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Total No. of Questions : 09

B.Tech.(AE) (Sem.–5th)

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 consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students has to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students has to attempt any TWO questions.

SECTION-A

l. Answer briefly :

a. Find the relative error in the product of approximate numbers 8.6 and 34.359.

b. Describe the Newton Raphson method geometrically.

c. Perform the iteration method to find the root of the equation

$5x^3 - 20x + 3 = 0$, starting with initial approximation 0.5.

d. State the convergence condition for Gauss-Seidal method.

e. Prove that $\Delta^3 y_2 = \nabla^3 y_5$.

f. Evaluate $I = \int_0^1 \frac{dx}{1+x}$, using Trapezoidal formula rule with eight equal subinterval.

g. Apply Euler's method to find the values $y(0.05)$ and $y(0.1)$ for the initial value problem $\frac{dy}{dx} = x^2 + y^2$; $y(0) = 1$.

h. Describe various aspects of the simulation language GPSS.

i. How System, Model and Simulation are related to each other?

j. Explain Monte Carlo evaluation of π.

SECTION-B

2. a) If $u = \dfrac{4x^2y^3}{z^4}$ and error in x, y, z be 0.001, compute the relative maximum error in u, when $x = y = z = 1$.

   b) Use Regula Falsi method to compute the root of the equation $x^3 + 2x - 2 = 0$ in (0, 1), correct to two decimal places.

3. Find the solution of following linear system of equations correct to two decimal places with the help of Gauss-Seidal method, starting with (0,0,0) initial approximations.

$$4x_1 - x_2 + 3x_3 = 8$$

$$x_1 + 3x_2 - x_3 = -3$$

$$-2x_1 + x_2 - 3x_3 = -6$$

4. a) The Population (in thousands) of a town in the decimal census was as given below.
   Estimate the population for the year 1955 using Newton backward difference formula:

Year	1921	1931	1941	1951	1961
Population	46	66	81	93	101

   b) Find $\dfrac{dy}{dx}$ at $x = 0.1$ from the following table :

x	0.1	0.2	0.3	0.4
y	0.9975	0.9900	0.9776	0.9604

5. Apply Runga Kutta method of order four with step size 0.1 to find the value of y (0.1) for the following initial value problem $\dfrac{dy}{dx} = x + y^2$; $y(0) = 1$.

6. a) Explain different types of queuing models with examples.

   b) Suppose we have a dairy farm whose daily milk yield varies randomly. We wish to estimate the average value of its daily yield within ± 40 litres of its true average yield with a confidence level of 95%. The standard deviation of the daily yields has been estimated to be 200 liters. For how many days must we measure the daily yield of the dairy farm?

SECTION-C

7. a) Find the roots of the equation $x^3 - 2x^2 - 5x + 6 + 0$ correct up to two decimal places by Graeffe's root squaring method.

   b) Using Lagrange's interpolation formula, find the value of sin $\left(\frac{\pi}{6}\right)$ from the following set of data points

x	0	π/4	π/2
sin x	0	0.70711	1.0

   Also estimate the error limit in the solution.

8. a) Determine the largest eigen value and eigen vector of $A = \begin{bmatrix} 0 & 2 & 4 \\ 1 & 1 & -2 \\ -2 & 0 & 5 \end{bmatrix}$.

   b) Evaluate the integral $\int_1^2 \frac{2x}{1+x^4}\,dx$ using Gauss Legendre's 2 and 3-points formula.

9. a) Using matrix partition method, find the inverse of the matrix

   $A = \begin{bmatrix} 3 & 3 & 4 \\ 2 & 1 & 1 \\ 1 & 3 & 5 \end{bmatrix}$ and hence find the solution of

$$3x_1 + 3x_2 + 4x_3 = 5$$
$$2x_1 + x_2 + x_3 = 7$$
$$x_1 + 3x_2 + 5x_3 = 6$$

   b) Draw and explain the flow chart for next-event time-advance approach.