VIII Semester

15UMAE875	Applied Numerical Methods	(4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

Study the numerical methods to solve algebraic, transcendental equations, partial differential equations and boundary value differential equations.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Apply the techniques of QR and singular value decomposition, least square approximation in solving inconsistent linear systems.		1,2	
CO-2	Employ interpolation and extrapolation to analyze the experimental data and predict.		1,2	
CO-3	Apply Numerical method to solve boundary valued differential equation and compute Area.	1,2		
CO-4	Apply the concept of Rank to solve Engineering Application Problems.	1,2		
CO-5	Apply suitable Numerical method to solve partial differential equation.		1,2	

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	2.4	2.4	-	-	-	-	-	-		-	-	-

Pre-requisites:

1. A basic course on Linear algebra.
2. A basic knowledge of ordinary and partial differential equations.

Contents:

Unit I

Linear Algebra -I: Condition number of a matrix L-U factorization method (Crout's method), Partition method. Bounds for Eigen values, Jacobi's method. Given's method. **10 Hrs.**

Unit II

Linear Algebra-II: Gram-Schmidt orthogonalization process. QR decomposition, singular value decomposition, least square approximations**.** Applications of SVD-PCA (Principal component analysis. Multi-regression analysis. **10 Hrs.**

Unit III

Interpolation and extrapolation

Central differences, central difference interpolation formulae. Gauss's forward interpolation formula. Gauss's backward interpolation formula, Stirling's interpolation formula, Everett's interpolation formula, Bessel's interpolation formula. Cubic Spline interpolation.

Numerical Differentiation
Derivatives using Stirling's formula, Bessel's formula.
Numerical Integration
Romberg integration, Gaussian quadrature, double integration by Trapezoidal and Simpson's $1/3^{rd}$ rules. **12 Hrs.**

Unit IV

Numerical solution of ODE:
Picard's method, Taylor's series method for simultaneous first order ordinary differential equations and second order Oedinary differential equations. Runge-Kutta method for simultaneous first order O.D.E and second order O.D.E, Linear Shooting method. Finite difference method. **10 Hrs.**

Unit V

Numerical solution of PDE:
Numerical solution of one dimensional heat equation. Bendre-Schmidt's method. Crank-Nicolsen method. Numerical solution of one dimensional wave equation; explicit method problems. Numerical solution of two dimensional Laplace equation. **10 Hrs.**

Reference Books:

1. Richard. L. Burden, J. Douglas Faires, Numerical Analysis, Thompson Publishing Company edition - 2001.
2. M.K. Jain, S.R.K. lyengar and R.K. Jain - Numerical methods for scientific and Engineering computation New Age Internationa! Publisher - 5^{lh} edition - 2007.
3. Anthony Ralston, Philip Rabinowitz - A first course in Numerical Analysis - McGraw Hill Publication - $2"^{J}$ edition – 2001
4. B.S.Grewal-Numerical methods in engineering and science- Khanna Publishers 9th edition- 2010.