

## I B. Tech II Semester Regular Examinations, June, 2015

### Numerical Methods

(Common to CE, EEE, ME, ECE, CSE, BME and IT)

Time: 3 hours

Max Marks: 70

#### PART – A

Answer ALL questions. All questions carry equal marks

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10 \* 2 Marks = 20 Marks

1). a The equation  $x^2 + 4x = 7$  has a real root in the interval (1, 2). After two approximations of the bisection method where is the root located? [2]

b What is the Cholesky decomposition  $A = LL^T$  of the matrix  $A = \begin{pmatrix} 4 & 2 \\ 2 & 2 \end{pmatrix}$ ? [2]

c Under usual notations establish the equivalence  $\mu = \sqrt{1 + \frac{\delta^2}{4}}$  [2]

d Estimate the model parameters  $a$  and  $b$  in the straight line  $y = ax + b$  from the following information:  $n = 5$ ,  $\sum x = 40$ ,  $\sum y = 96$ ,  $\sum x^2 = 164$ ,  $\sum xy = 116$  [2]

e Estimate the value of  $y'(0)$  from the following data [2]

X	0	4	8	12
Y	-3	1	7	19

f Find the Newton quadratic polynomial that fits the following data exactly [2]

X	2	4	6
Y	-2	8	26

g What is the value of the definite integral  $\int_{-1}^1 \frac{\sin x + 1}{\cos x + 2} dx$  by Gauss-Legendre 2 point rule? [2]

h Estimate  $y(0.1)$  by Euler's method given the initial value problem [2]  
 $y' = \frac{\sqrt{x} + \sqrt{y}}{2}$ ,  $y(0) = 1.44$

i Write the Stirling's central interpolation formula with 5 data points. [2]

j Write the normal equations for the model  $y = ax + \frac{b}{x}$  [2]

## PART – B

Answer any FIVE questions. All questions carry equal marks.

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5 \* 10 Marks = 50 Marks

2. (a) Use Newton Raphson method to find a real root of the equation  $x^4 + 2x^2 + 7x = 10.88$  to 3 decimal places. [10]

- (b) Perform 3 iterations of the Jacobi method to solve the linear system

$$5x + 2y + z = 6, \quad x + 4y + 2z = 3, \quad x + 3y + 5z = -1$$

Start with  $[1.1, 0.98, -1.02]^T$  as the initial approximation.

3. (a) Find  $y(3)$  by Lagrange's interpolation formula given the following table [10]

$x$	-2	0	1	4
$y$	-36	-20	-15	60

- (b) Use Gauss Backward Interpolation formula to estimate  $y(8)$  given the following table

$x$	3	6	9	12	15
$y$	-2	0	4	14	36

4. (a) Fit an exponential curve  $y = ab^x$  to the following data [10]

$x$	0	1	2	3	4
$y$	1.250	1.100	0.968	0.852	0.750

- (b) Fit a second degree parabola  $y = a + bx + cx^2$  to the following data

$x$	0	1	2	3
$y$	1.100	6.600	18.700	37.400

5. Determine the cubic spline segment in the range  $[3,4]$  for the following data under natural spline conditions [10]

$x$	1	2	3	4
$y$	3	10	29	65

6. (a) Estimate  $y(0.5)$  by Taylor's Series Method with  $h = 0.25$  given the initial value problem  $y' = 2x^2 + 3y$  subject to the initial condition  $y(0) = 0.414$  [10]

- (b) Evaluate the definite integral  $\int_0^2 \frac{x}{x^2 + x + 2} dx$  by Gauss Legendre 3 point rule

7. [10]

- (a) Perform a LU decomposition for the matrix  $A = \begin{pmatrix} 2 & -6 & 10 \\ 1 & 5 & 1 \\ -1 & 15 & -5 \end{pmatrix}$

- (b) If there are 4 control points, how many B-spline basis functions are required if one has to fit a quadratic B-spline curve? Show the dependency diagram.

8. (a) Find a real root of the equation  $x^2 + 4\sqrt{x} = 8$  by Regula Falsi (Perform only 3 iterations) [6] **[10]**  
(b) Derive a customized Newton Raphson Formula to calculate the cube root of a real number  $N$  [4]

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