I YEAR M. TECH (MACHINE DESIGN) FIRST SEMESTER

17MEMD1T5A COMPUTATIONAL METHODS Credits 4

Lecture: 4 periods/week **Internal assessment: 40 marks**

Tutorial: - - **Semester end examination: 60 marks**

COURSE OBJECTIVES:

- Able to find the solution of linear and non linear equations.
- To get good exposure to numerical integration, boundary value and characteristic value problems, finite difference solution of parabolic, elliptic and hyperbolic partial differential equations
- To find the curve of best fit for the given data by method of least squares.

COURSE OUTCOMES:

Upon completion of this course the student will be able to

1. Solve the linear and non linear system of equations using numerical methods and understand the concept of numerical integration.
2. Solve the boundary value and characteristic value problems and using regression analysis fit an approximation of functions.
3. Find the temperature distribution in a rectangular plates using finite difference method.
4. Find the temperature distribution in a rod and solve the wave equation by finite difference method.

UNIT-I

INTRODUCTION TO NUMERICAL METHODS APPLIED TO ENGINEERING PROBLEMS:

Examples, solving Sets of equations – Matrix notation – Determinants and inversion – Iterative methods –Relaxation methods – System of non-linear equations.

NUMERICAL INTEGRATION: Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration.

UNIT-II

BOUNDRY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS:

Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method –Characteristic value problems.

CURVE FITTING AND APPROXIMATION OF FUNCTIONS: Least square approximation fitting of non- linear curves by least squares –regression analysis- multiple linear regression, non linear regression.

UNIT-III

NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS:

Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

UNIT-IV

PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS:

Explicit method- Crank-Nickelson method – Derivative boundary condition, Stability and convergence criteria– Finite element for heat flow.

HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS:

Solving wave equation by finite differences- stability of numerical method –method of characteristics-wave equation in two space dimensions.

Learning Resources

Text Books:

1. Numerical Methods for Engineers by Steven C.Chapra, Raymond P.Canale, Tata Mc- Graw hill.
2. Applied numerical analysis by Curtis F.Gerald, partick.O.Wheatly, Addison-wesley, 1989.
3. Numerical methods (2^{nd} edition) by Douglas J..Faires,Riched Burden, Brooks/cole publishing , 1998.

References:

1. Numerical mathematics and computing (4^{th} edition) by Ward cheney & David Kincaid, Brooks/cole publishing 1999.
2. Mathematical Methods for Physics and Engineering by Riley K.F.M.P.Hobson &Bence S.J, Cambridge University press, 1999.