Roll No. ☐☐☐☐☐☐☐☐☐☐☐☐☐   **Total No. of Pages : 02**

Total No. of Questions : 09

B.Tech (AE)   (Sem.–5)
NUMERICAL METHOD AND SIMULATION IN ENGINEERING
Subject Code : AE-309
Paper ID : [A0717]

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

INSTRUCTIONS 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 have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Q1 Answer the following :

a) Define marginal probability distribution function of a bivariate random variable.

b) How the Power method can be used to compute an eigenvalue of a matrix which is closest to a given number q.

c) Find the condition number of the function $f(x) = \cos x$.

d) Determine the Lagrange interpolating polynomial passing through the points (2,4) and (5,3).

e) Write the relation between Arithmetic Mean (A.M.), Geometric Mean (G.M.) and Harmonic Mean (H.M.) of a given data.

f) Consider the data : 2,3,9,16,9,3,9. Since 16 is the highest value in the observations, is it correct to say that it is the mode of the data? Give reason.

g) What is the order of convergence when Newton Raphson's method is applied to the equation $x^2 - 6x + 9 = 0$ to find its multiple root.

h) Use the forward-difference formula to approximate the derivative of $f(x) = \ln x$ at $x_0 = 1.8$ using $h = 0.01$.

i) Compute $\int_0^\pi x \sin x\, dx$ using Simpson's rule.

j) Write the difference between Gauss Elimination and Gauss Seidel method.

SECTION-B

Q2 Use the Runge-Kutta method of order 4 ton approximate the solution of the following initial value problem.

$$y' = y - t^2 + 1, \ o \le t \le 2, \ y(0) = 0.5.$$

Q3 Apply inverse Power method (perform 4 iterations) to find the smallest in magnitude eigen value of the following matrix:

$$\begin{bmatrix} -2 & -3 \\ 6 & 7 \end{bmatrix}$$

Q4 The following data is given

1.0	1.3	1.6	1.9	2.2
0.7651977	0.6200860	0.4554022	0.2818186	0.1103623

Use Stirling's formula to approximate $f(1.5)$ with $x_0 = 1.6$.

Q5 From a city population, the probability of selecting (i) a male or a smoker is 7/10, (ii) a male smoker is 2/5 and (iii) a male, if a smoker is already selected is 2/3. Find the probability of electing (a) a non-smoker, (b) a male, and (c) a smoker, if a male is already selected.

Q6 Let $f(x) = (e^x - e^{-x}) / (x)$. Use three digit rounding arithmetic to evaluate $f(0.1)$. The actual value is $f(0.1) = 2.003335000$, using this value find the relative error.

SECTION-C

Q7 Determine the values of h that will ensure an approximation error of less than 0.00002 when approximating $\int_0^\pi \sin x dx$ and employing.

a) Composite trapezoidal rule.

b) Composite Simpson's rule.

Q8 The function $f(x) = \tan \pi x - 6$ has a zero at $\pi arctan6 \approx 0.447431543$. Let $p_0 = 0$ and $p_1 = 0.48$. Use ten iterations of the secant method to approximate this root.

Q9 A certain stimulus administered to each of the 12 patients resulted in the following increase in blood pressure:

$$5,2,8,-1,3,0,-2,1,5,0,4,6.$$

Can it be concluded that the stimulus will, in general, be accompanied by an increase in blood pressure.