14/05/18

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)

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

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

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)

02/05/19 FN

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 3/8th 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 kgf/cm^2	3.685	4.854	6.302	8.076	10.225

Find the pressure at temperatures $t = 142°C$ and $t = 175°C$.

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° from the following Table, using numerical differentiation based on Newton's forward interpolation formula. (6)

$x°$	0	10	20	30	40
cos $x°$	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)

2- Year 22/11/16 FN

15. (a) (i) Using Bender Schmidt's method solve $u_t = u_{xx}$ subject to the condition, $u(0,t)=0$, $u(1,t)=0$, $u(x,0)=\sin \pi x$, $0<x<1$ and $h=0.2$. Find the value of u up to $t=0.1$.

(ii) Evaluate the pivotal values of the equation $u_{tt} = 16u_{xx}$ taking $h=1$ upto $t=1.25$. The boundary conditions are $u(0,t)=u(5,t)=u_t(x,0)=0$ and $u(x,0)=x^2(5-x)$.

Or

(b) By Iteration method solve the elliptic equation $u_{xx}+u_{yy}=0$ over the square region of side 4, satisfying the boundary conditions $u(0,y)=0$, $0 \le y \le 4$, $u(4,y)=12+y$, $0 \le y \le 4$, $u(x,0)=3x$, $0 \le x \le 4$, $u(x,4)=x^2$, $0 \le x \le 4$. By dividing the square into 16 square meshes of side 1 and always correcting the computed values to two places to decimals. Obtain the values of u at 9 interior pivotal points.

Reg. No. :

Question Paper Code : 80612

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Fourth Semester

Civil Engineering

MA 6459 — NUMERICAL METHODS

(Common to Aeronautical Engineering, Electrical and Electronics Engineering, Instrumentation and Control Engineering, Electronics and Instrumentation Engineering, Instrumentation and Control Engineering, Geoinformatics Engineering, Petrochemical Engineering, Production Engineering, Chemical and Electrochemical Engineering, Textile Chemistry and Textile Technology)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Derive a formula to find the value of $\sqrt{N}$, where N is a real number, by Newton's method.

2. Which of the iteration method for solving linear system of equation converges faster? Why?

3. Using Lagrange's interpolation formula find y value when $x=1$ from the following data :

x:	0	–1	2	3
y:	–8	3	1	12

4. State Newton's forward formula and Backward formula.

5. Compare Trapezoidal rule and Simpson's 1/3 rule for evaluating numerical integration.

6. Change the limits of $\int_0^{\pi/2} \sin x \, dx$ into $(-1,1)$.

7. Compare Single-step method and Multi-step method.

8. Write down the Milne's predictor and corrector formulas.

9. Classify the following equation $u_{xx} + 4u_{xy} + 4u_{yy} - u_x + 2u_y = 0$.

10. Write down the standard five point formula.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find a root of $x\log_{10} x - 1.2 = 0$ using Newton Raphson method correct to three decimal places.

(ii) Solve by Gauss Seidal method, the following system :

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

Or

(b) (i) Find the dominant Eigen values of $A = \begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$ using power method.

(ii) Apply Gauss Jordan method, find the solution of the following system :

$2x - y + 3z = 8$, $-x + 2y + z = 4$, $3x + y - 4z = 0$.

12. (a) (i) Find an approximate polynomial for $f(x)$ using Lagrange's interpolation for the following data :

x :	0	1	2	5
$y = f(x)$:	2	3	12	147

(ii) Find the value of y at $x = 21$ from the data given below :

x :	20	23	26	29
y :	0.3420	0.3907	0.4384	0.4848

Or

(b) (i) Given the tables :

x :	5	7	11	13	17
$y = f(x)$:	150	392	1452	2366	5202

Evaluate $f(9)$ using Newton's divided difference formula.

(ii) Fit a cubic spline from the given table :

x :	1	2	3
$f(x)$:	–8	–1	18

Compute $y(1.5)$ and $y'(1)$ using cubic spline.

13. (a) (i) The population of a certain town is shown in the following table.

Year :	1931	1941	1951	1961	1971
Population (in thousands) :	40.6	60.8	79.9	103.6	132.7

Find the rate of growth of the population in the year 1945.

(ii) Evaluate $\int_0^1 \frac{1}{1+x}dx$ using Romberg's method and hence find the value of log 2.

Or

(b) (i) The velocity V of a particle at a distance S from a point on its path is given by the table.

S (ft) :	0	10	20	30	40	50	60
V (ft./sec) :	47	58	64	65	61	52	38

Estimate the time taken to travel 60 feet by using Simpson's $\frac{1}{3}$ rule.

(ii) Evaluate $\int_1^{1.4}\int_2^{2.4} \frac{1}{xy}dx\,dy$ using Trapezoidal rule by taking $h = k = 0.1$ and verify with actual integration.

14. (a) (i) Find the value of y at $x = 0.1$ from $\frac{dy}{dx} = x^2y - 1$, $y(0) = 1$ by Taylor's series method.

(ii) Solve $(1+x)\frac{dy}{dx} = -y^2$, $y(0) = 1$ by Modified Euler's method by choosing $h = 0.1$, find $y(0.1)$ and $y(0.2)$.

