King Saud University
Department of Mathematics
Syllabus of
MATH254, First semester 1442 H

Course code: MATH254

Course title: Numerical Methods

Pre-Requisite: (MATH107 or MATH202 or MATH244) and (CSC101 or CSC206 or CSC207)

Instructor: S. Obaidat
Room 2A123, Building 4, Mathematics Department.

Text Book: An Introduction to Numerical Analysis using MATLAB, Rizwan Butt, Copyright 2008 by Infinity Science Press, Hingham, Massachusetts, New Delhi.

References:

1-Numerical Analysis, by Richard L. Burden and J. Douglass Faires, Brooks/Cole, fifth edition.

2- An Introduction to Numerical Linear Algebra using MATLAB, by Rizwan Butt, Heldermann Verlag, Germany.

Course objectives

1. Learn the concepts of numerical methods in solving mathematical problems numerically
2. Analyse the convergence and error for these methods
3. Write computer algorithms to implement these methods for solving certain mathematical problems using computer.

Course learning outcomes

Students completing this course successfully will be able to:

- Solve a nonlinear equation using different numerical methods: Bisection method, fixed point method, Newton's method, secant method.
- Analyze the errors in these methods
- Write computer algorithms to implement these methods.
- Compute the multiplicity of the root of an equation.
- Compute the rate of convergence of a convergent iterative scheme.
- Solve a systems of linear equations using direct methods and analyze the related errors
- Solve a systems of linear equations using iterative methods and analyze the related errors
- Approximate functions and data using polynomial interpolation and analyzing the related errors
- Approximate first and second derivatives using difference formulas and analyze the errors
- Approximate definite integrals using trapezoidal and Simpson's rules and analyze the errors
- Solve an initial value problem involving ordinary differential equations numerically using Taylor methods, Runge-Kutta method of order two.

Course contents

Week #	Topics	Contact hours (Lectures+Tutorials)
1	Errors and their sources, Nonlinear equations, Bisection method	3+2
2	Fixed point method	3+2
3	Newton's method , Secant method	3+2
4	Multiple roots, modified Newton's method, Rate of convergence (error analysis)	3+2
5	Newton's method for solving nonlinear systems, Systems of Linear Equations, Gaussian elimination,	3+2
6	Gaussian elimination with partial pivoting, LU-decomposition.	3+2
7+8	Iterative methods: Jacobi and Gauss-Seidel methods. Error analysis for solving Linear system	6+4
9+10	Interpolation and Polynomial Approximations Lagrange interpolation formula, Divided differences, Newton's interpolation formula, Error in polynomial interpolation, interpolation using linear splines.	6+4
12	Numerical Differentiation; First derivative: two-point formulas (forward and backward) and three-point formulas (forward, central and backward). Second derivative: the central difference formula and error estimates.	3+2
13	Numerical Integration; Trapezoidal and Simpson's rules and error bounds.	3+2
14	Numerical solutions of ODE's; Taylor methods, Runge-Kutta method of order two and the local truncation error for Euler's and Taylor's formulas.	3+2
15	Review	3+2
16	**Final Exam**	

Homework assignments:

Chapter	Exercices
CHAPTER 2	2.1, 2.2, 2.4, 2.5, 2.6, 2.7, 2.8, 2.10.
CHAPTER 3	3.1, 3.2, 3.3, 3.4, 3.6, 3.7.
CHAPTER 4	4.1, 4.2, 4.3
CHAPTER 5	5.1, 5.2, 5.3, 5.5, 5.6.
CHAPTER 6	6.1, 6.2, 6.3.

Grading

Midterm Exam	30%
Two Quizzes	20%
Tutorial	10%
Final Exam	40%
Total	100%

Mid-term exam: 7- 9 PM, on Tuesday 17/3/1442 H, 3/11/2020G.