MTH 230 Numerical Methods (3-1-3)

Evaluation:

	Theory	Practical	Total
Internal	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

1. To introduce numerical methods for interpolation, regressions, and root finding to the solution of problems.
2. To solve elementary matrix arithmetic problems analytically and numerically.
3. To find the solution of ordinary and partial differential equations.
4. To provide knowledge of relevant high level programming language for computing, implementing, solving, and testing of algorithms.

Course Contents:

1. Solution of Nonlinear Equations (10 hrs)

1.1 Review of calculus and Taylor's theorem
1.2 Errors in numerical calculations
1.3 Bracketing methods for locating a root, initial approximation and convergence
criteria
1.4 False position method, secant method and their convergence, Newton's method and fixed point iteration and their convergence.

2. Interpolation and Approximation (7 hrs)

2.1 Lagrangian's polynomials
2.2 Newton's interpolation using difference and divided differences
2.3 Cubic spline interpolation
2.4 Curve fitting: least squares lines for linear and nonlinear data

3. Numerical Differentiation and Integration (5 hrs)

3.1 Newton's differentiation formulas
3.2 Newton-Cote's, Quadrature formulas
3.3 Trapezoidal and Simpson's Rules 3.4 Gaussian integration algorithm
3.5 Romberg integration formulas.

4. Solution of Linear Algebraic Equations (10 hrs)

4.1 Matrices and their properties
4.2 Elimination methods, Gauss Jordan method, pivoting
4.3 Method of factorization: Dolittle, Crout's and Cholesky's methods
4.4 The inverse of a matrix
4.5 Ill-Conditioned systems

4.6 Iterative methods: Gauss Jacobi, Gauss Seidel, Relaxation methods
4.7 Power method.

5. Solution of Ordinary Differential Equations **(8 hrs)**

5.1 Overview of initial and boundary value problems
5.2 The Taylor's series method
5.3 The Euler Method and its modifications
5.4 Huen'smethod
5.5 Runge-Kuttamethods
5.6 Solution of higher order equations
5.7 Boundary Value problems: Shooting method.

6. Solution of Partial Differential Equations **(5 hrs)**

6.1 Review of partial differential equations
6.2 Elliptical equations, parabolic equations, hyperbolic equations and their relevantexamples.

Laboratory:

Use of Matlab/Math-CAD/C/C++or any other relevant high-level programming language for applied numerical analysis. The laboratory experiments will consist of program development and testing of:

1. Solution of nonlinear equations
2. Interpolation, extrapolation, and regression
3. Differentiation and integration
4. Linear systems of equations
5. Ordinary differential equations (ODEs)
6. Partial differential equations (PDEs)

Text Books:

1. Gerald, C. F. & Wheatly, P. O. *Applied Numerical Analysis* (7th edition).New York: Addison Wesley Publidhing Company.
2. Guha, S. & Srivastava, R. *Numerical Methods: For Engineers and Scientists*. Oxford University Press.
3. Grewal, B. S. & Grewal, J. S. *Numerical Methods in Engineering & Science* (8th edition).
   New Delhi: Khanna publishers. 2010.
4. Balagurusamy, E. *Numerical Methods*. New Delhi: Tata McGraw Hill. 2010.

References:

1. Moin, Parviz. *Fundamentals of Engineering Numerical Analysis*. Cambridge University
   Press, 2001.
2. Lindfield, G. R. & Penny, J. E. T. *Numerical Methods: Using MATLAB*. Academic Press.
   2012.
3. Schilling, J. & Harris, S.L. *Applied Numerical Methods for Engineers using MATLAB and C*. Thomson publishers, 2004.

4. Sastry, S. S. *Introductory Methods of Numerical Analysis* (3rd edition). New Delhi:
   Prentice Hall of India. 2002.
5. Rao, S. B. & Shantha, C. K. *Numerical Methods with Programs in Basic, Fortran and Pascal.* Hyderabad: Universities Press. 2000.
6. Pratap, Rudra. *Getting Started with MATLAB*. Oxford University Press. 2010.
7. Vedamurthy, V.N. & Lyengar, N. *Numerical Methods*. Noida: Vikash Publication House. 2009.