

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

Reg. No. : 

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**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<sup>th</sup> 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)
- $$\begin{aligned} 28x + 4y - z &= 32 \\ 2x + 17y + 4z &= 35 \\ x + 3y + 10z &= 24 \end{aligned}$$

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 $kg/cm^2$	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  $\int_0^{\frac{\pi}{2}} \int_0^{\frac{\pi}{2}} \cos(x+y) dx dy$  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)

$x^\circ$	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)