B.Tech Even Semester Examination, May, 2025

Electronics & Communication Engineering

(4th Semester)

Course No: ECC-257

(Numerical Techniques)

Full Marks: 70
Pass Marks: 28
Time: 3 hours

Note:

1. Attempt any five questions taking one from each unit.
2. Begin each answer in a new page
3. Answer parts of a question at a place
4. Assume reasonable data wherever required
5. The figure in the right margin indicates full marks for the question
6. All the mathematical symbols and abbreviations have their usual meanings.

UNIT-I

1. (i) Explain mathematically, the concept of (a) Lagrange Interpolation and (b) Quadratic Interpolation.

   (ii) Calculate approximate value of 1n 9.2 from 1n 9.0= 2.1972 and 1n 9.5= 2.2513 by linear interpolation and also determine the error, using 1n 9.2= 2.2192 (given). 4+4+6=14

2. (i) Explain mathematically, the concept of (a) Piecewise Linear Interpolation and (b) Cubic Spline Interpolation.

   (b) Obtain the piecewise linear interpolation polynomials for the function f(x) defined by the data as given below :

x	1	2	4	8
f(x)	3	7	21	73

Hence estimate the values of f(3) and f(7). 4+4+6=14

UNIT-II

3. (i) Derive the Newton-Cote's formula, and hence prove the Trapezoidal rule in the interval (a,b) as giveb below:

$$\int_a^b f(x)dx = \frac{(b-a)}{2}[f(a)+f(b)]$$

(ii) Evaluate $\int_0^1 \frac{1}{1+x^2}$ dx by Trapezoidal rule.

5+5+4=14

4. (i) Derive the Newton-Cote's formula, and hence prove the Simpson's one third rule in the interval (a,b) as given below :

$$\int_a^b f(x)dx = \frac{(b-a)}{6}\left[f(a)+4f\left(\frac{(a+b)}{2}\right)+f(b)\right]$$

(ii) Evaluate $\int_0^1 \frac{1}{(1+x^2)}dx$ by Simpson's one third rule. 5+5+4=14

UNIT-III

5. Explain the graphical representation of Bisection method, with proper mathematical justification. Using Bisection method, find a real root of the equation: $f(x)= x^3-x-1=0$. 7+7=14

6. Derive the Newton-Raphson formula. Show that the Newton-Raphson process has quadratic convergence. Using Newton-Raphson method, find a root of the equation: $f(x)= x^3-2x-5=0$. 3+4+7=14

UNIT-IV

7. Discuss how Euler's method yield the solution of a differential equation. What is modified Euler method? Using Euler method, solve the following:

$\frac{dy}{dx} = -y$, withing given initial condition y(0)=1

6+2+6=14

8. Derive the second order Runge-Kutta formula, using Taylor series expansions. Given $\frac{dy}{dx}=y-x$, where y(0)= 2, find the following using Runge-Kutta formula

y(0,1), y(0,2), y(0,3), y(0,4)

UNIT-V

9. What is meant by eigenvalue and eigenvector of a matrix? Find the eigenvalues and eigenvectors of the matrix: 2+2+10=14

$$A=\begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$$

10. What is QR method? What is Singular Value Decomposition (SVD)? Obtain the SVD of the following matrix : 2+2+10=14

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

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