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

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

M.Tech I Semester End Examinations (Regular) - February, 2017

Regulation: IARE–R16

COMPUTER ORIENTED NUMERICAL METHODS
(Structural Engineering)

Time: 3 Hours **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 linear equations with partial pivoting **[7M]**

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

(b) Use Householder's method to convert the matrix $\begin{bmatrix} 4 & 1 & -2 & 2 \\ 1 & 2 & 0 & 1 \\ -2 & 0 & 3 & -2 \\ 2 & 1 & -2 & -1 \end{bmatrix}$ into tridiagonal form. **[7M]**

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

$$10x_1 - x_2 + 2x_3 = 6$$
$$-x_1 + 11x_2 - x_3 + 3x_4 = 25$$
$$2x_1 - x_2 + 10x_3 - x_4 = -11$$
$$3x_2 - x_3 + 8x_4 = 15$$

(b) Find the largest eigen value and corresponding eigen vector of the matrix $\begin{bmatrix} 1.5 & 0 & 1 \\ -0.5 & 0.5 & -0.5 \\ -0.5 & 0 & 0 \end{bmatrix}$ by using power method. **[7M]**

UNIT – II

3. (a) Using Newton divided differences, construct the interpolating polynomial for the data set given below **[7M]**

i	1	2	3	4	5
x	0	5	7	8	10
y	0	2	-1	-2	20

(b) The upward velocity of a rocket is given as a function of time in the following Table. **[7M]**

t(s)	0	10	15	20	22.5	30
v(t)(m/s)	0	227.04	362.78	517.35	602.97	901.67

Determine the value of the velocity at t=16 seconds with third order polynomial interpolation using Lagrangian polynomial interpolation.

4. Construct the free cubic spline to approximate $f(x) = \cos \pi x$ by using the values given by $f(x)\ \ at\, x = 0, 0.25, 0.5, 0.75$ and 1.0 **[14M]**

UNIT – III

5. (a) Using the formula $f'(x) = \frac{f(x+h)-f(x-h)}{2h}$ and Richardson extrapolation find $f'(3)$from the following table values. **[7M]**

x	-1	1	2	3	4	5	7
f(x)	1	1	16	81	256	625	2401

(b) Given the values of $f(x) = \ln x$, find the approximate values of $f'(2.0)\ and\, f''(2.0)$ using quadratic interpolation and also obtain an upper bound on the error. **[7M]**

x	2.0	2.2	2 .6
f(x)	0.69315	0.78846	0.95551

6. Find the maximum and minimum values from the following table **[14M]**

x	-2	-1	0	1	2	3	4
f(x)	2	-0.25	0	-0.25	2	15.75	56

UNIT – IV

7. (a) Estimate the values of $\frac{\delta f}{\delta x}$at $(0.2, 0.1)$, $\frac{\delta f}{\delta y}$ at $(0.2, 0.2)$ using first order formula and $\frac{\partial^2 f}{\partial x \partial y}$at $(0.2, 0.2)$ using second order formula from the following table values. **[7M]**

$x \rightarrow / y \downarrow$	0.1	0.2	0.3
0.1	2.02	2.0351	2.0403
0.2	2.0351	2.0801	2.1153
0.3	2.0403	2.1153	2.1803

(b) For the method $f'(x_0) = \frac{-3f(x_0)+4f(x_1)-f(x_2)}{2h} - \frac{h^2}{3} f'''(\zeta)\,;\ x_0 < \zeta < x_2$ determine the optimum value of h , using the criteria $|RE| = |TE|$. **[7M]**

8. Evaluate the integral $\int_1^2 \int_1^2 \frac{dxdy}{x+y}$ using trapezoidal rule with $h = k = 0.5 \ and \ h = k = 0.25$. Improve the estimate using Romberg Integration. **[14M]**

UNIT – V

9. (a) Apply Euler's method with step sizes $h = 0.3, 0.2 \ and \ 0.15$ to compute approximations to y(0.6) by solving ordinary differential equation $y' = x\,(y + x)\,,\ y\,(0) = 2$ **[7M]**

   (b) Using RK method of order 2 compute $y\,(2.5)$ from $y' = \frac{(y+x)}{x},\ y\,(2) = 2$, taking $h = 0.25$ **[7M]**

10. (a) Solve boundary value problem $u'' = u + x;\ u\,(0) = 0, u\,(1) = 0$ with $h = 1/4$ **[7M]**

    (b) Solve by Taylor's series method the equation $y' = \log\,(xy)\ ;\ y\,(1) = 2$ for $y\,(1.1)$ and $y\,(1.2)$ **[7M]**