MTH 317.3 Numerical Methods (3-1-3)

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

Course Objectives:

To be familiar with the theory of numerical analysis for solving algebraic and transcendental equations, solution of ordinary and partial differential equations related to engineering problems, numerical differentiation and integration.

Course Contents:

1. **Solution of Nonlinear Equations** (10 hrs)

   Review of calculus and Taylor's theorem, Errors in numerical calculations. Trial and error method, Bisection method, Newton's method, secant method and their convergence, Fixed point iteration and its convergence.

2. **Interpolation and Approximation** (8 hrs)

   Lagrang's polynomials, Newton's interpolation using difference and divided differences. Cubic spline interpolation, Least squares method for linear and nonlinear data.

3. **Numerical Differentiation and Integration** (5 hrs)

   Newton's differentiation formulas, Maxima and minima of tabulated function, Netwon-Cote's quadrature formulas, Gaussian integration algorithm, Romberg integration formulas.

4. **Solution of Linear Algebraic Equations** (10 hrs)
   Review of the existence of solutions and properties of matrices, Gaussian elimination method, pivoting, ill-conditioning, Gauss-Jordan method, Inverse of matrix using Gauss elimination method, Method of factorization, Dolittle algorithm, Cholesky's factorization, Iterative solutions, Solving eigen value problems using power method.

5. **Solution of Ordinary Differential Equations** (7 hrs)

   Review of differential equations, Initial value problem, Taylor series method, Picard's method, Euler's method and its accuracy, Heun's method, Runge-Kutta methods, Solution of the higher order equations, Boundary value problems: Shooting method and its algorithm.

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

   Review of partial differential equations, Deriving difference equations, Laplacian equation and Poisson's equation, Engineering examples.

Laboratory :

The laboratory experiments will consist of program development and testing of non-linear equations, interpolation, numerical integration and differentiation, linear algebraic equations, ordinary and partial differential equations.

Text Book :

1. C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis,* 5th Edition, Addison Wesley, ISBN: 0201435837.
2. Mathews, John H., *Numerical Mathematics for Mathematics, Science and Engineering*, Second Edition, PHI, ISBN: 81-203-0845-X.

Reference Books:

1. W. Chency and D. Kinciad, *Numerical Mathematics and Computing,* 2nd Edition, Brooks/Cole Publishing Co., 1985.
2. W.H. Press, B.P. Flannery et.al., *Numerical Recipes in C,* 1st Edition, Cambridge Press, 1988.
3. S. Yakwitz and F. Szidarovszky, *An Introduction to Numerical Computations,* 2nd Edition, Macmillan Publishing Co., New York.