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Reg. No. :

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 $A = \begin{pmatrix} 4 & 1 & 2 \\ 2 & 3 & -1 \\ 1 & -2 & 2 \end{pmatrix}$

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

$f(-1) = -8$, $f(0) = 3$, $f(2) = 1$ and $f(3) = 2$. Hence find the value of f(1). (8)

ii) Find the value of tan 45° 15′ by using Newton's forward difference interpolation formula for (8)

x° :	45	46	47	48	49	50
tan x° :	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)

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

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

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