M. Tech. 1st Semester (Civil Engg.) (Computer Aided Structural Engg.) (CBCS Scheme) Examination, November-2023

NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

Paper–21MTCASE21C4

Time allowed : 3 hours] [Maximum marks : 100

Note : The students have to attempt **five** questions in total, **first being compulsory** and selecting **one** from each Unit. All question carry equal marks.

1. (a) Differentiate between Jacobi's and Gauss-Seidel method.
   (b) What is the difference between Euler and Modified Euler's Method.
   (c) Write iterative formula for cube rood of unity for Newton-Raphson Method.
   (d) What is spline interpolation and interpolation.
   (e) Write the one-dimension heat and wave equation.
   (f) Define forward differences and backward differences.
   (g) Define partial pivoting in Gauss Elimination Method. 20

Unit–I

2. (a) What is error? Describe the different type of errors in numerical computation. What are the useful rules for estimating errors? 10
   (b) Fit a least square geometric curve $y = ax^b$ to the following data - 10

x :	1.0	2	3	4	5
f(x) :	0.5	2	4.5	8.0	12.5

3. (a) Prove that Newton Raphson Method has quadratic rate of convergence. 10

(b) Explain the interpolation and Extrapolation. Given the values- 10

x :	300	304	305	307
$\log_{10} x$:	2.4771	2.4829	2.4843	2.4871

Evaluate $\log_{10} 310$: Using-

(i) Lagrange's Formula

(ii) Newton's divided difference formula

Unit–II

4. (a) Solve system of linear equations using Gauss-Jacobi Iterative- 10

$27x + 6y - z = 85$; $6x + 15y + 2z = 72$;

$x + y + 54z = 110$

taking initial solution vector $x_0 = [0, 0, 0]^T$ up to 6^{th} iteration.

(b) By Gauss-elimination method solve the system of linear equations- 10

$2x - 2y + z = 6$, $4x + 2y + 3z = 4$, $x - y + z = 0$

5. Define Eigenvalue and Eigenvector of a matrix. Also, determine the eigenvalue of the matrix

$$A = \begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$$; using Power method. 20

Unit–III

6. Using Runge-Kutta method of fourth order, find approximate value of y for $x = 0.2$ taking $h = 0.1$, if $\frac{dy}{dx} = x + y^2$, given that $y(0) = 1$. 20

7. Derive standard five-point formula and diagonal five-point formula for Laplace equation using finite difference approximations. 20

Unit–IV

8. Describe in brief of Fuzzy logic and Neural Network and their application in various Structural problems. 20

9. Solve the boundary value problem $u_t = u_{xx}$ under the condition $u(0, t) = u(1, t) = 0$ and $u(x, 0) = \sin \pi x$, $0 \leq x \geq 1$ using Schmidt method. (Take $h = 0.2$ and $\alpha \frac{1}{2}$). 20