



K24P 3134

Reg. No. :

Name :

III Semester M.Sc. Degree (C.B.C.S.S. – OBE – Regular)

Examination, October 2024

(2023 Admission)

**MATHEMATICS/MATHEMATICS (MULTIVARIATE CALCULUS AND
MATHEMATICAL ANALYSIS, MODELLING AND SIMULATION, FINANCIAL
RISK MANAGEMENT)**

Open Elective Course

MSMAT03O03/MSMAF03O03 – Operations Research

Time : 3 Hours

Max. Marks : 80

PART – A

Answer **any five** questions. **Each** question carries **4** marks :

1. Define and explain the general Linear Programming Problem.
2. Explain degeneracy in L.P. Problems.
3. Write the dual of the following LPP :

Minimize $x_1 - 3x_2 - 2x_3$ subject to $2x_1 - 4x_2 \geq 12$, $3x_1 - x_2 + 2x_3 \leq 7$,
 $-4x_1 + 3x_2 + 8x_3 = 10$, $x_1, x_2 \geq 0$ and x_3 unrestricted.

4. Explain the occurrence of loops in transportation array.
5. Write a short note on Integer Programming Problem (IPP). Illustrate with an example.

6. Explain various types of games.

(5×4=20)

PART – B

Answer **any three** questions. **Each** question carries **7** marks :

7. Prove : The set S_p of feasible solutions if not empty is a convex set bounded from below and has at least one vertex.
8. Define the dual of the L.P. problem. Prove that the dual of a dual is the primal in L.P. problem.

P.T.O.



9. Use simplex method to solve the following LPP :

$$\text{Maximize } Z = 5x_1 + 3x_2$$

Subject to

$$x_1 + x_2 \leq 12,$$

$$5x_1 + 2x_2 \leq 10,$$

$$3x_1 + 8x_2 \leq 12,$$

$$x_1, x_2 \geq 0.$$

10. Solve the following Transportation problem :

	M1	M2	M3	M4	Capacity
F1	11	20	7	8	50
F2	21	16	10	12	40
F3	8	12	18	9	70
Requirement	30	25	35	40	–

11. Solve the following minimal assignment problem :

	I	II	III	IV	V	VI
A	9	22	58	11	19	27
B	43	78	72	50	63	48
C	41	28	91	37	45	33
D	74	42	27	49	39	32
E	36	11	57	22	25	18
F	3	56	53	31	17	28

(3×7=21)

PART – C

Answer **any three** questions. **Each** question carries **13** marks :

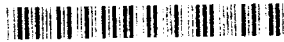
12. Solve the following LPP by dual simplex method :

$$\text{Minimize } x_1 + 3x_2 \text{ Subject to, } 2x_1 + 3x_2 \leq 30, x_1 + 2x_2 \geq 10, x_1, x_2 \geq 0.$$

13. Solve the following LPP by Cutting plane method :

$$\text{Minimize } 4x_1 + 5x_2 \text{ subject to,}$$

$$3x_1 + x_2 \geq 2, x_1 + 4x_2 \geq 5, 3x_1 + 2x_2 \geq 7, x_1, x_2 \geq 0.$$



14. a) Let $f(X, Y)$ be such that both $\max \min f(X, Y)$ and $\min \max f(X, Y)$ exists. Then state and prove the necessary and sufficient condition for the existence of a saddle point (X_0, Y_0) of $f(X, Y)$.
- b) Examine for saddle point and hence obtain the optimal strategies and the value of the following game :

Firm A/Firm B	B1	B2	B3	B4	B5
A1	3	-1	4	6	7
A2	-1	8	2	4	12
A3	16	8	6	14	12
A4	1	11	-4	2	1

15. Explain the Dominance property. The following table represents the pay off matrix with respect to Player A. Solve the game optimally using dominance property.

A/B	B1	B2	B3	B4	B5
A1	4	6	5	10	6
A2	7	8	5	9	10
A3	8	9	11	10	9
A4	6	4	10	6	4

16. a) Define mathematical expectations on the pay off function $E(X, Y)$ in the game where Pay off matrix $A = (a_{ij})$.
- b) Consider the payoff matrix of the Player A as shown below, solve it optimally using graphical method.

Player A/Player B	B1	B2	B3	B4	B5
A1	-4	2	5	-6	6
A2	3	-9	7	4	8

(3×13=39)
