2022

MCA

2nd Semester Examination

NUMERICAL METHODS AND OPTIMIZATION TECHNIQUE

PAPER—MCA-205

Full Marks : 100

Time : 3 Hours

The figures in the margin indicate full marks.

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

Illustrate the answers wherever necessary.

Attempt both the sections.

Section – I

(Numerical Analysis)

Group—A

1. Answer any *two* questions : 2×2

(a) What is round-off error ?

(b) What is the difference between Bisection and Regula Falsi method ?

(c) Calculate the error of Trapezoidal formula.

(d) What is pivots ?

Group—B

Answer any *two* questions. 2×15

2. Deduce the Newton forward interpolation formula. Using the Lagrange interpolation formula find f(3, 3) from the table :

x	1	3	4	6	7	10
f(x)	7	18	24	38	45	63

8+7

3. Deduce the Simpson's 1/3 formula to find the area of an equation f(x) from Newton Quadrature formula.

Find $\int_{1}^{2} \sqrt{\frac{x^2-1}{x}}\, dx$ by Simpson's 1/3 and trapezoidal formula by taking 10 intervals. 8+4+3

4. Find a real root of the equation $x^3 + 3x - 5 = 0$ using regula-falsi method. Solve the following linear equations by Jacobi iteration method :

$$2x + y + z = 5$$

$$3x + 5y + 2z = 15$$

$$2x + y + 4z = 8$$ 7+8

5. Find the value of $\frac{dy}{dx} = \frac{y-x}{1+x}$ given $y(0) = 1$, find $y(0.1)$ by taking $h = 0.02$ by Predictor-Corrector formula. Find $\sqrt[5]{17}$ using Newton Raphson Method. Solve using Gauss Elimination formula

$$x + y + z = 2$$

$$x + 2y + 3z = 5$$

$$2x + 3y + 4z = 11$$ 6+3+6

Section – II

(Optimization Technique)

Group—A

6. Answer any *two* questions : $2\times2\frac{1}{2}$

(a) Describe basic variables, non-basic variables and feasible solutions.

(b) What do you mean by optimization technique ? Give an example.

(c) Explain balanced and unbalanced transportation problems.

(d) What does duality helps you to achieve ?

Group—B

Answer any *two* questions. 2×15

7. (a) A furniture company produces inexpensive tables and chairs. The production process for

each is similar in that both require a certain number of hours of carpentry work and a certain number of labour hours in the painting department. Each table takes 4 hours of carpentry and 2 hours in the painting department. Each chair requires 3 hours of carpentry and 1 hour in the painting department. During the current production period, 240 hours of carpentry time are available and 100 hours in painting is available. Each table sold yields a profit of rupees 700 ; each chair produced is sold for rupees 5 profits. Find the best combination of tables and chairs to manufacture in order to reach the maximum profit.

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

$$\text{Maximize } z = 2x_1 + 3x_2$$
$$\text{subject to } x_1 + x_2 \leq 30$$
$$x_2 \geq 3$$
$$0 \leq x_2 \leq 12$$
$$0 \leq x_1 \leq 20$$
$$x_1 - x_2 = 0$$

7+8

8. (a) Solve the following LPP by simplex method :

$$\text{Maximize } x = 50x_1 + 70x_2$$

$$\text{subject to } 120x_1 + 120x_2 \leq 8400$$

$$x_1 + 2x_2 \leq 100$$

$$2x_1 + x_2 \leq 120$$

$$x_1, x_2 \geq 0$$

(b) Formulate the dual of the following LPP :

$$\text{Maximize } z = 10x_1 + 8x_2$$

$$\text{subject to } x_1 + x_2 \geq 5$$

$$2x_1 - x_2 \geq 12$$

$$x_1 + 3x_2 \geq 4$$

$x_1 \geq 0$ and

x_2 is unrestricted.

8+7

9. (a) There are five jobs to be assigned, one each to five machines and the associated cost matrix is as follows :

Machine → Job	1	2	3	4	5
A	11	17	8	16	20
B	9	7	12	6	15
C	13	16	15	12	16
D	21	24	17	28	26
E	14	10	12	11	15

Find the assignment of machines to jobs that will minimize the total cost.

(b) Using the Big-M method to show that the following linear program is infeasible :

Minimize $Z = 3x_1 + 2x_2 + 4x_3$

subject to $2x_1 + x_2 + 3x_3 = 60$

$3x_1 + 3x_2 + 5x_3 \geq 120$

and $x_1 \geq 0, x_2 \geq 0, x_3 \geq 0$

7+8

10. (a) Solve the following LP problem by Algebraic Simplex Method :

$$\text{Maximize } Z = 20x_1 + 10x_2$$

$$\text{subject to } x_1 - x_2 \leq 1$$

$$3x_1 + x_2 \leq 7$$

$$x_1, x_2 \geq 0$$

(b) Determine the initial basic feasible solution for the following transportation problem by VAM method :

	D_1	D_2	D_3	D_4	a_i
S_1	23	17	25	14	30
S_2	15	10	18	24	50
S_3	16	20	8	13	60
b_j	30	50	30	50	

8+7

[Internal assessment – 30]

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