

2071  
B.E. (Mechanical Engineering)  
Fourth Semester  
MEC-404: Numerical Analysis

Time allowed: 3 Hours

Max. Marks: 50

**NOTE:** Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section. Use of simple calculator is allowed. All questions carry equal marks.

x-x-x

1. (a) Explain significant digits. Find the same in the number 0.0033543. Also find the absolute error if the number 0.0033543 is truncated to three decimal places.
- (b) Write a brief note on bisection method, Prove that its rate of convergence is linear.
- (c) Find the second divided differences with arguments  $p, q, r$  of the function  $\frac{1}{x}$ .
- (d) Explain the difference between direct and indirect methods for linear system:  $AX = B$ . Write down the sufficient condition for the linear system Cholesky's method.
- (e) By Taylor series expansion, find  $y(1.1)$  given that:  $\frac{dy}{dx} = x + y, y(1) = 1$ .

**SECTION-A**

2. (a) Prove that relative error of a product of three non-zero numbers does not exceed the sum of the relative errors of the given numbers. The numbers  $x = 1.26$  and  $y = 0.786$  are correct to the digits specified. Find estimates of the relative errors in  $x + y, x - y, xy$  and  $\frac{x}{y}$ .
- (b) Find the real root of the equation:  $x \log_{10} x - 1.2 = 0$  correct to three decimal places by Regula-falsi and Secant method using four iterations of each method.
3. (a) Find a quadratic factor of the polynomial:  $f(x) = x^3 - 2x^2 + x - 2$  by Bairstow's method.
- (b) The following are the numbers of deaths in four successive ten years age groups. Find the number of deaths at 45-50 and 50-44.

Age group:	25-35	35-45	45-55	55-65
Deaths:	13229	18139	24225	31495

(2)

4. (a) Using the following table, find  $f(x)$  as a polynomial in powers of  $(x - 6)$ :

x:	-1	0	2	3	7	10
f(x):	-11	1	1	1	141	561

- (b) Explain the difference between Lagrange and Hermite interpolation. Apply Hermite interpolation formula to obtain a cubic polynomial which satisfies the following specifications:

x:	0.1	0.2
f(x):	0.201	0.408
$\frac{df}{dx}$ :	2.03	2.12

### SECTION-B

5. (a) Solve the following linear system of equations by Cholesky's factorization method:  $x + 2y + 6z = 5$ ;  $2x + 5y + 15z = 2$ ;  $6x + 15y + 46z = 6$ .

- (b) Explain power method. Find the largest eigen value and corresponding eigen

vector of the matrix:  $\begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ .

6. (a) State Gerschgorin and Brauer theorems. Find the bounds on eigenvalues of a

matrix:  $A: \begin{bmatrix} 0 & 2 & 4 \\ 1 & -1 & -2 \\ -2 & 0 & 5 \end{bmatrix}$  using Brauer theorem.

- (b) Evaluate  $\int_0^6 [f(x)]^2 dx$  using Simpson one-third rule, given that:

x:	0	1	2	3	4	5	6
f(x):	1	3	1	4	9	16	25

7. (a) Using Taylor series method, find  $y$  at  $x = 0.1$ , if  $\frac{dy}{dx} = x^2 y - 1$ ,  $y(0) = 1$ .

- (b) Solve the BVP:  $\frac{d^2 y}{dx^2} = x + y$ ,  $y(0) = y(1) = 0$ .

- (c) Write a brief note on economization of power series.