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22MT108 NUMERICAL METHODS

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Advanced calculus, (advanced) linear algebra, and differential equations.

COURSE DESCRIPTION AND OBJECTIVES:

The course is intended to train the students in various numerical methods starting from finding roots of polynomial equations to the extent of solving partial differential equations. Numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern systems science. This course includes techniquesfor optimization, interpolation from the known to the unknown, linear algebra underlying systems of equations, ordinary differential equations to simulate systems.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

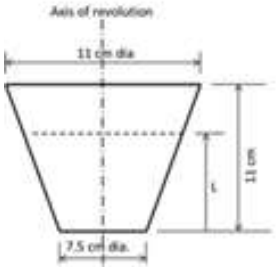
NUMERICAL SOLUTION OF EQUATIONS AND SYSTEM OF EQUATIONS: Solution of Algebraic and Transcendental Equations, bisection, regula falsi, newton's method, Horners method, Graeffe.s root squaring method, Solution of Simultaneous Linear Algebraic Equation, gauss elimination gauss Jordan, method of Triangularization, Crouts method, Jacobi method, Seidal method, Relaxation Method.

UNIT-2 **12L+8T+0P=20 Hours**

INTERPOLATION: Finite Differences and properties, Interpolation of equal and Unequal Intervals, forward and backward interpolation, Central Difference Interpolation Formulae (For Equal Intervals), devided difference and lagranges interpolation formula, stirling formula for equal and unequal intervals.

PRACTICES:

- Determine the solution of the nonlinear polynomial Equation f(x): x4-2x3+x2-3x+3=0 using the Horners method, Giraffe's root squaring method.
- Use the Newton-Raphson's method to find the roots of the following nonlinear polynomial equation: f(x) = x4+7x3+x2+5x+3=0
- Determine the locate the mark line for the content volume of 500 milli liter in a measuring cup with its dimensions shown in the right of Figure



- Determine the solution of the following differential equation using the forward finite difference scheme $\frac{d^2x(t)}{dt^2} + x(t) = 0$, with specified initial conditions x(0)=1,x^1 (0)=0.
- Solve Equations 2x+5y=21,x+2y=8,3x+5y=12 by using Crout's method.

SKILLS:

- ✓ *Solving differential equations.*
- ✓ *Computing roots of polynomial equations.*
- ✓ *Interpolate given data.*

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

NUMERICAL DIFFERENTIATION AND INTEGRATION: Numerical Differentiation and Integration, Newton's forward, backward to find up to 2nd derivative. Newton cote's formula, trapezoidal and Simpson's rule (1/3 and 3/8), Romberg's method, Weddle's rule.

UNIT-2 **12L+8T+0P=20 Hours**

NUMERICAL SOLUTIONS FOR ORDINARY DIFFERENTIAL EQUATIONS: Difference Equations, order and degree, complementary function and particular integral of difference equation, Numerical solution of ODE- RK 4th order method to solve differential equation, Predictor- corrector methods(Milne's and Adam's) .

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS: Graphical representation, classification of pde, SFPF AND DFPF, Liebmen's iteration, Bender Schmidt method, Crank – Nicholson method

PRACTICES:

- Estimate the Solution y at x=28from the following data using Stirling's formula.

x	20	25	30	35	40
f(x)	49225	48316	47236	45926	44306

- Using Lagrange's interpolation formula find y(10) from the following table:

x	5	6	9	11
f(x)	12	23	14	16

- Compute integral 0 to 4 f(x)dx using the Romberg integral technique on the trapezoidal integrals evaluated by the trapezoidal rule taking h = 1 and h = 0.5. The tabulated values are given below.

x	0	0.5	1	1.5	2.0	2.5	3.0	3.5	4.0
f(x)	1	4	3	2	2.5	2.9	3.6	4	1.8

- Use the Crank-Nicolson method and the central difference for the boundary conditions to solve the boundary value problem

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}, 0 < x < 1.\ u(x,0) = 2, 0 \le x \le 1, u(0,t) = 2, t \ge 0, \frac{\partial u}{\partial t}(1,t) = -u(1,t), t \ge 0$$

- Determine the solution of the partial differential equation by using Bender Schmidt method $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the conditions u(0,t) = u(5,t) = 0 and u(x,0) = x2(25-x2) taking h = 1 and k = 1/2, tabulate the values of u upto t=4 sec.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.	Analyze	1	1,2,3
2	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.	Apply	1	1,2,5
3	Apply numerical methods to obtain approximate solutions to mathematical problems.	Apply	2	1,2,3,5
4	Analyze and evaluate the accuracy of common numerical methods.	Analyze	2	1,2,3,5

TEXT BOOKS:

1. 1. B.S. Grewal, “Numerical Methods in Engineering & Science”, Khanna Publication, 9th edition.
2. P. Kandasamy, ‘’ Numerical methods”, S chand and company ltd India, Ist edition.

REFERENCE BOOKS:

1. E. Balagurusamy, “Numerical Method”, Tata McGraw Hill Publication.
2. S.S. Sastry, “Introductory Methods of Numerical Analysis”, PHI learning Pvt. Ltd.