Department of Mathematics & Statistics, KFUPM

Math 472 Syllabus (181)

Khaled M. Furati

Course Title: Numerical Analysis II

Course 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.

Prerequisite: MATH 371 or CISE 301

Textbook: Richard L. Burden and Douglas Faires, Numerical Analysis, 10th ed, 2016

Learning Outcomes: After completion of the course, the student should be able to:

- Interpolate functions and data using Taylor series and polynomials
- Approximate functions and data using Least Square Approximation
- Approximate derivatives and integrations
- Calculate numerical solutions of IVP for ODEs
- Solve numerically BVP for ODEs

Assignment: Homework, Midterm Exam, and Final Exam

Ch	Sec	Topics	No. Weeks
3	Interpolation and Polynomial Approximation		3
	Review	Taylor Polynomials and Series (sec 1.1)	
	3.1	Interpolation and the Lagrange Polynomial	
	3.3	Divided Difference	
	3.4	Hermite Interpolation	
	3.5	Cubic Interpolation	
4	Numerical Differentiation and Integration		3
	4.1	Numerical Differentiation	
	4.2	Richardson's Extrapolation	
	4.3	Elements of Numerical Integration	
	4.4	Composite Numerical Integration	
	4.7	Gaussian Quadratures	
5	IVPs for ODEs		4
	5.2	Euler Method	
	5.4	Runge-Kutta Methods	
	5.6	Multistep Methods	
	5.1	Stability	
	5.11	Stiff Differential Equations	
11	BVPs for ODEs		2
	11.1	The Linear Shooting Method	
	11.3	Finite-Difference Methods for Linear Problems	
8	Approximation		2
	8.1	Discrete LSA	
	8.3	Chebyshev Polynomials	
	8.4	Rational Function Approximation	