

King Fahd University of Petroleum and Minerals
Department of Mathematics
Math 472 - Term 222 – Syllabus (Proposal)

Title	Numerical Analysis II
Credit	3-0-3
Textbook	Numerical Analysis” by Richard L. Burden, J. Douglas Faires 10th (2016)
References	<ol style="list-style-type: none"> 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	<p>Upon completion of this course, students should be able to:</p> <ol style="list-style-type: none"> 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 Assignments	Homework – Computer Assignments – mini-project - Mid-Term Exam – Final Exam

Pacing Schedule

Week	Section	Topics
1	Interpolation and Polynomial Approximation	
	3.1	Interpolation and the Lagrange Polynomial
	3.5	Cubic Spline Interpolation
2	3.6	Parametric Curves
	3.7	Numerical Software
Approximation Theory		
3	8.1	Discrete Least Squares Approximation
	8.2	Orthogonal Polynomials and Least Squares Approximation
4	8.4	Rational Function Approximation
	8.5	Trigonometric Polynomial Approximation
6	8.6	Fast Fourier Transforms (FFT)
	8.7	Numerical Software
Numerical Differentiation and Integration		
7	4.1	Numerical Differentiation
	4.3	Elements of Numerical Integration
8	4.4	Composite Numerical Integration
	4.5	Romberg Integration
9	4.7	Gauss Quadrature
	4.8	Multiple Integrals
10	4.10	Numerical Software
	Initial-Value Problems for Ordinary Differential Equations	
	5.3	Higher-order Taylor Methods
11	5.4	Runge-Kutta Methods
	5.6	Multistep Methods
12	5.9	Higher-order Equations and System of Differential Equations
	5.10	Stability
13	5.11	Stiff Differential Equations
	5.12	Numerical Software
	Boundary-Value Problems for Ordinary Differential Equations	
14	11.1	The Linear Shooting Method
	11.3	Finite-Difference Methods for Linear Problems
	11.4	Finite-Difference Methods for Nonlinear Problems
15	11.5	Collocation Methods for BVP's
	11.6	Numerical Software