MCA 2nd Semester Examination, 2023

MCA

(*Numerical Methods and Optimization Technique*)

PAPER – MCA-205

Full Marks : 100

Time : 3 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

SECTION – I

(*Numerical Methods*)

GROUP – A

Answer any **three** questions : 2×3

1. Differentiate between round-off error and truncation error.

2. What are absolute, relative and percentage errors ?

3. What is the difference between Regula-Falsi and Bisection method ?

4. Find the Newton-Raphson formula to find $\sqrt{N}$, where N is a positive integer.

5. Compare Gauss-Elimination method and Gauss-Jordan method for solving a linear system of equations.

GROUP – B

Answer any **two** questions : 15×2

6. (*i*) Find the root of the equation $x^4 - x - 10 = 10$ by Bisection method, correct up to two decimal places.

   (*ii*) Find the value of y at $x = 1$ for the given set of points (1, 6), (3, 4), (2, 5) using Lagrange Interpolation method. $8 + 7$

7. (*i*) Find the value of $y(0.1)$ and $y(0.2)$ from the following differential equation using Euler's method :

$$\frac{dy}{dx} = x^2 + y^2 \text{ with } y(0) = 1.$$

(*ii*) Solve the following system of equations by Gauss-Elimination method :

$$5x - y - 2z = 142$$

$$x - 3y - z = -30$$

$$2x - y - 3z = -50.$$ 7 + 8

8. (*i*) Solve the following system of equations by Gauss-Siedel iteration method correct up to four decimal places :

$$2x + 6y - z = 54$$

$$6x + 15y + 2z = 72$$

$$x + y + 54z = 110.$$

(*ii*) Find the value of the following by taking 6 sub intervals with the help of Trapezoidal rule :

$$\int_0^6 \frac{dx}{1+x^2}.$$ 8 + 7

9. (*i*) The following table gives the value of $y = f(x)$ for certain equidistance value of x. Find the value of y when $x = 1895$ using Newton's forward difference formula :

x :	1891	1901	1911	1921	1931
y :	46	66	81	93	101

(*ii*) Find the eigenvalues and eigenvectors of the following matrix :

$$A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}.$$

8 + 7

SECTION – II

(*Optimization Technique*)

GROUP – A

Answer any **two** questions : 2 × 2

10. What is the necessity of optimization technique ?

11. What do you mean by basic feasible solution ?

12. Define slack and surplus variable.

13. Prove that the dual of a dual is primal.

14. Write down the advantages of Two-phase method over Big-M method.

GROUP – B

Answer any **two** questions : 15×2

15. (*i*) Solve the following LPP by simplex method :

Maximize $z = 6x_1 + 8x_2$

Subject to $5x_1 + 10x_2 <= 60$

$4x_1 + 4x_2 <= 40$

x_1 and $x_2 >= 0$.

(*ii*) Formulate the dual of the following primal problem :

Maximize $z = 4x_1 + 10x_2 + 25x_3$

Subject to

$$2x_1 + 4x_2 + 8x_3 <= 25$$
$$4x_1 + 9x_2 + 8x_3 <= 30$$
$$6x_1 + 8x_2 + 2x_3 <= 40$$
$$x_1, x_2 \text{ and } x_3 >= 0$$

10 + 5

16. (*i*) Determine the initial basic feasible solution for the following transportation problem by VAM method.

	*D*1	*D*2	*D*3	*D*4	*Demand*
*S*1	3	1	7	4	300
*S*2	2	6	5	9	400
*S*3	8	3	3	2	500
Supply	250	350	400	200	

(*ii*) Use the graphical method to solve the following LP problem :

Maximize $z = 2x_1 + 3x_2$

Subject to $x_1 + x_2 >= 6$

$$7x_1 + x_2 >= 14$$

x_1 and $x_2 >= 0$.

8 + 7

17. (*i*) Use the Big-M method to solve the following LP problem :

Maximize $z = 5x_1 + 3x_2$

Subject to

$$2x_1 + 4x_2 <= 12$$
$$2x_1 + 2x_2 = 10$$
$$5x_1 + 2x_2 >= 10$$
$$x_1 \text{ and } x_2 >= 0.$$

(*ii*) Find the optimal assignments for the assignment problem with the following cost matrix :

	*M*1	*M*2	*M*3	*M*4	*M*5
*J*1	3	8	2	10	3
*J*2	8	7	2	9	7
*J*3	6	4	2	7	5
*J*4	8	4	2	3	5
*J*5	9	10	6	9	10

8 + 7

18. (*i*) Solve the following nonlinear programming problem using Kuhn-Tucker conditions :

Maximize $z = 3x_1^2 + 14x_1x_2 - 8x_2^2$

Subject to

$$3x_1 + 6x_2 <= 72$$

$$x_1 \text{ and } x_2 >= 0.$$

(*ii*) Explain Genetic algorithm with suitable example. 10 + 5

[*Internal Assessment* — 30 Marks]