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**Department of Electrical Engineering.**

**College of Enginering**

**University of Salahaddin**

**Subject: Numerical Analysis**

**Course Book – (Year 3)**

**Lecturer's name: Dlawar Rauf Maruf, MSc.**

**Academic Year: 2019/2020**

**Course Book**

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| **1. Course name** | **Numerical Aanlysis** | |
| **2. Lecturer in charge** | **Dlawar Rauf Maruf** | |
| **3. Department/ College** | **Electrical Engineering/ College of Engineering** | |
| **4. Contact** | **e-mail:** [**Dlawar.Maruf@su.edu.krd**](mailto:Dlawar.Maruf@su.edu.krd)  **Tel: (optional)** | |
| **5. Time (in hours) per week** | **Theory: 3**  **Practical: 6** | |
| **6. Office hours** | **All days** | |
| **7. Course code** | **SUH 10112** | |
| **8. Teacher's academic profile** |  | |
| **9. Keywords** | **Numerical Analysis and Matlab Lab.** | |
| **10. Course overview:**  This course deals with the numerical methods with Matlab codes  1-Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.  2-Apply numerical methods to obtain approximate solutions to mathematical problems.  3-Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.  4-Analyse and evaluate the accuracy of common numerical methods.  5-Implement numerical methods in Matlab.  6Write efficient, well-documented Matlab code and present numerical results in an informative way. | | |
| **11. Course objective:**  The course gives the way to solve different types of complicated equations and relations by an approximate standard methods, mainly by using computers (MATLAB Program), since most of the methods depends on iteration or trial and error until it reaches the result with acceptable error. There is one hour/week for the theoretical part and two hours for the computer lab. The course covers:   * Types of errors * Solution of equations (finding the roots) * Solution of simultaneous equations * Curve fitting and interpolation * Numerical Integration * Numerical Differentiation * Solution of ordinary differential equations (ODE) | | |
| **12. Student's obligation**  The Attendance is obligatory for all students. The allowable absence is %10 for unexcused cases and %15 for excused cases. | | |
| **13. Forms of teaching**  1- The data show, 2- The white board, 3- The printed lecture and  4- The power point. | | |
| **14. Assessment scheme**  Students are required to do one closed book examination at the end of each course, beside of 5 quizzes examination before final examination**.**  Quizzes 5% for Numerical Analysis  Exam 1 25% for Numerical Analysis  Quizzes 5% for Matlab Lab  Exam 1 15% for Matlab Lab  The average 50%  Final examination 50% (30% Theoritically and 20% Practically).  ‌ | | |
| **15. Student learning outcome:**  After completion of the course, the syudent will be able to:   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **1.** | Understand the difference between analytical and numerical solution of a mathematical problem. | | | | | |  | |  |  | | | | | | |  | |  | **2.** | | | | | Use and develop mathematical software for the solution of engineering problems. |  |  | |  |  | | | | | | |  | |  | **3.** | | | Understand the importance of numerical stability and problem conditioning | | |  |  | |  |  | | | | | | |  | |  | **4.** | | | | | Understand the notion of computational cost of an algorithm (expressed using rates of convergence or flop counts). |  |  | |  |  | | | | | | |  | |  | **5.** | | | | | Understand and apply the basic algorithms for solving sets of linear equations. |  |  | |  |  | | | | | | |  | |  | **6.** | | | | Understand the applications and basic algorithms of linear least-squares. | |  |  | |  |  | | | | | | |  | |  | **7.** | | | | Understand the importance of orthogonal factorizations in matrix computations. | |  |  | |  |  | | | | | | |  | |  | **8.** | | | Understand and apply the basic iterative methods for solving sets of nonlinear equations. | | |  |  | |  |  | | | | | | |  | |  | **9.** | | | Have a basic understanding of several subjects selected from the following list (the selection varies with the instructor): Interpolation, Numerical integration decomposition. | | |  |  | |  |  | | | | | | |  | |  | **10.** | | | Have a basic understanding of several subjects selected from the following list (the selection varies with the instructor): Numerical methods for ordinary differential equations, Unconstrained optimization, nonlinear least-squares, Linear programming. | | |  |  | |  |  | | | | | | |  | |  | **11.