Numerical Methods

Code	Credit Hours
MATH-352	2-1

COURSE DESCRIPTION:

This course is designed to introduce the field of computational techniques for solving problems concerning Calculus, Linear algebra and Differential equations. This covers the following

- Solve one variable equation
- Estimate the function values using different interpolation techniques
- Calculate derivatives and integrals numerically
- Solve systems of linear and nonlinear equations arising in mathematical models
- Solve some classes of ODE's and PDE's arising in engineering fields, e.g., equations governing heat transfer fluid flow etc.

TEXT AND MATERIAL

Textbooks:

1. Numerical Analysis Latest Available Edition By R. L. Burden and J. D. Faires
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley Latest Edition
3. Mathematics by Aviation Maintenance Technician Certification Series, Latest Available Edition

Reference Material:

1. Numerical Methods for Engineers by Steven by (7^{th} edition) C. Chapra, Raymond P. Canale-(2014)
2. Advanced Engineering mathematics (5^{th} edition) by D. G. Zill and W. S. Wright
3. Elementary Linear Algebra (incl. Online chapters) (6th edition) by Ron Larson and David C. Falvo (2008)

ASSESSMENT SYSTEM:

Quizzes	10-15%
Assignments	5-10%
Mid Terms	30-40%
ESE	40-50%

TOPICS COVERED:

Week No	Ref	Description	MATLAB/MAPLE
1-2	Introduction Iterative Methods for Solving One Variable Equations	Course outline, objectives, teaching plan, assessment method, Introduction to numerical methods. Bisection method, Fixed point method, Newton-Raphson method, Secant method and Regula-Falsi method	Basic MATLAB/MAPLE loop commands for approximating one variable equation solutions
3-4	Systems of Algebraic Equations (Linear Systems)	Iterative methods for systems of linear equations: Jacobi & Gauss-Seidel methods.	Extension of MATLAB/MAPLE loop commands to solve multi variable equations
5-6	Systems of Algebraic Equations (Non-Linear Systems)	Fixed Point methods (Jacobi & Gauss Seidel methods) and Newton's method for systems of nonlinear equations	Extension of MATLAB/MAPLE loop commands to solve multi variable equations
7-8	Interpolation	Approximate functions by applying Lagrange Interpolation. Newton Divided Difference, Newton Forward Difference, Newton Backward Difference & Stirling Central Difference. Hermite interpolating polynomial.	MATLAB/MAPLE builtin commands and coding for interpolations
9	**MID TERM EXAM**		
10	Numerical Differentiation	1^{st} and 2^{nd} order derivative approximations Trapezoidal and Simpson's Rules for numerical integration, Composite Trapezoidal and Composite Simpson's rule.	MATLAB/MAPLE coding for numerical differentiation and integration methods

11	Numerical Integration	Rectangular, Trapezoidal and Simpson's rule for numerical integration.	MATLAB/MAPLE coding for numerical differentiation and integration methods
12	Solution of IVPs (ODEs & Systems of IVPs)	Euler Method, Taylor Method of order n and Runge-Kutta Methods of order 2 and 4. (First order , higher order ODEs & systems of 1^{st} order ODEs)	MATLAB/MAPLE coding for numerical methods to solve IVPs
13-14	Solution of BVPs (ODEs)	Finite Diference Method for linear and nonlinear BVPs	MATLAB/MAPLE coding for numerical methods to solve BVPs
15	Solution of Second Order Linear PDEs	Classification of partial differential equations Apply finite difference method to approximate solutions of Parabolic PDEs Elliptic PDEs Hyperbolic PDEs	MATLAB/MAPLE built in commands for BVPs (partial differential equations)
16		approximate solutions of Parabolic PDEs	MATLAB/MAPLE built in and coding commands for BVPs (partial differential equations)
17		approximate solutions of Elliptic PDEs Hyperbolic PDEs	MATLAB/MAPLE built in and coding commands for BVPs (partial differential equations)
18	**END SEMESTER EXAMINATION**		