination
4. Respect all rules and regulations of the University

References

[1] Bondy, J. A., and Murthy, U.S.R., Graph Theory with applications, Elseiver Science Publishing Co. Inc., 1982.

[2] Diestel, R., Graph Theory, Electronic Edition, 2000.

[3] Gupta R.P., The chromatic index and the degree of a graph (Abstract 66T-429). Not. Amer: Math. Soc. 13 (1966),

[4] Tutte W. T., A contribution to the theory of chromatic polynomials. Canad. J.Math. 6 (1954).

[5] Tutte W. T., Introduction to the Theory of Matroids. Amer. Elsevier (1970).