Numerical Methods

Year: III **Semester: II**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	2	40	25	3	60	-	-	125

Course Objective:

After completion of this course, the students will be able to solve the engineering problems by using the theory of numerical Computational procedures

Course Content:

1. Introduction (3 hrs)
- 1.1. Introduction and Importance of Numerical Method
- 1.2. Approximation and Errors in computation
- 1.3. Uses and Importance of Computer programming in Numerical Methods
- 1.4. Application of Numerical Computing in Civil Engineering

2. Solution of non – Linear equation (8 hrs)
- 2.1. Iterative methods and stopping criteria
- 2.2. Bisection method & its Convergence
- 2.3. Newton- Raphson method and its convergence
- 2.4. Secant method and its convergence
- 2.5. Fixed Point method
- 2.6. Evaluation of polynomials using Horner's Rule

3. Curve Fitting (8 hrs)
- 3.1 Interpolation
  - 3.1.1 Linear interpolation
  - 3.1.2 Lagrange interpolation
  - 3.1.3 Newton's Gregory Forward and Backward interpolation
  - 3.1.4 Newton's Divided Difference interpolation
  - 3.1.5 Central Interpolation (Gauss Forward/ Backward Formulae)
- 3.2. Regression
  - 3.2.1 Least Squares Regression
  - 3.2.2 Fitting Transcendental Equations.
  - 3.2.3 Fitting a polynomial function
- 3.3. Spline Interpolation (Cubic Spline)

4. Numerical Differentiation & Integration (7 hrs)
- 4.1 Differentiating continuous function
  - 4.1.1 Forward Difference Quotient
  - 4.1.2 Backward Difference Quotient
  - 4.1.3 Central Difference quotient

4.2 Newton cotes methods of integration
  4.2.1 Trapezoidal rule and composite trapezoidal rule
  4.2.2 Simpson's 1/3 rule & its composite
  4.2.3 Simpson's 3/8 rule.
4.3 Romberg integration
4.4 Gaussian integration (Gaussian – Legendre 2 point and 3 point Formula)

5. Linear Algebraic Equations (8 hrs)

5.1 Elimination Approach
  5.1.1 Basic Gauss Elimination
  5.1.2 Gauss Elimination with partial pivoting
  5.1.3 Gauss Jordon method
  5.1.4 Finding inverse matrix using Gauss Jordan Method
  5.1.5 LU decomposition methods
    5.1.5.1 Do Little Method
    5.1.5.2 Crout's Method
5.2 Iterative method
  5.2.1 Jacobi method
  5.2.2 Gauss- Seidal method
5.3 Eigen values and Eigen vectors using power method

6. Solution of ordinary differential equations (7 hrs)

6.1 Euler's method
6.2 Heun's method
6.3 Fourth order Runge-Kutta method
6.4 Systems of differential equations using Heun's method
6.5 2nd order differential equations using Heun's method

7. Solutions of partial differential equations (4 hrs)

7.1 Elliptic equations
  7.1.1 Laplace's equations (standard five point formula with iterative method)
  7.1.2 Poisson's equations (finite difference formula with iterative method))
7.2 Parabolic Equations (Solution of heat equation by Bender –Schmidt recurrence method)
7.3 Hyperbolic Equations (Solution of wave equation by finite difference method)

Laboratories:

1. Bisection method, N-R method
2. Secant method & Horner's rule
3. Lagrange interpolation
4. Linear Regression
5. Basic Gauss elimination method
6. Finding inverse matrix using Gauss Jordan
7. Trapezoidal rule ,Simpson's 1/3 rule, Simpson's 3/8 rule
8. Solution of differential equation using Euler's , Heun's and R-K method

References

1. E. Balagurusamy " Numerical Methods '' Tatal Mc Graw Hill
2. Dr. B.S. Grewal, "Numerical Methods in Engineering and Science", Khanna Publication
3. S.Yakwitz and F. szidarouszky " An Introduction to Numerical Computations " 2nd Edition Macmillan Publishing co , New York
4. C.F Gerald and P.o. Wheatley " Applied Numerical Analysis ",4th Edition, Addipon wesley publishing co. New york .

**Latest edition will be preferable.*

Evaluation Scheme: Marks Division

Question Type	No. of Questions	Marks	Total Marks
Group A	6	4	24
Group B	6	6	36
Total			60