Hall Ticket No | | | | | | | | | | | Question Paper Code: BST003

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

M.Tech I Semester End Examinations (Supplementary) - February, 2018

Regulation: IARE–R16

COMPUTER ORIENTED NUMERICAL METHODS

Time: 3 Hours **(STE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Solve the following system of equations with partial pivoting. **[7M]**

$$\begin{aligned} x_1 - x_2 + 3x_3 &= 3 \\ 2x_1 + x_2 + 4x_3 &= 7 \\ 3x_1 + 5x_2 - 2x_3 &= 6 \end{aligned}$$

(b) Use the Givens method to find the Eigen values of the matrix

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

[7M]

2. (a) Use the triangular method to solve the following simultaneous linear equations. **[7M]**

$$\begin{bmatrix} 25 & 5 & 1 \\ 64 & 8 & 1 \\ 144 & 12 & 1 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} = \begin{bmatrix} 106.8 \\ 177.2 \\ 279.2 \end{bmatrix}$$

(b) Solve the following linear system of equations using by Jacobi method rounded to four decimal places. **[7M]**

$$\begin{aligned} 10x_1 - x_2 + 2x_3 &= 6 \\ -x_1 + 11x_2 - x_3 + 3x_4 &= 25 \\ 2x_1 - x_2 + 10x_3 - x_4 &= -11 \\ 3x_2 - x_3 + 8x_4 &= 15 \end{aligned}$$

UNIT – II

3. (a) A robot arm with a rapid laser scanner is doing a quick quality check on holes drilled in a $15'' \times 10''$ rectangular plate. The centers of the holes in the plate describe the path the arm needs to take, and the hole centers are located on a Cartesian coordinate system (with the origin at the bottom left corner of the plate) given by the specifications in Table 1. **[7M]**

Table 1

x(in.)	2.00	4.25	5.25	7.81	9.20	10.60
y(in.)	7.2	7.1	6.0	5.0	3.5	5.0

Find the path traversed through the six points using a fifth order Lagrange polynomial.

(b) Construct Newtons forward difference interpolating polynomial for the following data given in Table 2 hence evaluate f(4) **[7M]**

Table 2

x	0	1	2	3
f(x)	1	2	1	10

4. (a) Given the following values of f(x) and $f'(x)$ estimate the values of f(-0.5) using the Hermite interpolation **[7M]**

Table 3

x	f(x)	$f'(x)$
-1	1	-5
1	3	7

(b) For linear interpretation, in the case of equispaced tabular data, shows that the error does not exceed 1/8 of the second difference. **[7M]**

UNIT – III

5. (a) A rod is rotating in a plane. The Table 4 below gives the angle θ (in radians) through which the rod has turned for various values of the time t (in seconds). **[7M]**

Table 4

t	0	0.2	0.4	0.6	0.8	1.0	1.2
θ	0	0.12	0.49	1.12	2.02	3.20	4.67

Calculate the angular velocity when t=0.6.

(b) Compute $f'(4)$ from the following Table 5 using appropriate interpolating polynomial **[7M]**

Table 5

x	1	2	4	8	10
f(x)	0	1	5	21	27

6. (a) By repeated application of Richardson extrapolation find $f'(1)$ from the following Table 6 values. **[7M]**

Table 6

x	0.6	0.8	0.9	1.0	1.1	1.2	1.4
f(x)	0.707178	0.859892	0.925863	0.984007	1.033743	1.074575	1.127986

Use the formula $f'(x) = \frac{f(x+h)-f(x-h)}{2h}$ and h=0.4,0.2,0.1.

(b) Find f (32) by applying central difference formula given that f (25) =0.2707, f (30) =0.3027, f (35) =0.3386, f (40) =0.3794. **[7M]**

UNIT – IV

7. (a) For the method $f'(x) = \frac{1}{6}[2f(x_1) - 3f(x_2) + 6f(x_3) - f(x_4)] + TE + RE$ determine the optimum value of H , using the criteria $|RE| = |TE|$, where TE and RE are respectively the truncation error and round error. **[7M]**

(b) Find the jacobian matrix for the system of equations **[7M]**
$f_1(x, y) = x^2 + y^2 - x = 0$
$f_2(x, y) = x^2 - y^2 - y = 0$ at the point (1,1) using the second order differentiation method.

8. (a) A solid of revolution is formed by rotating about X-axis, The area between the X-axis and the lines x=0 and x=1 is a curve through the points with the following coordinates shown in Table 7. **[7M]**

Table 7

x	0	2.5	5.0	7.5	10.0	12.5	15.0
y	5	5.5	6.0	6.75	6.25	5.5	4.0

Estimate the volume of the solid so generated.

(b) Determine a,b and c such that the formula $\int_0^h f(x)dx = h\{af(0) + bf(\frac{h}{3}) + cf(h)\}$ is exact for polynomial of as high order as possible. **[7M]**

UNIT – V

9. (a) Using Euler's method solve for y at x=2 from $y' = 3x^2 + 1, y(1) = 2$ taking h=0.25 **[7M]**

   (b) Apply the fourth order Runge Kutta method to find y at x=1.2 from $y' = x^2 + y^2, y(1) = 1.5$ taking h=0.1 **[7M]**

10. (a) Solve the boundary value problem $u'' = u + 1, 0 < x < 1; u(0) = 0, u(1) = e - 1$ by using shooting method. **[7M]**

    (b) given the boundary value problem $x^2y^{11} + xy^1 - y = 0, y(1) = 1, y(2) = 0.5$ apply the cubic spline method to determine the value of y (1.5). **[7M]**