** | | Several homework assignments delving on core concepts and reinforcing analytical skills learned in class. | | | |  |  | |  |  | | | | | | |  | |  | **12.** | | Computer assignments included in the homework assignments and/or one or two computer projects. Opportunity to conduct Matlab-based projects requiring some independent reading, programming, simulations and technical writing. | | | |  |  | |  |  | | | | | | |  | |  | **13.** | Opportunities to interact weekly with the instructor and teaching assistant(s) during regular office hours, discussion sections, and the course forum in order to further the students' learning experience and the students' interest in the material. | | | | |  |  | | | |
| **16. Course Reading List and References‌:**  There are many reference books in this subject, but the following text book was useful because it contains many solved examples and MATLAB programs that enhance student scientific backgrounds:   * "Numerical Techniques" By: J. S. Chitode, Technical Publication Pune, 2nd Edition 2008 * “Numerical Methods for Scientific and Engineering Computation” By: M.K. Jain. * “Numerical Analysis, An Introduction” By: Gautschi | | |
| **17. The Topics:** | | **Lecturer's name** |
| Week 1:  **Chapter 1**/ Course outline, Introduction to Numerical analysis .  Types of errors: definitions: Round off errors, Truncation Errors.  Significant digits, Accuracy & Precision, Absolute error.  Week 2:  **Chapter 1/** Relative error, Error propagation (multiplication, division, addition & subtraction).  Week 3:  First quiz, where the results were very low so it was cancelled.  **Chapter 2/** Solution of Equations: Roots of simple quadratic  equations, Polynomials, Transcendental functions.  Week 4:  **Chapter 2/** Bracketing Methods: Graphical method and Bisection.  Week 5:  **Chapter 2/** Open Methods: Newton-Raphson method  Week 6:  **Chapter 2/** Open Methods: / Secant method.  **Chapter 3/** Solution of linear simultaneous  equations: ILL-conditioned equations.  Week 7:  **Chapter 3/** Methods of solutions: Gaussian Elimination  method  Week 8:  **Chapter 3/** Gauss-Jordan method  Week 9:  Matrix inverse  Week 10:  **Chapter 3/** Iterative methods :   1. Jacobi method.   2- Gauss-Seidel method  Week11:  **Chapter 4/** Curve Fitting & Interpolation: Definitions: Arithmetic means,  Least Squares Approximation: Linear regression  Week 12:  **Chapter 4/**  Least Squares Approximation :Polynomial regression  Week 13:  **Chapter 4/**  Interpolation:1- Linear interpolation  2- Quadratic interpolation  Week 14:  **Chapter 4/** Newton's interpolating polynomials/ Lagrange interpolating equations.  Week 15:  **Chapter 5/ Numerical Differentiation and Integration** | | 1 hour/ week |
| **18. Practical Topics (If there is any)** | |  |
| Most of the topics are practically done in the computer laboratory.  Introduction to numerical computing and analysis. Floating point representation and round-off error; numerical methods for systems of linear equations; methods for systems of nonlinear equations. Introduction to linear programming, least squares, interpolation, approximation, numerical integration; and differential equations. | | All weeks  6hrs / week |
| **19. Examinations:**  ***1. Compositional:***  Solve the following system of equations using Gauss-Jordan elimination method.  **Solution**: The augmented matrix of the equations is:  We will perform row operations until obtain the unit matrix.  R2 - 2R1 ,  R3 – 4R1    R3 + 4R2      R2-3R3  R1 - R3      From the final matrix, we can read the solution:  R1 - R2  x=3, y= 4 and z=-2  ***2.******True or false type of exams:***  1-As soon as a new value for a variable is found by iteration, it is used immediately in the following equation. This method is called Gauss sediel method.  2- Proper choice of initial value is very important in Secant Method.  ***3. Multiple choices:***  **1**-Error caused by taking the value of 1/6 = 0.6666 instead of 0.666666…. is  (a) Round off error **(**b) Truncation error (c) Inherent error (d) relative error  **2**- Polynomials are the most commonly used functions for interpolation because they are easy to  (a) evaluate (b) differentiate (c) integrate (d) evaluate, differentiate and integrate | | |
| **20. Extra notes:** NULL | | |
| **21. Peer review**  I see that his course book contents , cover all subjects that are written in the syllabus of the electrical engineering.  The lecturer: Dr. Fadil Tofeeq | | |