Department of Mathematics ……………….

College of Education…………………….

Salahddin University -Erbil………………….

Subject: Numerical Analysis………….

Course Book – (Year 3)

Lecturer's name:

Dr. Pakhshan Mohammedameen Hasan

Academic Year: 2022/2023

Course Book

1. Course name	**Numerical Analysis**
2. Lecturer in charge	**Dr. Pakhshan Mohammedameen Hasan**
3. Department/ College	**Mathematics/Education**
4. Contact	**e-mail: pakhshan.hasan@su.edu.krd** **Tel: (optional)**
5. Time (in hours) per week	**Theory: 3** **Practical: 2**
6. Office hours	**Group A** **Monday (10:30-11:30)** **Thursday (8:30-10:30)** **Lab. A_1 Monday (12:30-2:30)** **A_2 Monday (2:30-4:30)** **Group B** **Monday (11:30-12:30)** **Tuesday (10:30-12:30)** **Lab. B_1 Wednesday (8:30-10:30)** **B_2 Wednesday (10:30-12:30)**
7. Course code	
8. Teacher's academic profile	**Name: Dr.** Pakhshan Mohammedameen Hasan **Academic Qualification** 1991 B.Sc University of Salahaddin College of science , Department of Mathematics. 1999 M.Sc University of Technology , School of Applied Science. 2020 PhD University of Salahaddin College of Education, Department of Mathematics. During my work in University of Salahaddin , I have taught the following courses at • all the four undergraduate levels 1- Calculus. 2- Advanced Programming.

	3- Numerical analysis. 4- Operation Research. • Postgraduate level Advance Numerical Analysis.
9. Keywords	

10. Course overview:

The course provides an introduction to scientific computing. Several numerical methods are presented for the computer solution of mathematical problems arising in different applications. The software MATLAB is used to solve the problems and verify the theoretical properties of the numerical methods.

Students who successfully complete this course will:

- Number System and Errors
- Solution of Equations
- Numerical approximation of nonlinear equations.
- Numerical approximation of nonlinear system of equations.
- Numerical approximation of linear equations.
- Numerical Linear Algebra (direct and iterative methods).
- Interpolation, approximation of functions and data.
- Numerical integration and derivation.
- Numerical methods for Ordinary Differential Equations.

11. Course objective:

The aim of the course is to teach students basic methods and principles of scientific computing to enable them to solve basic and frequently occurring mathematical problems using computers and numerical software.

12. Student's obligation

1- Attendance.
2- Application in laboratory.
3- Examinations 50% (theoretical 25% and practical 25%)
4- Final Exam. 50% (only theoretical)

13. Forms of teaching

1- Green board.
2- Computers.

14. Assessment scheme

In Each course

1- Examinations 50% (2-3 theoretical exam 25% and 2-3 practical exam 25%)

2- Final Exam. 50% (only theoretical 50%)

15. Student learning outcome:

Students should have learned how to construct computer program flow diagrams, implement programs using MATLAB and apply those skills towards the numerical solution of the problems. Specifically:

- o Understand basic foundations of Numerical Solutions of the problems
- o Have a basic understanding of how to test and debug computer programs
- o Have the ability and an appreciation for good documentation of computer programs
- o Understand basic algorithms for

(1) solution of non- linear equations, (2) numerical integration, (3) numerical differentiation, (4) curve fitting, (5) solution of simultaneous linear equations and (6) numerical solution of Ordinary differential equations

- o Have a reasonably good knowledge of the MATLAB programming environment

16. Course Reading List and References:

1. Introduction to Numerical Methods, Peter A. Stark, 1970, Macmillan Inc, USA.
2. Numerical Analysis, Richard L. Burden, 2011, Brooks/Cole, 9th edition, USA.
3. Numerical Analysis, Purna Chandra Biswal, 2008, Prentice-Hall, 1st edition, India.
4. Applied Numerical Analysis, Gerald Wheatley, 2004, Pearson Education, Inc., 7th edition, USA.
5. Elementary Numerical Analysis, Atkinson Han, 2004, John Wiley & Sons, Inc., 3rd edition, USA.
6. Numerical methods for computer science, engineer, and math, Mathew, 1987, Prentice-Hall, USA.

