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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015

Sixth Semester

Computer Science and Engineering

MA 2264/MA 51/MA 1251/10177 MA 401/10144 CSE 21 — NUMERICAL METHODS

(Common to Information Technology)

(Regulations 2008/2010)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What do you mean by the order of convergence of an iterative method for finding the root of the equation $f(x)=0$?

2. Solve the equations $x+2y=1$ and $3x-2y=7$ by Gauss-Elimination method.

3. State Newton's forward interpolation formula.

4. Using Lagrange's formula, find the polynomial to the given data.

X:	0	1	3
Y:	5	6	50

5. State the local error term in Simpson's $\frac{1}{3}$ rule.

6. State Romberg's integration formula to find the value of $I=\int_a^b f(x)\,dx$ for first two intervals.

7. State the advantages and disadvantages of the Taylor's series method.

8. State the Milne's predictor and corrector formulae.

9. State Crank-Nicholson's difference scheme.

10. Write down Bender-Schmidt's difference scheme in general form and using suitable value of λ, write the scheme in simplified form.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the numerically largest eigens value of $A = \begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$ and its corresponding eigen vector by power method, taking the initial eigen vector as $(1\,0\,0)^T$ (upto three decimal places). (8)

(ii) Using Gauss-Jordan method, find the inverse of $\begin{bmatrix} 2 & 2 & 6 \\ 2 & 6 & -6 \\ 4 & -8 & 8 \end{bmatrix}$ (8)

Or

(b) (i) Solve the system of equations by Gauss-Jordan method : $5x_1 - x_2 = 9;\ -x_1 + 5x_2 - x_3 = 4;\ -x_2 + 5x_3 = -6$. (8)

(ii) Using Gauss-Seidel method, solve the following system of linear equations $4x + 2y + z = 14;\ x + 5y - z = 10;\ x + y + 8z = 20$. (8)

12. (a) (i) Using Newton's divided difference formula, find $f(x)$ from the following data and hence find $f(4)$. (8)

x:	0	1	2	5
$f(x)$:	2	3	12	147

(ii) Find the value of y when $x = 5$ using Newton's interpolation formula from the following table : (8)

x:	4	6	8	10
y:	1	3	8	16

Or

(b) (i) Use Lagrange's method to find $\log_{10} 656$, given that $\log_{10} 654 = 2.8156$, $\log_{10} 658 = 2.8182$, $\log_{10} 659 = 2.8189$ and $\log_{10} 661 = 2.8202$. (8)

(ii) Obtain the cubic spline for the following data to find $y(0.5)$. (8)

x:	-1	0	1	2
y:	-1	1	3	35

13. (a) (i) Find the first three derivatives of $f(x)$ at $x = 1.5$ by using Newton's forward interpolation formula to the data given below. (8)

x:	1.5	2	2.5	3	3.5	4
y:	3.375	7	13.625	24	38.875	59

(ii) Using Trapezoidal rule, evaluate $\int_{-1}^{1} \frac{1}{(1+x^2)}\, dx$ by taking eight equal intervals. (8)

Or

(b) (i) Evaluate $\int_0^2 \frac{x^2 + 2x + 1}{1 + (x+1)^2}\, dx$ by Gaussian three point formula. (8)

(ii) Evaluate $\int_1^{1.4} \int_2^{2.4} \frac{1}{xy}\, dx\, dy$ using Simpson's one-third rule. (8)

14. (a) (i) Obtain y by Taylor series method, given that $y' = xy + 1$, $y(0) = 1$, for $x = 0.1$ and 0.2 correct to four decimal places. (8)

(ii) Use Milne's method to find $y(0.8)$, given $y' = \frac{1}{x+y}$, $y(0) = 2$ $y(0.2) = 2.0933, y(0.4) = 2.1755, y(0.6) = 2.2493$. (8)

Or

(b) Using Runge-Kutta method of order four, find y when $x = 1.2$ in steps of 0.1 given that $y' = x^2 + y^2$ and $y(1) = 1.5$. (16)

15. (a) By iteration method, solve the elliptic equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$ over a square region of side 4, satisfying the boundary conditions.

(i) $u(0,y)=0,\ 0\le y\le 4$

(ii) $u(4,y)=12+y,\ 0\le y\le 4$

(iii) $u(x,0)=3x,\ 0\le x\le 4$

(iv) $u(x,4)=x^2,\ 0\le x\le 4$.

By dividing the square into 16 square meshes of side 1 and always correcting the computed values to two places to decimals, obtain the values of u at 9 interior pivotal points. (16)

Or

(b) Solve by Crank-Nicolson's method $\frac{\partial^2 u}{\partial x^2}=\frac{\partial u}{\partial t}$ for $0<x<1,\ t>0$ given that $u(0,t)=0,\ u(1,t)=0$ and $u(x,0)=100x(1-x)$. Compute u for one time step with $h=\frac{1}{4}$ and $K=\frac{1}{64}$. (16)