(b) Solve the following geometric programming problem: 9

$$\text{Min } f(x) = 20\, x_1 x_3 + 40\, x_2 x_3 + 80\, x_1 x_2$$

subject to -

$$8x_1^{-1}\, x_2^{-1}\, x_3^{-1} \le 1$$

$$x_1\,,\ x_2\,,\ x_3 > 0$$

8. (a) Discuss the 'λ-form' of the separable programming problem. 5

(b) Solve the following separable programming problem:

$$\text{Max } f(x) = 3\, x_1 + 2\, x_2$$

subject to -

$$g(x) = 4x_1^2 + x_2^2 \le 16$$

and $x_1\,,\ x_2 \ge 0$ 9

Unit - V

9. (a) Discuss the characteristics of dynamic programming problem. 7

(b) A positive quantity c is to be divided into n parts in such a way that the product of the n parts is to be maximum. Obtain the optimal subdivision. 7

10. (a) Solve the following fractional programming problem: 8

$$Max\ z = \frac{5x_1 + 3x_2}{5x_1 + 2x_2 + 1}$$

subject to -

$$3x_1 + 5x_2 \le 15,\quad 5x_1 + 2x_2 \le 10 \text{ and } x_1, x_2 \ge 0$$

(b) State Bellman's principle of optimality in dynamic programming problem. 4

(c) Obtain the functional equation for maximizing

$$z = g_1(x) + g_2(x) + \ldots + g_n(x)$$ 2

subjec to,

$$x_1 + x_2 + \ldots + x_n = c$$

$$x_1\,,\ x_2\,,\ \ldots\,,\ x_n \ge 0$$

★★★

PG Even Semester Examination, May 2025

MATHEMATICS

4th Semester

Course No. : MAT - 653 (E)

Advanced Operations Research-II (Elective-III)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(Answer one question from each unit)

(All the symbols have their usual meanings)

Unit - I

1. (a) Formulate and solve the mathematical model for the replacement of items whose maintenance cost increases with time and the value of money remains the same during the period. 7

(b) Following failur rates have been observed for a certain types of light bulbs

End of week	1	2	3	4	5	6	7	8
Prob of failure to date	0.05	0.13	0.25	0.43	0.68	0.88	0.96	1.00

The cost of replacing an individual bulb is Rs. 2.25, the decision is made to replaced all the bulbs simultaneously at fixed intervals and also to replace individual bulbs as they fail in service. If the cost of group replacement is 60 paise per bulb and the total number of bulbs is 1000, what is the best interval between group replacement. 7

2. (a) A manufacturer is offered two machines $M_1 < M_2$. M_1 is priced at Rs. 5000/- and recurring costs are estimated at Rs. 800/- for each of the 5 years, increasing Rs. 200/- per year in the 6th and subsequent years. Machine M_2 which have the same capacity as M_1 costs Rs. 2500/-. Recurring costs are estimated at Rs. 1200/- for each of the 6 year increasing by Rs. 200/- per year thereafter. If money is worth 10% per year, which machine should be purchased. Assume that the machines have negligible resale value. 8

(b) State and prove mortality theorem. 6

Unit - II

3. (a) Write a short note on decision theory. 4

(b) A steel manufacturing company is concerned with the possibility of a strike. It will cost an extra Rs. 20000/- to acquire an adequate stock file. If there is a strike and the company has not stock filed management estimates an additional expense of Rs. 60000/- on account of last sales. Should the company stock file or not if it is to use

(i) Optimistic criterion (ii) Wald creterion (iii) Savagae criterion (iv) Hurwica criterion for α=0.4 (v) Laplace criterion. 10

4. (a) A grocery receives its wekly supply of packet paneer every thursday morning. This shipment must last until the following thursday when a new shipment is received. Any packet paneer left unsold by thursday is destroyed. Packet paneer sell for \$ 10 per hundred packets and cost \$ 8 per hundred

packets. The weekly demand for paneer at they grocery varies from week to week. From past experience the following probability distribution is assigned to weekly demanding

Demand (100 packet of paper)	10	11	12	13	14
Probability	0.1	0.2	0.4	0.2	0.1

6

(b) A news paper boy has the following probabilities of selling a magazine. 8

No. of copies sold	10	11	12	13	14
Probability	0.1	0.15	0.2	0.25	0.3

Cost of a copy is 30 paise and sale price is 50 paise. He can not return unsold copies. How many copies should be order? Solve the problem by using different criterion under condtion of risk.

Unit - III

5. (a) Solve the Goal programming problem graphically

Min $z = d_1^- + d_1^+$ 6

such that

$$80x_1 + 40x_2 + d_1^- - d_1^+ = 800$$
$$x_1 + x_2 \le 10 \text{ and}$$
$$x_1, x_2, d_1^+, d_1^- \ge 0$$

(b) Explain the modified simplex method with various steps. 8

6. (a) Write notes on application of Goal programming. 5

(b) Explain the main features of linear goal programmingl 5

(c) What are the variants of Goal programming. 4

Unit - IV

7. (a) Discuss the unconstrained geometric programming problem. 5