
# Department of Mathematics

# College of Science

# Salahaddin University-Erbil

# Subject: Numerical Analysis II with MATLAB

# Course Book : Third year (Second Course)

# Lecturer's name: Fuad W. Khdhr

# Academic Year: 2022-2023

# Course Book

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| **1. Course name** | Numerical Analysis with MATLAB |
| **2. Lecturer in charge** | Fuad Wahid Khdhr |
| **3. Department/ College** | Mathematics / Science |
| **4. Contact** | e-mail: fuad.khdhr@su.edu.krd<br>Tel: +9647504493156 |
| **5. Time (in hours) per week** | For example Theory: 2<br>Practical: 2 |
| **6. Office hours** | |
| **7. Course code** | |
| **8. Teacher's academic profile** | "My name is **Fuad Wahid Khdhr**, I born in Erbil, Iraq in 1981. I graduated from mathematics Department / College of Science in Salahaddin University-Erbil in 2004-2005, in Erbil, Iraq. I got Master of Science in mathematics (Numerical Analysis) in 2010. I got PhD in mathematics (Numerical Analysis) in 2021.<br><br>I am working as a lecturer in mathematics department / college of science / Salahaddin University-Erbil". |
| **9. Keywords** | Error, Approximation root, Interpolation, Differentiation and Integration Approximate. |

**10. Course overview:**

This introductory course in numerical analysis covers a wide range of methods and applications in physics. The field of Numerical analysis Physics has the support of Mathematics and of Theoretical Physics, providing the necessary algorithms for the computing codes used by the Computational Physics. Surely, the results of numerical computations have many applications, both in the field of Theoretical Physics and in different domains of Applied (Technical) Physics. Taking into account that the validity domain of the different Physics theoretical models corresponds to some numerical values of the similitude criteria, one finds that the Numerical analysis Physics is also very important for the classification of these domains and, for the Physics teaching, consequently.

On the other hand this course covers the solution of nonlinear equations in one variable as well as large system of simultaneous linear and nonlinear equations. Also covers the approximating of functions (Interpolation), numerical differentiations and the numerical integrations. Finally we will study numerical solutions of ordinary differential equations with boundary value problems. The methods considered are suitable for implementation on computers and the course includes practical work. The course will use Matlab to provide a programming environment in which we will implement many of these algorithms.

**11. Course objective:**

The overall goal of the field of numerical analysis is the design and analysis of techniques to give approximate but accurate solutions to hard problems. Also to introduce students to the topic of

Numerical Analysis and some of the major issues involved, including accuracy and convergence, through the study of some simple numerical algorithms. Therefor introduce students to Matlab programme and the use it with the topic of numerical analysis, because many of times calculation of the problem by hands is difficult. Finally to learn how to apply numerical methods to a variety of physical problems.

**12. Student's obligation**

- **a.** Students must come on time and remain in the classroom for the duration of scheduled classes and Labs.
- **b.** Students own an obligation to write tests and final examinations at the times scheduled by the teacher or the College.

## 13. Forms of teaching

I give hard copy of My lecture notes to students before coming lecturer time. first I remember students about previous lecture, and then I start new lecture. At the end of the lecture give a homework for the next lecture. During this proses I am use presentation and whiteboard.

## 14. Assessment scheme

1. ***Practical:*** 35% Matlab assignments and quizzes in Lab.
2. ***Theoretical:*** 15% (Midterm exams and other activities).
3. ***Final Exam: Theoretical:*** 50% .

## 15. Student learning outcome:

- **a.** Students will be learn to concept of Numerical analysis and type of errors.
- **b.** Students will be learn to find out approximate root of linear and non-linear of equations and systems by different methods.
- **c.** Students will be learn to interpolate and least square of polynomial.
- **d.** Students will be learn to Numerical Differentiation and integration**.**
- **e.** Students will be learn to Numerical Solution of Ordinary Differential Equations.

## 16. Course Reading List and References:


[1] Saeed, R. k., Jwamer, K. H., Hamasalh F. K. (2015) “Introduction to Numerical Analysis, First Edition”, Sulaimani, Kurdistan Region – Iraq.

[2] **Burden, R. L. and Faires, J. D. (2011)** ″Numerical Analysis, Ninth Edition″, Prindle, Weber and Schmidt.

[3] **Kincaid, D. and Cheney, W. (2002)** ″Numerical Analysis: mathematics of Scientific computing, third edition″, Brooks/Cole Publishing Company.

[4] **Phillips, G. M. and Taylor, P. J. (1973)** ″Theory and applications of Numerical Analysis″, New York: Academic Press.

[5] **Ralston, A. and Rabinowitz, P. (1978)** ″A First course in Numerical Analysis″, New York: McGraw-Hill.


| **17. The Topics:** | **Lecturer's name** |
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| **Chapter Three: Solving systems of linear Equations**<br>Solution of equations by iterative methods:<br>(i) Jacobi method<br>(ii) Gauss-Siedel method.<br><br>**Chapter Four: Solving systems of nonlinear Equations**<br>Introduction.<br>Newton method.<br>Modified Newton method**.**<br>**Chapter Five: Interpolation**<br>Introduction.<br>Finite difference operators.<br>Newton forward difference interpolation formula.<br>Newton backward difference interpolation formula.<br>Polynomial interpolation (Lagrange interpolation).<br>Divided differences.<br>Spline (degree one and two) interpolation.<br><br>**Chapter Six: Least square and Curve fitting**<br>Least square theory (discrete and continuous).<br>**Chapter Seven**: **Numerical Differentiation and integration**<br>Numerical differentiation. Numerical integration (Simpson method, Trapezoid Method)<br>**Chapter Eight: Numerical Solution of Ordinary Differential Equations**<br>Introduction. Taylor-series method. Runge-Kutta methods. Multistep methods. Systems and higher-order Ordinary Differential Equations. | 14 week (2 hours) |
| **18. Practical Topics** | |
| **Chapter:** Coding Topics of methods in Numerical Analysis.<br>**4.1: Solving systems of linear Equations**<br>**4.2: Solving systems of nonlinear Equations**<br>**4.3: Interpolation**<br>**4.4: Least square and Curve fitting**<br>**4.5:- Numerical Differentiation and integration** | 14 week (2 hours) |
| **19. Examinations:**<br>Questions in the examination will be arranged the matching mode by way of the examples and exercises that I give delivered in the lecture notes.<br>Sometimes will be have extra mark in examination for worthy students.<br>Many of the questions will be taken from this book: Thomas, **Burden, R. L. and Faires, J. D. (2011)** "Numerical Analysis, Ninth Edition", Prindle, Weber and Schmidt. | |
| **20. Extra notes:** | |

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| Answers of examination will be find in the board's declaration mathematics department after every examination. |
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