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**Question Paper Code : 91787**

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 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)  
(Regulations 2013)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions.

PART – A

(10×2=20 Marks)

1. State the convergence criterion for fixed point iteration.
2. What is diagonal dominance ?
3. Construct the Newton's backward difference table for the following data :

<b>x</b>	1	2	3	4	5
<b>f(x)</b>	2	5	7	14	32

4. State Newton's divided difference interpolation formula.
5. Write down the formula upto the fourth order differences for finding  $\frac{d^2y}{dx^2}$  at any point using Newton's forward interpolation formula.
6. State the three-point Gaussian quadrature formula.
7. What is the difference between an initial value problem and a final value problem ?



8. State Adams-Bashforth predictor corrector formulae.
9. State the Bender-Schmidt scheme for solving one-dimensional heat conduction equation.
10. State the standard five-point formula for solving Poisson equation.

## PART - B

(5×16=80 Marks)

11. a) i) Using Power method, find the numerically largest eigenvalue and

the corresponding eigenvector of the matrix  $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ . Start with

an initial approximation for the eigenvector as  $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ . (8)

- ii) Using Gauss-Seidel method, solve the system of equations and obtain the solution correct to four decimal places.

$$8x - 3y + 2z = 20; 4x + 11y - z = 33; 6x + 3y + 12z = 35 \quad (8)$$

(OR)

- b) i) Find the inverse of  $A = \begin{pmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{pmatrix}$  using Gauss Jordan method. (8)

- ii) Find the real root of  $xe^x - 2 = 0$  correct to 3 decimal places using Newton Raphson method. (8)

12. a) i) Using Lagrange's formula, express the function  $\frac{3x^2 + x + 1}{(x-1)(x-2)(x-3)}$  as a sum of partial fractions. (8)

- ii) From the following table, estimate the number of students who obtained marks between 40 and 45. (8)

Marks (out of 100)	30-40	40-50	50-60	60-70	70-80
Number of Students	31	42	51	35	31

(OR)



- b) Fit a natural cubic spline for the following data and hence evaluate  $y(1.5)$  and  $y'(3)$  (16)

x	1	2	3	4
y	1	2	5	11

13. a) i) Using Newton's divided difference formula, find the values of  $f'(8)$  and  $f'(9)$  from the following data : (8)

x	4	5	7	10	11
f(x)	48	100	294	900	1210

- ii) Compute  $I = \int_0^{1/2} \frac{x dx}{\sin x}$  using Simpson's  $1/3^{\text{rd}}$  rule with  $h = \frac{1}{4}, \frac{1}{8}, \frac{1}{16}$  and apply Romberg's method to obtain improved approximation. (8)

(OR)

- b) i) Given the velocity of a particle for 20 seconds at an interval of 5 seconds as in the table below, find the initial acceleration using the entire data : (8)

time t (sec)	0	5	10	15	20
velocity v (m/sec)	0	3	14	69	228

- ii) Using trapezoidal rule, evaluate  $I = \int_1^2 \int_1^2 \frac{dx dy}{x+y}$  using four sub-intervals in each direction. (8)

14. a) i) Using the method of Taylor's series upto fourth order, find  $y$  at  $x = 1.1$  and  $x = 1.2$  given  $\frac{dy}{dx} = x^2 + y^2, y(1) = 2$ . (8)

- ii) Using Milne's predictor-corrector method, solve  $\frac{dy}{dx} = x - y^2, y(0) = 0$  for  $y(0.8)$  given  $y(0.2) = 0.02, y(0.4) = 0.0795$  and  $y(0.6) = 0.1762$ . (8)

(OR)

- b) i) Find the values of  $y(0.2)$  and  $y(0.4)$  using Runge-Kutta fourth order method with  $h = 0.2$  given  $\frac{dy}{dx} = \sqrt{x^2 + y}, y(0) = 0.8$ . (10)

- ii) Given  $\frac{dy}{dx} = y - x^2 + 1, y(0) = 0.5$ , find  $y(0.2)$  by modified Euler's method. (6)



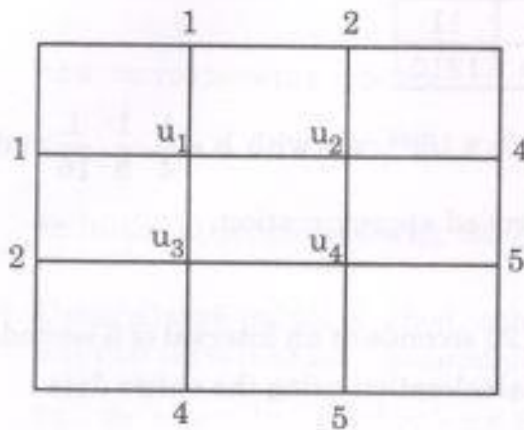
15. a) i) Solve the equation  $y'' = x + y$  with boundary conditions  $y(0) = y(1) = 0$  with  $h = 1/4$ . (8)

ii) Evaluate the pivotal values of  $u_{tt} = 16u_{xx}$  taking  $\Delta x = 1$  upto  $t = 1.25$ . The boundary conditions are

$$u(0, t) = u(5, t) = 0, u_t(x, 0) = 0 \text{ and } u(x, 0) = x^2(5 - x). \quad (8)$$

(OR)

b) i) Solve  $u_{xx} + u_{yy} = 0$  for the following square mesh. (8)



ii) Using Crank-Nicolson scheme for solving  $u_t = u_{xx}$ ,  $0 \leq x \leq 1$ ,  $t \geq 0$  subject to  $u(x, 0) = \sin \pi x$ ,  $0 < x < 1$ ,  $u(0, t) = u(1, t) = 0$ ,  $t > 0$ . Take  $\Delta x = 1/3$  and  $\Delta t = 1/36$ . (8)