Or

(b) (i) Using Runge-Kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$, $y(0) = 1$ at $x = 0.2$.

(ii) Given $\frac{dy}{dx} = x - y^2$, $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.0795$ and $y(0.6) = 0.1762$. Compute $y(0.8)$ using Milne's method.

15. a) Solve $\nabla^2 u = -10(x^2 + y^2 + 10)$ in the square region $0 \le x, y \le 3$ with $u = 0$ on the boundary and mesh length 1 unit. (16)

(OR)

b) i) Solve the boundary value problem $x\,y'' + y = 0$ with the boundary conditions $y(1) = 1$ and $y(2) = 2$, taking $h = 1/4$ by finite difference method. (8)

ii) Solve $u_t = u_{xx}$ in $0 < x < 4, t > 0$, given that $u(0, t) = 0$, $u(4, t) = 0$, $u(x, 0) = x(4 - x)$. Compute u up to $t = 4$ with $\Delta x = \Delta t = 1$. (8)

11/11/19 FN

Reg. No. :

Question Paper Code : 50785

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017

Fourth Semester

Electrical and Electronics Engineering

MA 6459 : NUMERICAL METHODS

(Common to Aeronautical Engineering/Agriculture Engineering/Civil 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. Write down the order of convergence of Newton-Raphson method.

2. State the rate convergence of Gauss Jacobi method and Gauss Seidel method.

3. What is the nature of n^{th} divided differences of a polynomial of n^{th} degree ?

4. Distinguish between interpolation and extrapolation.

5. Write the formula for the derivative to compute at $\frac{dy}{dx}$ at the point $x = x_0$ by using Newton's forward difference formula.

6. What is two-point Gaussian quadrature formula ? For what class of functions f (x) does it given exact answers.

7. State the modified Euler formula to find $y(x_1)$ for solving $\frac{dy}{dx} = f(x, y)$, $Y(x_0) = y_0$.

8. How many prior values are required in predictor-corrector formulae ?

9. Write down the diagonal five point formula to solve the Laplace's Equation $\nabla^2 u(x, y) = 0$.

10. Write down the explicit formula to solve the hyperbolic equation $u_{tt} = 9u_{xx}$ when $\Delta x = 0.25$ and $\Delta t = 1/16$.

PART – B (5×16=80 Marks)

11. a) i) Find the smallest positive root of $x^3 - 2x - 5 = 0$ by the fixed point iteration method, correct to three decimal places. (8)

ii) Find the inverse of the matrix $A = \begin{pmatrix} 4 & 1 & 2 \\ 2 & 3 & -1 \\ 1 & -2 & 2 \end{pmatrix}$ by Gauss-Jordan method. (8)

(OR)

b) i) Solve the following system of equations by Gauss-Seidel method, correct to three decimal places :
$28x + 4y - z = 32$; $x + 3y + 10z = 24$ and $2x + 17y + 4z = 35$. (8)

ii) Find, by power method, the largest eigenvalue and the corresponding eigenvector of a matrix $A = \begin{pmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$ starting with initial vector $X^{(0)} = (1\ 0\ 0)^T$. (8)

12. a) i) Find the interpolation polynomial f (x) by Lagrange's formula and hence find f (3) for (0, 2), (1, 3) (2, 12) and (5, 147). (8)

ii) Find the interpolation polynomial f (x) by using Newton's forward difference interpolation formula and hence find the value of f(5) for

x :	4	6	8	10
f(x) :	1	3	8	16

(8)

(OR)

b) Find the cubic spline approximation for the function given below.

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

Assume that M(0) = 0 = M(3). Hence find the value of f(2.5). (16)

13. a) i) Find the first and second derivatives of y with respect to x at x = 10 from the following data :

x :	3	5	7	9	11
y :	31	43	57	41	27

(8)

ii) Evaluate $\int_0^2\int_0^2 f(x,y)\,dx\,dy$ by Trapezoidal rule for the following data, correct to three decimal places :

y \ x	0	0.5	1	1.5	2
0	2	3	4	5	5
1	3	4	6	9	11
2	4	6	8	11	14

(8)

(OR)

b) i) The following data give the corresponding values for pressure (p) and specific volume (v) of a superheated steam. Find the rate of change of pressure with respect to volume when v = 2.

v :	2	4	6	8	10
p :	105	42.7	25.3	16.7	13.0

(8)

ii) Using Simpson's one-third rule, evaluate $\int_0^{0.6} e^{-x^2}\,dx$ correct to three decimal places by step-size = 0.1. (8)

14. a) Given $dy/dx = xy + y^2$, y(0) = 1, y (0.1) = 1.1169 and y (0.2) = 1.2773, find

i) y (0.3) by R-K method of fourth order and

ii) y (0.4) by Milne's method. (16)

(OR)

b) i) Use Taylor series method to find y at x = 0.1, given $dy/dx = x^2 - y$, y(0) = 1, correct to 4 decimal places. (8)

ii) Using Adam's method, find y(0.4), given dy/dx = (xy)/2, y (0) = 1, y (0.1) = 1.01, y (0.2) = 1.002 and y (0.3) = 1.023. (8)