**Roll No. .....** **Total No. of Pages : 03**

**Total No. of Questions : 09**

**B. Tech. (AE) (Sem.–5)**

**NUMERICAL METHODS IN SIMULATION ENGINEERING**

**Subject Code : AE-309**

**Paper ID : [A0717]**

**Time : 3 Hrs.** **Max. Marks : 60**

**INSTRUCTION TO CANDIDATES :**

1. **SECTION-A is COMPULSORY.**
2. **Attempt any FOUR questions from SECTION-B.**
3. **Attempt any TWO questions from SECTION-C.**

**SECTION-A** **(10 × 2 = 20 Marks)**

l. (a) Find the absolute error and relative error in $\sqrt{6}+\sqrt{7}+\sqrt{8}$ correct to 4 significant digits.

(b) State convergence conditions for Gauss Seidal's method.

(c) Find a real root of the equation $x^3 - 2x - 5 = 0$ by the method of false position correct to three decimal places.

(d) Drive error in linear interpolation formula.

(e) Prove that $\Delta\nabla = \delta^2$.

(f) Find the missing term in the table ;

| $x$ | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| $y$ | 45·0 | 49·2 | 54·1 | ... | 67·4 |

(g) Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using Simpson's 1/3 rule.

(h) Given $\frac{dy}{dx} = \frac{y-x}{y+x}$ with initial condition $y = 1$ at $x = 0$; find $y$ for $x = 0{\cdot}1$ by Euler's method.

(i) How system, model and simulation are related to each other.

(j) Write characteristic of central tendency.

**SECTION-B** **(4 × 5 = 20 Marks)**

2. Find a real root of $2x - \log_{10}x = 7$ correct to four decimal places using iteration method.

3. Find all roots of the equation $x^3 - 2x^2 - 5x + 6 = 0$ by Graeffe's method.

4. Using Newton's forward interpolation formula. Show that $\Sigma n^3 = \left\{\frac{n(n+1)}{2}\right\}^2$.

5. Using Runge-Kutta method of fourth order, solve for $y$ at $x = 1{\cdot}2,\ 1{\cdot}4$ from $\frac{dy}{dx} = \frac{2xy + e^x}{x^2 + xe^x}$ given $x_0 = 1$, $y_0 = 0$.

6. How a system is related to simulation ? Explain the benefits and limitations of experimenting with the actual system and with a model of the system.

**SECTION-C** **(2 × 10 = 20 Marks)**

7. (a) Find the largest eigen value and the corresponding eigen vector of the matrix $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$, using power method. Take $[1, 0, 0]^T$ as initial eigen vector.

(b) Using the partition method, find the inverse of $A = \begin{bmatrix} 13 & 14 & 6 & 4 \\ 8 & -1 & 13 & 9 \\ 6 & 7 & 3 & 2 \\ 9 & 5 & 16 & 11 \end{bmatrix}$.

8. (a) Use Simpson's 1/3rd rule to find $\int_0^{0.6} e^{-x^2} dx$ by taking seven ordinates.

(b) The velocity $v$ (km/min) of a moped which starts from rest, is given at fixed intervals of time $t$ (min) as follows :

| $t$ | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|
| $v$ | 10 | 18 | 25 | 29 | 32 | 20 | 11 | 5 | 2 | 0 |

9. The median and mode of the following wage distribution are known to be 3, 350 and 3400 (in Rs.) respectively. Find the value of A, B and C. Also find mean.

| Wage (in Rs.) | No. of employees |
|---|---|
| 0-1000 | 4 |
| 1000-2000 | 16 |
| 2000-3000 | A |
| 3000-4000 | B |
| 4000-5000 | C |
| 5000-6000 | 6 |
| 6000-7000 | 4 |

Total No. of employees is 230.