17. The Topics:		Lecturer's name
Date	**Subjects (First Course)**	**Dr. Pakhshan Mohammedameen Hasan**
Week 1	Conducting Course Book of Numerical Analysis, review of Calculus.	
Week 2	**Chapter One**: Number System and Errors Definition of error, types of error	
Week 3	**Chapter Two**: Solution of Equations Bisection method, Secant method, False position method	

Week 4	Newton-Raphson's method, Fixed point iteration method.	
Week 5	Order of convergence, Aiken method	
Week 6	Roots of polynomials	
Week 8	Non-linear system	
Week 9	**Chapter Three**: Numerical Solution of Linear System Direct Method (Exact): Gauss elimination, Gauss Jordan method	
Week 10	Direct Method (Exact): LU-Decomposition method, m atrix inverse	
Week 11	Iterative Method: Gauss-Jacobi method, Gauss-Seidel method	
Week 12	Iterative Method: Gauss-Seidel method	
	Subjects (Second Course)	
Week 13	**Chapter Four**: Interpolation and Approximation Existence and Uniqueness of interpolating polynomials	
Week 14	Lagrange interpolating polynomials	
Week 15	Newton-Gregory forward interpolating polynomials	

Week 16	Newton-Gregory backward interpolating polynomials	
Week 17	Central Difference interpolation formula	
Week 18	Bessel's formula for interpolation	
Week 19	Divide Difference	
Week 20	Spline	
Week 21	Least square polynomial approximation	
Week 22	**Chapter Five**: Numerical Differentiation Derivatives using Newton-Gregory forward and backward	
Week 23	Derivatives using Divide Difference and Bessel's Formula	
Week 24	**Chapter Six**: Numerical Integration Rectangle, Midpoint, and Trapezoidal rule	
Week 25	Simpson's rule	
Week 26	Gaussian Quadrature formula: Legendre, and Chebyshev	
Week 27	**Chapter Seven**: Initial Value Problem Taylor and Euler method	

Week 28	Runge-Kutta method	

18. Practical Topics (If there is any)	
The same Subjects above will be applied in the laboratory on computers by MATLAB.	**Dr. Evan** **Mrs. Amal**

19. Examinations:

1. Compositional: **Q1**\ Let $\left.\begin{aligned} f(x,y)=0 \\ g(x,y)=0 \end{aligned}\right\}$ be a non-linear system of equations, and

$\left.\begin{aligned} x=F(x,y) \\ y=G(x,y) \end{aligned}\right\}$ be a Fixed-Point iteration form of it. Show that the sufficient

condition for convergence of this iteration is $|F_x|+|G_x|<1$ & $|F_y|+|G_y|<1$.

Q2\ Find the approximate solution of the following system

$3x_1 + x_2 + x_3 = 2$

$x_1 + 5x_2 + 3x_3 = 3$

$4x_1 + 2x_2 + 8x_3 = 5$, using Triangular factorization method.

Q3\ **a-** Derive Lagrange interpolation polynomial of degree one.

b- Use the best method and best x_0 to estimate the value of $f(1.9)$ and $f(3)$ from the data (0.5,3), (1.5,5), (2.5, 6), and (3.5, 8).

2. True or false type of exams:

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

3. Multiple choices:

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.

20. Extra notes:

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.

21. Peer review **پێداچوونەوەی هاوەڵ**

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).

ئەم کۆرسبووکە دەبێت لەلایەن هاوەڵێکی ئەکادیمیەوە سەیر بکرێت و ناوەڕۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند ووشەیەک بنووسێت لەسەر شیاوی ناوەڕۆکی کۆرسەکە و واژووی لەسەر بکات.
هاوەڵ ئەو کەسەیە کە زانیاری هەبێت لەسەر کۆرسەکە و دەبیت پلەی زانستی لە مامۆستا کەمتر نەبێت.