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18MCM11

First Semester M.Tech. Degree Examination, July/August 2021
Applied Mathematics

Time: 3 hrs. Max. Marks: 100

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

1 a. Obtain a second degree polynomial approximation to $f(x)=\sqrt{1+x}$, $x\in[0, 0.1]$ using Taylor series about x = 0. Find f(0.05) and bound of the truncation error. **(08 Marks)**

b. An object of mass 10kg released from rest 1000m above the ground and allowed to fall under the influence of gravity. Assume the gravitational force is constant, with $g = 9.81 m/sec^2$, and force due to air resistance is proportional to the velocity of the object with proportional constant C = 10N-sec/m. Determine velocity and when the object will strike the ground. **(12 Marks)**

2 a. Object real root of the equation $f(x) = x^3 - 5x + 1$ by using Secant method. **(07 Marks)**

b. Using Regula-Falsi method compute real root of the equation $\cos x - xe^x = 0$ **(07 Marks)**

c. Use Newton-Raphson method to compute smallest positive root of the equation $f(x) = x^3 - 5x + 1$. **(06 Marks)**

3 a. Determine smallest positive root of $f(x) = x^3 - 5x + 1$ by Muller method (perform 3 iterations). **(10 Marks)**

b. Find the approximate value of the integral $I=\int_0^1 \frac{dx}{1+x}$ using composite trapezoidal rule with 2, 3, 5, 9 nodes and Romberg integration. **(10 Marks)**

4 a. The following data for the function $f(x) = x^4$ given:

x	0.4	0.6	0.8
f(x)	0.0256	0.1296	0.4096

Find $f'(0.8)$ and $f''(0.8)$ using interpolation. Compare with exact solution and also obtain bound on the truncation errors. **(10 Marks)**

b. Evaluate integral $I=\int_{-1}^{1}(1-x^2)^{\frac{3}{2}}\cos x\,dx$ using the Gauss-Chebyshev 1-point, 2-point and 3-point quadrature rules. **(10 Marks)**

5 a. Determine A^{-1} by using partition method. Hence, find the solution of the system of equations,

$$A=\begin{bmatrix}1 & 1 & 1\\ 4 & 3 & -1\\ 3 & 5 & 3\end{bmatrix}$$ **(10 Marks)**

b. Solve the system of equations

$$\begin{bmatrix}1, & 2, & 3\\ 2, & 8, & 22\\ 3, & 22, & 82\end{bmatrix}\begin{bmatrix}x\\ y\\ z\end{bmatrix}=\begin{bmatrix}5\\ 6\\ -10\end{bmatrix}$$ using the Cholesky method. **(10 Marks)**

6 a. Solve the system of equations:

$$\begin{bmatrix} 2 & 1 & 1 & -2 \\ 4 & 0 & 2 & 1 \\ 3 & 2 & 2 & 0 \\ 1 & 3 & 2 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \\ t \end{bmatrix} = \begin{bmatrix} -10 \\ 8 \\ 7 \\ -5 \end{bmatrix}$$

Using the Gauss elimination method with partial pivoting. **(10 Marks)**

b. Find the inverse of the co-efficient matrix of the system by Gauss Jordan method.

$$\begin{bmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 6 \\ 4 \end{bmatrix}$$ Hence find the solution of equations. **(10 Marks)**

7 a. Using the Jacobi method find all the eigen values and 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. Transform the matrix $A = \begin{bmatrix} 1 & 2 & 4 \\ 2 & 1 & 2 \\ 4 & 2 & 1 \end{bmatrix}$ to Tridiagonal form by Givens method. Find largest positive eigen value by Newton's-Raphson method. **(10 Marks)**

8 a. Using the Householder's transformation reduce the matrix

$$A = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$ into a tridiagonal matrix. **(10 Marks)**

b. Find all the eigen values of matrix $A = \begin{bmatrix} 4 & 3 \\ 1 & 2 \end{bmatrix}$ using the Rutishauser method. **(10 Marks)**

9 a. Determine loop currents in the network shown in Fig.Q.9(a). **(12 Marks)**

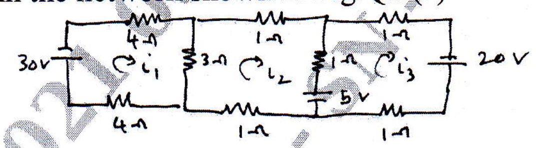

Fig.Q.9(a)

b. If T is linear transformation, then prove that

i) $T(\vec{0}) = \vec{0}$

ii) $T(c\vec{u} + d\vec{v}) = cT(\vec{u}) + dT(\vec{v})$ **(08 Marks)**

10 a. Find a QR factorization of $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$. **(10 Marks)**

b. Find a least-squares solution of the inconsistent system

$$\begin{bmatrix} 4 & 0 \\ 0 & 2 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \\ 11 \end{bmatrix}$$ **(10 Marks)**

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