CBCS SCHEME

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17AE753

Seventh Semester B.E. Degree Examination, July/August 2021
Numerical Methods

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Explain the terms : (i) Absolute and Relative errors (ii) Inherent errors (iii) Round off errors (iv) Truncation error. **(06 Marks)**

b. Use Taylor series expansion (zero through fourth order) to predict f(2) for f(x) = ln(x) with a base point at x = 1. Determine the true percentage relative error for each approximation. **(07 Marks)**

c. What are the pitfalls of Gauss-elimination method? Solve the following system of equation using Gauss Elimination method.

$$2x + y + z = 10$$
$$3x + 2y + 3z = 18$$
$$x + 4y + 9z = 16$$

(07 Marks)

2 a. Solve the system of equation by LU factorization method,

$$2x + 3y + z = 9$$
$$x + 2y + 3z = 6$$
$$3x + y + 2z = 8$$

Take all the diagonal elements of L as 1 **(10 Marks)**

b. Solve the following equations by Gauss-Seidel method,

$$8x + 2y - 2z = 8$$
$$x - 8y + 3z = -4$$
$$2x + y + 9z = 12$$

(10 Marks)

3 a. Find the form of the function f(x) under suitable assumption from the following data.

x	0	1	2	5
f(x)	2	3	12	147

Hence find f(3). **(10 Marks)**

b. Find the dominant eigen value and the corresponding eigen vector of the matrix by power method. Given

$$A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}, \quad x_0 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

(10 Marks)

4 a. Using the Jacobi method find all the eigen values and the corresponding eigen vectors of the matrix,

$$A = \begin{bmatrix} 1 & \sqrt{2} & 2 \\ \sqrt{2} & 3 & \sqrt{2} \\ 2 & \sqrt{2} & 1 \end{bmatrix}$$

(10 Marks)

b. Reduce the matrix into a tridiagonal matrix using the House Holder's method,

$$A = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}.$$

(10 Marks)

5 a. From the table of values below compute $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for x = 1.

x	1	2	3	4	5	6
y	1	8	27	64	125	216

(10 Marks)

b. Evaluate the integral $I = \int_1^2 \frac{2x}{1+x^4} dx$ using the Gauss Legendre 2 point and 3 point quadrature rule. **(10 Marks)**

6 a. A rod is rotating in a plane about one of its ends. If the following table gives the angle θ radians through which the rod has turned for different values of time t seconds. Find its angular velocity and angular acceleration at t = 7 secs. **(10 Marks)**

t secs	0.0	0.2	0.4	0.6	0.8	1.0
θ radians	0.0	0.12	0.48	0.10	2.0	3.20

b. Evaluate $I = \int_0^1 \int_0^1 e^{x+y} dx dy$ using the Trapezoidal and Simpson's rule with h = k = 0.5

(10 Marks)

7 a. Given the data points :

x	1	2	3	4	5
y	13	15	12	9	13

Find the natural cubic spline interpolation at x = 3.4 **(10 Marks)**

b. The following data for a function f(x, y) is given,

y \ x	0	1
0	1	1.414214
1	1.732051	2

Construct the bivariate polynomial and hence find $f(0.25, 0.75)$. **(10 Marks)**

8 a. Find the cubic polynomial which takes the following values y(0) = 1, y(1) = 0, y(2) = 1, y(3) = 10. Hence or otherwise obtain y(4). **(10 Marks)**

b. We are given the following values of a function of the variable t.

t	0.1	0.2	0.3	0.4
f	0.76	0.56	0.44	0.35

Obtain a least squares fit of the form $f = ae^{-3t} + be^{-2t}$. **(10 Marks)**

9 a. Determine a root of the equation $\sin x + 3\cos x - 2 = 0$ using the secant method. The initial approximation are (0, 1.5). Carry out the iteration upto five decimal place accuracy. **(10 Marks)**

b. Perform three iterations of the Muller's method to find the smallest positive root of the equation in the interval (0, 1), $f(x) = x^3 - 5x + 1 = 0$. **(10 Marks)**

10 a. Perform three iterations of the Newton Raphson method to solve the system of equations,

$$x^2 + xy + y^2 = 7$$
$$x^3 + y^3 = 9$$

(10 Marks)

b. Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$

Starting from the point $x_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ using conjugate gradient method. **(10 Marks)**

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