P.G. Semester-IV Examination, 2023

MATHEMATICS

Course ID : 42151 **Course Code : MATH-401C**

Course Title : Operations Research

Time : 2 Hours Full Marks : 40

The figures in the right-hand margin indicate marks.

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

Answer any **five** of the following questions: 8×5=40

1. a) Write down the fundamental theorem of LPP.

   b) Consider a chocolate manufacturing company which produces only two types of chocolate A & B. Both chocolates require milk and choco only. To manufacture each unit of A and B following quantities are required:

   i) Each unit of A requires 2 units of milk and 6 units of choco.

   ii) Each unit of B requires 5 units of milk and 5 units of choco.

   The company has a total of 16 units of milk and 30 units of choco. On each sale the company makes a profit of Re. 1 per unit A sold and Re.1 per unit B sold. Now the company wishes to maximize its profit. Write down the LPP to maximize the profit of the firm.

   c) Find optimal solution of the above LPP using simplex method. 2+2+4

2. Solve the following LPP by using revised simplex method:

   Max $z = x_1 + 2x_2$

   subject to constraints

   $x_1 + x_2 \le 3$

   $x_1 + 2x_2 \le 5$

   $3x_1 + x_2 \le 6$

   and $x_1, x_1 \ge 0$. 8

3. a) A department of a company has 4 employees with 4 jobs to be performed. The time that each employee takes to perform each job is given in the effectiveness matrix.

	J_1	J_2	J_3	J_4
E_1	9	2	7	8
E_2	6	4	3	7
E_3	5	8	1	8
E_4	7	6	9	4

   Solve the above assignment problem.

b) Solve the following travelling salesman problem. The corresponding cost matrix is given below:

	A	B	C	D	E
A	∞	2	5	7	1
B	6	∞	3	8	2
C	8	7	∞	4	7
D	12	4	6	∞	5
E	1	3	2	8	∞

4+4

4. The optimal table of the following LPP

Max $z = 2x_1 - x_2$

subject to constraints

$x_1 + x_2 \leq 2$

$x_1 - x_2 \leq 1$

& $x_1, x_2 \geq 0$

is given below:

		C_j	2	-1	0	0
BV	C_B	X_B	x_1	x_2	s_1	s_2
x_2	-1	1/2	0	1	1/2	$-1/2$
x_1	2	3/2	1	0	1/2	1/2
$c_j - z_j$			0	0	$-1/2$	$-3/2$

Using sensitivity analysis find the optimal solution of the new problems with following changes in the given problem:

a) Cost c_1 is changed from 2 to -1.

b) A new constraint $2x_1 + x_2 \leq 5$ is added.

4+4

5. a) Write down the Johnson's algorithm for n-jobs and 2-machines problem.

b) Find the optimal job sequence that minimizes the total completion time for the following 8-jobs and 2-machines problem:

Job i / Machine	J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8
M_1 (time in hours)	4	3	8	1	4	8	7	9
M_2 (time in hours)	5	7	3	2	6	5	5	2

c) Using the graphical method solve the following 2-jobs and m-machines problem given below:

Job 1	Sequence	A	B	C	D	E
	Time in hours	3	4	2	6	3
Job 2	Sequence	B	C	A	D	E
	Time in hours	5	4	3	2	6

Find the job for each machine which should be done first. Also calculate the total time elapsed to complete both jobs. 2+2+4

6. Using Gomory's integer method, solve the following integer programming problem.

Max $z = x_1 + x_2$

subject to constraints

$3x_1 + 2x_2 \leq 5$

$x_2 \leq 2$

where x_1, x_2 are non-negative integers. 8

7. The time estimates (in weeks) for the activities of a PERT network are given below:

Activity	t_o	t_m	t_p
1–2	1	1	7
1–3	1	4	7
1–4	2	2	8
2–5	1	1	1
3–5	2	5	14
4–6	2	5	8
5–6	3	6	15
6–7	1	3	5

a) Using project network diagram find the critical path and expected project completion time.

b) Find the probability of completion of the project on or before 18 weeks.

c) What should be the scheduled completion time for which the probability of completion will be 0.99? (2+2)+2+2

8. a) What is inventory? Discuss the classification of inventories.

b) Write down the different types of costs involved in inventory problem.

c) Consider that a textile mill buys its raw material from a vendor. The annual demand of the raw material is 9000 units. The ordering cost is Rs. 100 per order and the carrying cost is 10% of the purchase price per unit per month, where the purchase price per unit is Rs. 120. Find the following:

i) Optimal lot size (EOQ).

ii) Total cost.

iii) No of orders per year. (1+2)+2+3

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