Department of Mathematics

College of Basic Education

Salahaddin University - Erbil

Subject: Graph theory

Course Book – Diploma

Lecturer's name: Dr. Payman A. Rashed

Academic Year: 2023/2024- First semester

Course Book

1. Course name	Graph theory
2. Lecturer in charge	Dr. Payman A. Rashed
3. Department/ College	Mathematics/ Basic Education
4. Contact	e-mail: payman.rashed@su.edu.krd Tel:
5. Time (in hours) per week	Theory: 2 hours per week
6. Office hours	
7. Course code	
8. Teacher's academic profile	• B. Sc. in Mathematics, Mathematics Department - College of Science – Mosul University - Mosul in 1987. • M. Sc. in Mathematics. Mathematics Department - College of Science Salahaddin University - Erbil in 2002. • Ph. D. in Mathematics. Mathematics Department - College of Computer Sciences and Mathematics – University of Mosul in 2015.
9. Keywords	Graph, Size, order, matching, special graphs, genus, colorable, polynomials, topological index…etc.

10. Course overview:

   This course unit is concerned with the study of concepts Basics in Graph theory , digraph and their structure, the study of subgraph, special graphs and the properties of them like dimeter, radius , eccentricity,…ect. Connected graph , cut vertex and distance in graph, a Tree with its properties, and planer graph which is the graph can be embedded in one plan with genus thickness and crossing number is studied, study some type of polynomials and topological indices.

   Students must be understand some fundamental concepts in Graph theory like degree, size, order, sequence of degree, cycle, path, completeness ..etc,   and compare among several kinds of special graphs and there properties.

11. Course objective:

In recent years, graph theory has established itself as an important mathematical tool in a wide variety of subjects, ranging from operational research and chemistry to genetics and linguistics, and from electrical engineering and geography to sociology and architecture.

At the same time it has also emerged as a worthwhile mathematical discipline

in its own right. In view of this, there is a need for an inexpensive introductory text on the subject, suitable both for mathematicians taking courses in graph theory and also for no specialists wishing to learn the subject as quickly as possible.

12. Student's obligation

Please do not miss any class unless absolutely necessary. If you miss a class period, you are still responsible for learning the material covered on the day you missed, and also for any work which was assigned on the day you missed.

13. Forms of teaching:
White board and Presentation slides in Power point , Lecture notes.

14. Assessment scheme
There will be two tests and a final exam , and Your final grade will be computed as follows:

Test	20%
Seminar and presentation	30%
Final Exam.	50%
Total	100%

16 References.

1- Chartrand. G and Lesniak .L, (1996), Graph and Digraph, 2nd ed. Wadsworth and Brooks/Cole, California.
2- Balakrishnan, R. and Ranganthan. K, (2000), A text Book of Graph theory, Springer- Verlag, New York.
3- Bondy J. A. and Nurty, U.S.R. (2008), Graph theory, library of Congress Control Number: 2007940370.
4- Harary, F., (1971), Graph theory, Addison Wesley, reading,
5- على عزیز علی ، مقدمه فی نظریه البیانات ، جامعه الموصل 1983.

17 Syllabus of Graph theory.

1- Introduction:

1.1 Definition and basics Concepts in graph theory

1.2 Walks, trail, Path and cycles.

1.3 Components.

1.4 Connectivity.

1.5 Distance and neighbourhood.

2-Type of graphs

2.1 path, cycle, complete, bipartite graph. And complete n-partite.

2.2 Graph Isomorphism and Subgraphs.

2.3 Connectedness graph, Eccentricity, diameter, and radius

2.4 Binary operations on graphs

3-Graph and Matrices (Matrix representation of graphs)

3.1 Adjacency Matrix

3.2 Incident matrix

3.3 cut matrix

3.4 characteristic polynomial of matrix

4- Graph Coloring

4.1Vertex coloring

4.2 Edge coloring

4.3 Map coloring.

5- Graph polynomials

5.1 Hosoya polynomial.

5.2 Chromatic polynomial.

6-Topological indices .

6.1 Zegrab index.

6.2 ABC index.

6.3 GA index.

7- Graph Applications.

7.1 Graph theory via Algebra.

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19. Examinations:

Sample of Examination:

Q1/ A- Define degree set and degree sequence, and show that S: 6, 4, 4, 3, 3, 3, 3, 2, 2, 2,1, 1 is graphical.

B- Define embedding and planner graph, show that $V(K_{5,6}) < 24$.

Q2/ Define cage and state (Erdos and Sachs) theory about cage and prove that (3,5) cage is Peterson graph.

Q3/ Answer the following (draw the graph if needed).

1-Adjacent and incident matrix of K_5.

2-The total number of non identical graphs of order three.

3-Find chromatic number of K_6 .

4-(3,6)-cage.

5-Maximal and perfect matching of Peterson graph.

Q4/A) Find $P_3 + C_5$.

B) The graph G is bipartite iff it contains no odd cycles, prove.

Q5/ Define thickness and prove that the thickness of complete bipartite is $\left\lceil \dfrac{mn}{2(m+n-2)} \right\rceil$.

Q6/ Find topological index of complete, cycle, path and bipartite graph,

K4, C11, P12, K3,4.

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20. Extra notes: