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**Department of Mathematics**

**College of Education**

**University of Salahaddin**

**Subject: Graph Theory**

**Course Book –Fourth Stage**

**Lecturer's name: Ivan Subhi Latif**

**Academic Year: 2022/2023**

Course Book

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| 1. Course name | Graph Theory |
| 2. Lecturer in charge | Ivan Subhi Latif |
| 3. Department/ College | Mathematics\ Education |
| 4. Contact | e-mail:Ivan.latif@edu.su.krdTel:+967504536027 |
| 5. Time (in hours) per week  | Three hours |
| 6. Office hours | Tuesday 8,5-10,5 am Wednesday 8,5-9,5 am  |
| 7. Course code |  |
| 8. Teacher's academic profile  | Ivan Subhi – assit .prof. mathematics teacher mathematics teacher work in college of education Kurdistan region-Iraq, Erbil *Current*: Salahaddin University college of education mathematics department. *Education*: M.Sc. in mathematics (mathematical statistics).Ph.D .in mathematics(Numerical Optimization)*Summary* : I am a native Kurdish speaker and graduate from Salahaddin who is working towards to rise Scientific title |
| 9. Keywords | Mathematical logic, Set theory, relation and construction of numbers. |
| 10.  Course overview:In recent years, graph theory has established itself as an important mathematical tool ina wide variety of subjects, ranging from operational research and chemistry to geneticsand 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 non-specialists wishing to learn the subject as quickly as possible. It is my hope that this course goes some way towards filling this need. The only prerequisites to reading it are a basic knowledge of elementary set theory and matrix theory, although a further knowledge of abstract algebra is needed for more difficult exercises. |
| **11. Course objective:**The basis of graph theory is in combinatory and the role of “graphics” is only in visualizing things. Graph-theoretic applications and models usually involve connections to the ”real world” on the one hand often expressed in vivid graphical terms and the definitional and computational methods given by the mathematical combinatory and linear-algebraic machinery on the other. For many, this interplay is what makes graph theory so interesting. There is a part of graph theory which actually deals with graphical drawing and presentation of graphs. |
| 12.  Student's obligationThe students are obliged to attend to the class room. Student also enforced to make examination. |
| 13. Forms of teachingDifferent forms of teaching will be used to reach the objectives of the course: power point presentations for the head titles and definitions ,figure and summary of conclusions, classification of materials and any other illustrations. |
| 14. Assessment schemeMidterm exam degree (40%) is calculated as follows:- - Theory: 20 marks  - Practice: 20 marks- Final exam degree (60%) is calculated as follows:  Theory: 30 marks Practice: 30 marks  |
| 15. Student learning outcome:The student will be familiar with main topics in Mathematics such as: set Theory, and logic. |
| 16. Course Reading List and References‌:[1]Solutions to A First Course in Graph Theory using Mathematica ColophonBenefits of using Mathematica: typesetting, helping with mechanics of solution, empirical testing of hypothetical solutions.Visualization and interaction help in understanding[2]Lecture Notes on GRAPH THEORY,Tero Harju, Department of Mathematics,University of TurkuFIN-20014 Turku, Finland,e-mail: harju@utu.fi,1994 – 2011[3] B\_ela Bollob\_as. Modern Graph Theory. Graduate texts in mathematics. Springer,Heidelberg, 1998.[4] John Adrian Bondy and Uppaluri S. R. Murty. Graph Theory with Applications.Elsevier, New York, 1976.[5] Gary Chartrand and Linda Lesniak. Graphs & Digraphs. Wadsworth Publ. Co.,Belmont, CA, USA, 1986.[6] Reinhard Diestel. Graph Theory, 4th Edition. Graduate texts in mathematics.Springer, 2012.[7] L\_asl\_o Lov\_asz. Combinatorial Problems and Exercises. Akad\_emiai Kiad\_o, 1979.[8] Douglas B. West. Introduction to Graph Theory. Prentice Hall, 2 edition, September2000.**Course Outline**: The course topic outline which follows identifies the lecture topics which will be presented throughout this academic year:**Week 1,2,3,**: 1 Introduction to Graphs . 1.1 Basic Definitions,1.2 Degrees and Degree Sequences in Graphs,1.3 Subgraphs and Spanning Subgraphs,1.4 Fundamental Graph Classes,1.5 Isomorphic Graphs,1.6 Exercises **Week 5, ,6 & 7**: 2 Graphs and Their Operations . 2.1 Union, Intersection and Ringsum of Graphs2.2 Complement of Graphs,2.3 Join of Graphs,2.4 Deletion and Fusion,2.5 Subdivision and Smoothing,2.6 Exercises **Week 8,9,10:** 3 Connectedness of Graphs 3.1 Paths, Cycles and Distances in Graphs,3.2 Connected Graphs,3.3 Edge Deleted and Vertex Deleted Subgraphs **Week 11,12 & 13:** 4 Traversability in Graphs4.1 Eulerian Graphs ,4.2 Chinese Postman Problem ,4.3 Hamiltonian Graphs ,4.4 Some Illustrations ,4.5 Weighted Graphs ,4.6 Travelling Salesman’s Problem.**Week 14, 15:** 5 Directed Graphs 5.1 Directed Graphs ,5.2 Types of Directed graphs ,5.3 Networks **Week 16,17:** 6 Trees 6.1 Properties of Trees ,6.2 Distances in Trees ,6.3 Degree Sequences in Trees 6.4 On Counting Trees ,6.5 Spanning Trees ,6.6 Fundamental Circuits ,6.7 Rooted Tree ,6.8 Binary Tree **Week 17,18:** 7 Connectivity in Graphs 7.1 Cut-Vertices and Vertex-Cuts of a Graph ,7.2 Cut-Sets of a Graph ,7.3 Fundamental Cut-Sets ,7.4 Connectivity in Graphs ,7.5 Exercises . **Week 19,20:** 8 Planar Graphs 8.1 Three Utility Problem ,8.2 Planarity of Graphs ,8.3 Kuratowski Graphs and Their Nonplanarity ,8.4 Detection of Planarity and Kuratowski’s Theorem ,8.5 Euler Theorem and Consequences ,8.6 Geometric Dual of a Graph ,8.7 Exercises .**Week 21,22&23:** 9 Matrix Representations of Graphs 9.1 Incidence Matrix of a Graph ,9.2 Cycle Matrix ,9.3 Cut-Set Matrix ,9.4 Relation between Af ;Bf and Cf ,9.5 Adjacency Matrix ,9.6 Path Matrix ,9.7 Exercises .**Week 24&25:** 10 Graph Algorithms . 10.1 Computer Representation of a Graph ,10.2 Algorithm for Connectedness and Components ,10.3 Spanning Tree Algorithm ,10.4 Minimal Spanning Tree Algorithms REFERENCES |
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| 18. Practical Topics (If there is any) |  |
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| 19. Examinations:Q1/ Draw the following graphs:   (10Marks)      (i) the null graph N5;(ii) the complete graph K6;(iii) the complete bipartite graph K7 4;(iv) the union of Kl 3 and W4;(v) the complement of the cycle graph C4.Q2\How many edges has each of the following graphs:(i)Kl0; (ii)K57; (iii) Q4; (iv) W8; (v) the Petersen graph?    (10Marks)      Q3\ Show that every two identical graphs are isomorphic. |
| 20. Extra notes:No more notes |
| 21. Peer reviewپێداچوونه‌وه‌ی هاوه‌ڵ                    This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject). |