King Fahd University of Petroleum and Minerals
Department of Mathematics
Math 472 - Term 222 – Syllabus
Dr. Faisal A. Fairag

Title: Numerical Analysis II

Credit: 3-0-3

Textbook: Numerical Analysis" by Richard L. Burden, J. Douglas Faires 10th

References:
1) Scientific Computing - An Introduction using Maple and MATLAB by Walter Gander Martin J. Gander Felix Kwok
2) Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven Chapra

Description: Approximation of functions: Polynomial interpolation, spline interpolation, least squares theory, adaptive approximation. Differentiation. Integration: basic and composite rules, Gaussian quadrature, Romberg integration, adaptive quadrature. Solution of ODEs: Euler, Taylor series and Runge-Kutta methods for IVPs, multistep methods for IVPs, systems of higher-order ODEs. Shooting, finite difference and collocation methods for BVPs. Stiff equations.

Learning Outcomes: Upon completion of this course, students should be able to:
1. Interpolate functions and data using Taylor series and polynomials
2. Approximate functions and data using Least Square Approximation
3. Approximate derivatives and integrations.
4. Calculate numerical solutions of IVP for ODEs.
5. Solve numerically BVP for ODEs;

Grading Policy:

Homework 21%	Computer Assignments 21%	Attendance and Class Activities 3%	Exam-1: 16%	Exam-2: 16%	Final Exam: 23%

Software: We will implement all algorithms in MATLAB and start the course with a MATLAB tutorial.

Prerequisite: Math 371 or CISE 301

Attendance: Students are expected to attend all lectures. DN will be awarded to any who accumulates (9 un or 12 ex & un)

Academic Integrity: All KFUPM policies regarding ethics apply to this course.

Pacing Schedule:

Week	Section	Topics
1	Numerical Differentiation	
	4.1	Numerical Differentiation and MATLAB tutorial
	Boundary-Value Problems for Ordinary Differential Equations	
	11.3	Finite-Difference Methods for Linear Problems
2	11.4	Finite-Difference Methods for Nonlinear Problems (CA1)
	11.5	Collocation Methods for BVP's (CA2)
	11.6	Numerical Software
3	Interpolation and Polynomial Approximation	
	3.1	Interpolation and the Lagrange Polynomial
	3.5	Cubic Spline Interpolation
4	3.6	Parametric Curves (CA3)
	3.7	Numerical Software
	EXAM-1: [4.1, 11.3-11.6 , 3.1 – 3.7]	
5	Approximation Theory	
	8.1	Discrete Least Squares Approximation
	8.2	Orthogonal Polynomials and Least Squares Approximation
6	8.4	Rational Function Approximation
	8.5	Trigonometric Polynomial Approximation
7,8	8.6	Fast Fourier Transforms (FFT) (CA4)
	8.7	Numerical Software
	EXAM-2: [8.1 – 8.7]	
9	Initial-Value Problems for Ordinary Differential Equations	
	5.3	Higher-order Taylor Methods
	5.4	Runge-Kutta Methods
10	5.6	Multistep Methods
	5.9	Higher-order Equations and System of Differential Equations (CA5)
11	5.1	Stability
	5.11	Stiff Differential Equations (CA6)
12	5.12	Numerical Software
	Boundary-Value Problems for Ordinary Differential Equations	
	11.1	The Linear Shooting Method
13	Numerical Integration	
	4.3	Elements of Numerical Integration
	4.4	Composite Numerical Integration
14	4.5	Romberg Integration
	4.7	Gauss Quadrature
15	4.8	Multiple Integrals (CA7)
	4.1	Numerical Software