Reg. No. : [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Question Paper Code : 53252

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth/Fifth/Sixth/Seventh Semester

Civil Engineering

MA 6459 — NUMERICAL METHODS

(Common to Aeronautical Engineering/Agriculture Engineering/Electrical and Electronics Engineering/Electronics and Instrumentation Engineering/Geoinformatics Engineering/Instrumentation and Control Engineering/Manufacturing Engineering/Mechanical and Automation Engineering/Petrochemical Engineering/Production Engineering/Chemical Engineering/Chemical and Electrochemical Engineering/Handloom and Textile Technology/Petrochemical Technology/Plastic Technology/Polymer Technology/Textile Chemistry/Textile Technology

(Regulation 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the order of convergence of the Iterative method.

2. Solve by Gauss Elimination method: $10x + y = 7$ and $x - 10y = 31$.

3. State Newton's forward and backward interpolation formulas.

4. Define Cubic Spline.

5. State Simpson's $3/8^{th}$ formula

6. State three point Gaussian- quadrature formulae.

7. State Modified Euler's formula to solve first order initial value problems.

8. State Adams —Bashforth predictor-corrector formulae.

9. Write down the Bender-Schmidt's difference equation to solve one dimensional heat flow equation.

10. Write down the difference equation to solve one dimensional wave equation.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the root of the equation $e^x = 2x + 1$, correct to 4 places of decimals, using Newton-Raphson method. (6)

(ii) Solve by Gauss–Seidal method: (10)

$28x + 4y - z = 32$

$2x + 17y + 4z = 35$

$x + 3y + 10z = 24$

Or

(b) (i) Find A^{-1}, if $A = \begin{bmatrix} 8 & -4 & 0 \\ -4 & 8 & -4 \\ 0 & -4 & 8 \end{bmatrix}$, by Gauss-Jordan method. (8)

(ii) Find the numerically largest Eigen value of = $\begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix}$, by the power method. (8)

12. (a) (i) Find $f(x)$ from the following data, using Newton's divided difference formula and hence find $f(6)$ and $f(8)$. (8)

x	3	7	9	10
$f(x)$	168	120	72	63

(ii) Use Lagrange's interpolation formula to fit a polynomial to the following data and hence find $f(2)$. (8)

x	0	1	3	4
$f(x)$	–12	0	6	12

Or

(b) (i) Determine the value of $y(1.5)$ from the following data, using the cubic spline: (6)

x	1	2	3
y	–8	–1	18

(ii) The following data are taken from the steam table: (10)

Temp. °C	140	150	160	170	180
Pressure $kg\,f/cm^2$	3.685	4.854	6.302	8.076	10.225

Find the pressure at temperatures $t = 142^\circ C$ and $t = 175^\circ C$.

13. (a) (i) The velocity "v" of a particle at distance "s" from a point on its linear path is given in the following data:

s(m)	0	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0
v(m/sec)	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)

(ii) Evaluate $\int_0^{\frac{\pi}{2}}\int_{\frac{\pi}{2}}^{\pi} \cos(x+y)\,dx\,dy$ using trapezoidal rule. (8)

Or

(b) (i) Find the approximate value of $I = \int_0^1 \frac{dx}{1+x}$ using composite trapezoidal rule with $h = \frac{1}{2}, \frac{1}{4}, \frac{1}{8}$ and then using Romberg's method. (10)

(ii) Find the value of $\sin 18^\circ$ from the following Table, using numerical differentiation based on Newton's forward interpolation formula. (6)

x°	0	10	20	30	40
$\cos x^\circ$	1.0000	0.9848	0.9397	0.8660	0.7660

14. (a) (i) Using Taylor's series method, find y at $x = 1.1$ by solving the equation $\frac{dy}{dx} = x^2 + y^2; y(1) = 2$ (8)

(ii) Use Runge-Kutta method of the fourth order to find $y(0.\ 2)$, given that $y\frac{dy}{dx} = y^2 - x, y(0) = 2$. (8)

Or

(b) Given that $\frac{dy}{dx} = \frac{1}{x^2} - \frac{y}{x}; y(1) = 1,\ y(1.1) = 0.996,\ y(1.2) = 0.986$ and $y(1.3) = 0.972$, find the values of $y(1.4)$ and $y(1.5)$, using Milne's predictor –corrector method. (16)

15. (a) Solve the Poisson equation $\nabla^2 u = -\frac{160}{x^2 y^2}$ over the square mesh with sides $x = 0$; $y = 0$; $x = 3$; and $y = 3$ with $u = 0$ on the boundary and mesh length 1 unit. (16)

Or

(b) (i) Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ satisfying the conditions $u(0,t) = 0, t \geq 0; u(5, t) = 0, t \geq 0;$ and $u(x, 0) = 10x(5 - x), 0 \leq x \leq 5$. Compute u for one time-step by Crank-Nicolson's implicit scheme, taking $h = 1$ and $k = 1$. (10)

(ii) Solve the equation $y'' - \frac{14}{x} y' + x^3 y = 2x^3$, for $y\left(\frac{1}{3}\right)$ and $y\left(\frac{2}{3}\right)$, given that $y(0) = 2$ and $y(1) = 0$. (6)
