Reg. No.

**Question Paper Code : 57511**

**B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 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 Also common to Petrochemical Technology, Polymer Technology, Plastic Technology & Chemical Engineering and Also Sixth Semester Manufacturing Engineerings)**

**(Regulation 2013)**

**Time : Three Hours** **Maximum : 100 Marks**

**Answer ALL questions.**

**PART – A (10 × 2 = 20 Marks)**

1. What is the condition for convergence in Fixed point Iteration method ?

2. Name the two methods to solve a system of linear simultaneous equations.

3. Construct a table of divided difference for the given data :

| | | | | |
|---|---|---|---|---|
| $x$ : | 654 | 658 | 659 | 661 |
| y : | 2.8156 | 2.8182 | 2.8189 | 2.8202 |

4. Write down the Newton's forward difference interpolation formula for equal intervals.

5. Write down the general quadrature formula for equidistance ordinates.

6. Write down the forward difference formulae to compute the first two derivatives at $x = x_0$.

7. Write down the improve Euler's formula for first order differential equation.

8. How many values are needed to use Milne's predictor-corrector formula prior to the required value ?

9. Write down the diagonal five point formula in the solution of elliptic equations.

10. Classify the partial differential equation :

$$\frac{\partial^2 u}{\partial x^2} - 2\frac{\partial^2 u}{\partial x\, \partial y} + \frac{\partial^2 u}{\partial y^2} = 0$$

## PART – B (5 × 16 = 80 Marks)

11. (a) (i) Find the approximate root of $xe^x = 3$ by Newton's method correct to three decimal places. **(8)**

(ii) Using Gauss-Jordan method solve the given system of equations : **(8)**

$10x + y + z = 12,$

$2x + 10y + z = 13,$

$x + y + 5z = 7$

**OR**

(b) (i) Solve the following system of equations using Jacobi's iteration method. **(8)**

$20x + y - 2z = 17,$

$3x + 20y - z = -18,$

$2x - 3y + 20z = 25$

(ii) Using power method find the dominant eigen value and the corresponding eigen vector for the given matrix. **(8)**

$$A = \begin{bmatrix} 15 & -4 & -3 \\ -10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$$

12. (a) (i) From the given table compute the value of sin 38°. **(8)**

| | | | | | |
|---|---|---|---|---|---|
| $x$ : | 0 | 10 | 20 | 30 | 40 |
| $\sin x$ : | 0 | 0.17365 | 0.34202 | 0.5 | 0.64279 |

(ii) Using Lagrange's formula find the value of $\log_{10}323.5$ for the given data : **(8)**

| | | | | |
|---|---|---|---|---|
| $x$ : | 321.0 | 322.8 | 324.2 | 325.0 |
| $\log_{10}x$ | 2.50651 | 2.50893 | 2.51081 | 2.51188 |

**OR**

(b) (i) Find the cubic polynomial from the following table using Newton's divided difference formula and hence find f(4). **(8)**

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

(ii) Find the cubic splines for the following table :

| | | | |
|---|---|---|---|
| $x$ : | 1 | 2 | 3 |
| y : | –6 | –1 | 16 |

Hence evaluate y(1.5) and y'(2).

13. (a) (i) Find the first and second derivatives of the function tabulated below at $x = 1.5$ **(8)**

| | | | | | | |
|---|---|---|---|---|---|---|
| $x$ : | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 |
| $f(x)$ | 3.375 | 7.0 | 13.625 | 24.0 | 38.875 | 59.0 |

(ii) Find the value of $\log 2^{1/3}$ from $\int_0^1 \frac{x^2}{1+x^3}\,dx$ using Simpson's $\frac{1}{3}$ rule with h = 0.25. **(8)**

**OR**

(b) (i) Evaluate $\int_1^2 \frac{1}{1+x^3}\,dx$ using Gauss 3 point formula. **(8)**

(ii) Evaluate $\int_0^{\pi/2}\int_{\pi/2}^{\pi} \cos(x+y)\,dxdy$ by using Trapezoidal rule by taking $h = k = \frac{\pi}{4}$ **(8)**

14. (a) (i) Using Taylor series method, compute the value of $y(0.2)$ correct to 3 decimal places from $\frac{dy}{dx} = 1 - 2xy$ given that $y(0) = 0$. (8)

(ii) Using modified Euler's method, find $y(0.1)$ and $y(0.2)$ for the given equation $\frac{dy}{dx} = x^2 + y^2$, given that $y(0) = 1$. (8)

**OR**

(b) (i) Find the value of $y(1.1)$ using Runge-Kutta method of 4th order for the given equation $\frac{dy}{dx} = y^2 + xy$ ; $y(1) = 1$. (8)

(ii) Using Adam's method find $y(0.4)$ given that $\frac{dy}{dx} = \frac{xy}{2}$, $y(0) = 1$, $y(0.1) = 1.01$, $y(0.2) = 1.022$ $y(0.3) = 1.023$. (8)

15. (a) Solve the Laplace's equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ at the interior points of the square region given as below : (16)

| | | | | |
|---|---|---|---|---|
| 0 | 11.1 | 17.0 | 19.7 | 18.6 |
| | 41 | 42 | 43 | |
| 0 | | | | 21.9 |
| | 44 | 45 | 46 | |
| 0 | | | | 21.0 |
| | 47 | 48 | 49 | |
| 0 | | | | 17.0 |
| 0 | 8.7 | 12.1 | 12.8 | 9.0 |

**OR**

(b) Given that $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$, $u(0, t) = 0$, $u(4, t) = 0$ and $u(x, 0) = \frac{x}{3}(16 - x^3)$.

Find $u_{ij}$ : $i = 1, 2, 3, 4$ and $j = 1, 2$ by using Crank-Nicholson method.