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**Question Paper Code : 41316**

**B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018**

**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. What is the condition for convergence and the order of convergence of Newton Raphson method ?
2. Why Gauss-Seidel method is better than Gauss-Jordan method ?
3. When to use Newton's forward interpolation and when to use Newton's backward interpolation formula ?
4. Find the first and second divided differences with arguments a, b, c of the function  $f(x) = \frac{1}{x}$ .
5. Write the formula for  $y'(x)$  and  $y''(x)$  using Newton's backward differences.
6. Evaluate  $\int_{-1}^1 \frac{dx}{1+x^2}$  by two point Gaussian formula.
7. What are multi-step methods ? How are they better than single step method ?



8. State the formula for Adams-Bashforth Predictor and Corrector method.
9. What is the error for solving Laplace and Poisson's equation by finite difference method?
10. Write the Crank-Nicolson formula to solve parabolic equation.

## PART - B

(5×16=80 Marks)

11. a) i) Find, by power method, the largest eigen value and the corresponding eigen vector

of a matrix  $A = \begin{pmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{pmatrix}$  with initial vector  $(1 \ 1 \ 1)^T$ . (8)

- ii) Solve, by Gauss - Seidal method, the system of equations. (8)

$$20x + y - 2z = 17, 3x + 20y - z = -18, 2x - 3y + 20z = 25$$

(OR)

- b) Consider the system of equations of the form  $AX = B$ , where  $A = \begin{pmatrix} 4 & 1 & 2 \\ 2 & 3 & -1 \\ 1 & -2 & 2 \end{pmatrix}$

$$X = \begin{pmatrix} x \\ y \\ z \end{pmatrix} \text{ and } B = \begin{pmatrix} 7 \\ -3 \\ 7 \end{pmatrix}. \text{ Find by using Gauss-Jordan method, i) } A^{-1} \text{ and}$$

- ii) the numerical solution of the given system. (8+8)

12. a) i) Use Lagrange's interpolation formula to fit a polynomial to the given data

$$f(-1) = -8, f(0) = 3, f(2) = 1 \text{ and } f(3) = 2. \text{ Hence find the value of } f(1). \quad (8)$$

- ii) Find the value of  $\tan 45^\circ 15'$  by using Newton's forward difference interpolation formula for

$x^\circ$ :	45	46	47	48	49	50
$\tan x^\circ$ :	1.00000	1.03553	1.07237	1.11061	1.15037	1.19175

(OR)

- b) Fit the cubic spline for the data : (16)

$x$ :	0	1	2	3
$f(x)$ :	1	2	33	244

13. a) i) From the following table of values of  $x$  and  $y$ , obtain  $y'(x)$  for  $x = 16$  (6)

$x$ :	15	17	19	21	23	25
$y$ :	3.873	4.123	4.359	4.583	4.796	5

ii) Using Romberg's method, evaluate  $\int_0^1 \frac{dx}{1+x}$  with step size 0.5, 0.25 and 0.125 correct to three decimal places. (10)

(OR)

b) i) Find the first derivative of  $f(x)$  at  $x = 2$  for the data  $f(-1) = -21$ ,  $f(1) = 15$ ,  $f(2) = 12$  and  $f(3) = 3$ , using Newton's divided difference formula. (8)

ii) Evaluate  $\int_2^{2.6} \left[ \int_4^{4.4} \frac{1}{xy} dx \right] dy$  by Simpson's one-third rule with  $h = 0.2$  and  $k = 0.3$ . (8)

14. a) i) Find the values of  $y$  at  $x = 0.1$  given that  $\frac{dy}{dx} = x^2 - y$ ,  $y(0) = 1$  by modified Euler's method. (8)

ii) Find the value of  $y$  at  $x = 0.1$ , given that  $\frac{dy}{dx} = x^2 - y$ ,  $y(0) = 1$  by Taylor's series method. (8)

(OR)

b) Given  $\frac{dy}{dx} = xy + y^2$ ,  $y(0) = 1$ ,  $y(0.1) = 1.1169$  and  $y(0.2) = 1.2774$ , find i)  $y(0.3)$  by Runge-Kutta method of fourth order and ii)  $y(0.4)$  by Milne's method. (16)

15. a) i) Solve the boundary value problem  $y'' = xy$  subject to the conditions  $y(0) + y'(0) = 1$ ,  $y(1) = 1$ , taking  $h = \frac{1}{3}$ , by finite difference method. (8)

ii) Solve  $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}$ ,  $0 < x < 1$ ,  $t > 0$  given  $u(x, 0) = 0$ ,  $\frac{\partial u}{\partial t}(x, 0) = 0$ ,  $u(0, t) = 0$  and  $u(1, t) = 100 \sin \pi t$ . Compute  $u(x, t)$  for four times steps with  $h = 0.25$ . (8)

(OR)

b) Solve the Laplace equation over the square mesh of side 4 units, satisfying the boundary conditions : (16)

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

$$u(x, 0) = 3x, u(x, 4) = x^2, 0 \leq x \leq 4.$$

