



# Postgraduate Course book

**Department of Mathematics**

**College of Education**

**Salahaddin University - Erbil**

**Subject: Algebraic Graph Theory**

**Course Book Level: Ph. D.**

**Lecturer's name: Assist. Prof. Dr. Rashad Rashid Haji**

**Academic Year: 2023 – 2024 First Semester**

# Course Book

<b>1. Course name</b>	<b>Advanced Mathematical Analysis</b>
<b>2. Lecturer in charge</b>	<b>Assist. Prof. Dr. Rashad Rashid Haji</b>
<b>3. Department/ College</b>	<b>Mathematics / Education</b>
<b>4. Contact</b>	e-mail: <a href="mailto:rashad.haji@su.edu.krd">rashad.haji@su.edu.krd</a> Tel: (optional)
<b>5. Time (in hours) per week</b>	<b>For example Theory: 3</b>
<b>6. Office hours</b>	<b>8</b>
<b>7. Course code</b>	<b>Algebraic Graph Theory</b>
<b>8. Teacher's academic profile</b>	<p>2014-2015: Ph.D., in Mathematics, at the School of Mathematics, College of Engineering and Physical Science in the University of Birmingham, UK. The title of the thesis is: Harmonic Analysis Using Methods of Nonstandard Analysis. Supervised by Dr. Richard Kaye.</p> <p>2012-2013: MPhil qual (MASTER OF PHILOSOPHY), in Mathematics, at the School of Mathematics, College of Engineering and Physical Science in the University of Birmingham, UK. The title of the thesis is: A Nonstandard Approach to Fourier Series. Supervised by Dr Richard Kaye.</p> <p>1999-2000: M.Sc., in Mathematics, at the Department of Mathematics, College of Science in the Salahaddin University-Erbil, Iraq. The title of the thesis is: Nonstandard Approximation and Successive Shadows Development. Supervised by Dr. Tahir Hasan Ismail.</p> <p>1988-1989: B.Sc., in Mathematics at the Department of Mathematics, College of Education in the Salahaddin University-Erbil, Iraq.</p> <p>I am interesting in the fields of Mathematical analysis, Topology, Algebra and Graph Theory.</p>
<b>9. Keywords</b>	<b>Density of Rational and Irrational Numbers, Sequences of Real Numbers, Metric spaces, Continuity between Metric spaces, Sequences of Functions.</b>
<b>10. Course overview:</b>	<p><b>By the end of studying of this module, the student should be able to know the following subjects: Permutations, Graph isomorphism, Special graphs and graph operations, The adjacency matrix, The coefficients and roots of a polynomial, The characteristic polynomial and spectrum of a graph, Cospectral graphs and bipartite graphs, Bounds on the chromatic number, The chromatic polynomial, The Laplacian and signless Laplacian matrices, The matrix tree theorem, Regular graphs and strongly regular graphs, Quotient graphs, Automorphisms and eigenpairs, Equitable partitions of graphs, Stochastic Processes, and Stochastic Calculus.</b></p>

<p><b>11. Course objective:</b> This should not be less than 100 words</p>	
<p><b>12. Student's obligation:</b> The attendance of students is very necessary in order to understand the subjects of the module throughout the semester, completion of all example class exercises, tests, and exams.</p>	
<p><b>13. Forms of teaching:</b> Data show, lecture notes. We use chalk and green boards, white boards as tools of writing to explain the theoretical steps of the module to students.</p>	
<p><b>14. Assessment scheme:</b> Throughout this Semester there are two Exams, Midterm and Final term. We set different types of questions such as: Prove or disprove, giving examples, short proves. In addition, four Quizzes during whole the term.</p>	
<p><b>15. Student learning outcome:</b> Our aim in this module is to teach the students. They will learn the following new topics:</p> <ol style="list-style-type: none"> <li>1- Permutations</li> <li>2- Graph isomorphism</li> <li>3- Special graphs and graph operations</li> <li>4- The adjacency matrix</li> <li>5- The coefficients and roots of a polynomial</li> <li>6- The characteristic polynomial and spectrum of a graph</li> <li>7- Cospectral graphs and bipartite graphs</li> <li>8- Bounds on the chromatic number</li> <li>9- The chromatic polynomial</li> <li>10- The Laplacian and signless Laplacian matrices</li> <li>11- The matrix tree theorem</li> <li>12- Regular graphs and strongly regular graphs</li> <li>13- Quotient graphs</li> <li>14- Automorphisms and eigenpairs</li> <li>15- Equitable partitions of graphs</li> </ol>	
<p><b>16. Course Reading List and References:</b> [1] P. Erdős and A. Rényi. Asymmetric graphs. Acta Math. Acad. Sci. Hungary, 14:295–315, 1963. 29 [2] C. Godsil and G. Royle. Algebraic Graph Theory. Springer, 2001. 29 [3] A.J. Hoffman. On the exceptional case in a characterization of the arcs of a complete graph. IBM Journal of Research and Development, 4(5):487– 496, 1960. 70 [4] H.S. Wilf. The eigenvalues of a graph and its chromatic number. Journal of the London Mathematical Society, 42(1967):330, 1967. 97 149</p>	
<p><b>17. The Topics:</b></p>	<p><b>Lecturer's name</b></p>

<p><b>Some known Groups such as the symmetric group of n symbols <math>S_n</math>, Graphs and operation on graphs, Graph isomorphism, some Special graphs and graph operations, The adjacency matrix of graphs, The coefficients and roots of a polynomial of graphs, The characteristic polynomial and spectrum of a graph, Cospectral graphs and bipartite graphs, Bounds on the chromatic number, The chromatic polynomial, The Laplacian and signless Laplacian matrices, The matrix tree theorem, Regular graphs and strongly regular graphs, Quotient graphs, Automorphisms and eigenpairs, Equitable partitions of graphs.</b></p>	<p>Assist. Prof. Dr. Rashad Rashid Haji</p> <p>ex: (3 hrs)</p> <p>ex: 15/10/2023</p>
<p><b>18. Practical Topics (If there is any)</b></p>	
<p>In this section The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture.</p>	<p>Assist. Prof. Dr. Rashad Rashid Haji</p> <p>ex: 15/10/2023</p>
<p><b>19. Examinations:</b></p> <p><b>1. Compositional:</b> In this type of exam the questions usually starts with Explain how, What are the reasons for...?, Why...?, How....? With their typical answers Examples should be provided</p> <p><b>2. Prove or disprove the statements:</b>In this type of exam a short sentence about a specific subject will be provided, and then students will comment on the trueness or falseness of this particular sentence. Examples should be provided</p> <p><b>3. state and prove the following:</b> In this type of exam there will be a number of phrases next or below a statement, students will match the correct phrase. Examples should be provided.</p>	
<p><b>20. Extra notes:</b> Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.</p>	
<p><b>21. Peer review</b> <span style="float: right;"><b>پیداچوونہوہی ہاوہل</b></span></p> <p>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).</p> <p>نہم کورسبوو کہ دہبیت لہ لایہن ہاوملکی نیکادیمیہوہ سہیر بکریٹ و ناوہرۆکی بابہتہکانی کورسہکہ پەسەند بکات و جەند ووشەبەک بنووسیت لەسەر شیاوی ناوہرۆکی کورسہکە و واژووی لەسەر بکات. ہاوہل ئەو کەسەیە کہ زانیاری ھەبیت لەسەر کورسەکە و دہبیت پلەہی زانستی لە ماموستا کەمتر نەبیت.</p>	