Roll No. Total No. of Pages : 03

Total No. of Questions : 09

B.Tech (Automation & Robotics) (2011 & Onwards) (Sem.–5)

NUMERICAL METHODS IN ENGINEERING

Subject Code : ME-309

Paper ID : [A2060]

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

1. Write briefly :

a) The function $f(x) = \tan^{-1} x$ can be expressed as

$$\tan^{-1} x = x - \frac{x^3}{3} + \frac{x^5}{5} - ... + (-1)^{n-1}\frac{x^{2n-1}}{2n-1} + ...$$

Find n such that the series determine $\tan^{-1} x$ correct to eight significant digits at $x = 1$.

b) Show that $x_{n+1} = \frac{1}{2}x_n\left(3 - \frac{x_n^2}{\alpha}\right)$ has second order convergence near $\sqrt{\alpha}$.

c) Using Newton Raphson method, find iterative formula to find $\sqrt[k]{N}$.

d) Using Newton' divided difference formula, find the missing value from the table:

x	1	2	4	5	6
y	14	15	5	–	9

e) Discuss Principle of least squares to fit a straight line to the given data.

f) Derive Simpson's one-three rule from Newton's Cote quadrature formula.

g) Let λ be an eigen value of the matrix A. Show that $\frac{1}{\lambda}$ is an eigen value of the inverse matrix A^{-1}.

h) Write Adam's predictor corrector formulas.

i) Use modified Euler's method to solve $\frac{dy}{dx} = x + |\sqrt{y}|,\ y(0) = 1$, at $x = 0.2$.

j) By Gauss 3-point formula, write the value of $\int_{-1}^{1} f(x)\,dx$.

SECTION-B

2. Using Regula Falsi method, find a real root of $3x + \sin x = e^x$, correct to there decimal places.

3. Fit a second degree parabola using Principle of least squares to the following data :

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

4. Employ Stirling's formula to compute $y_{12.2}$ from the following table :

x	10	11	12	13	14
y	23967	28060	31788	35209	38368

5. Evaluate $\int_{0.2}^{1.5} e^{-x^2}\,dx$ using the 3-point Gaussian quadrature formula.

6. Using Runge-Kutta method of 4^{th} order to find y for x = 0.1, 0.2, 0.3 for $\frac{dy}{dx} = xy + y^2,\ y(0) = 1$. Continue the solution at x = 0.4 using Milne's predictor corrector method.

SECTION-C

7. a) Solve the system of non-linear equations $x^2 + y = 11$, $y^2 + x = 7$. Using Newton Raphson method, given $x_0 = 3.5$ and $y_0 = -1.8$.

b) The velocity 'v' (in meter/second) of a particle at a distance 's' (in meters) from a point on its linear path is given in the following data

s :	0	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0
v :	16	19	21	22	20	17	13	11	9

Estimate the time taken by the particle to traverse the distance of 20 meters, using Simpson's one-third rule.

8. a) From the table below, for what value of x, y is minimum? Also find this value of y

x	3	4	5	6	7	8
y	0.205	0.240	0.259	0.262	0.250	0.224

b) Using Jacobi's method, find all the eigen values and eigen vectors of the given matrix

$$\text{matrix} \begin{bmatrix} 1 & \sqrt{2} & 2 \\ \sqrt{2} & 3 & \sqrt{2} \\ 2 & \sqrt{2} & 1 \end{bmatrix}.$$

9. a) Solve the boundary value problem $y^{iv} + 81y = 729x^2$, $y(0) = y'(0) = y''(1) = y'''(1) = 0$, on taking $n = 3$.

b) Given the values of $u(x, y)$ on the boundary of the square in the given figure, evaluate the function $u(x, y)$ satisfying the Laplace equation $\nabla^2 u = 0$ at the pivotal points of this figure by Gauss Seidal's method.