Exam Date & Time: 10-May-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, APRIL-MAY 2024

INTRODUCTION TO OPERATIONS RESEARCH [MME 4305]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) Solve the Linear Programming Problem using Simplex Method

A) Maximize $Z = 10X_1 + 15X_2 + 20X_3$

Subjected to

$2X_1 + 4X_2 + 6X_3 \leq 24$

$3X_1 + 9X_2 + 6X_3 \leq 30$

$X_1, X_2, X_3 \geq 0$ (4)

B) Explain Redundancy, Looping and Dangling with the help of network diagram. (3)

C) Mr. Raman is a salesman with Tata company. He has to visit five cities 1,2,3,4 and 5 starting with city 1 where he is stationed. The distance between various cities is given in the below table. Mr. Raman wants to develop a tour though the four other cities and return to his home city in such a way that he has to travel minimum distance.

CITY	1	2	3	4	5
1	-	1	8	3	4
2	1	-	8	2	3
3	1	3	-	5	1
4	2	5	6	-	5
5	5	3	7	6	-

(3)

2) A) A firm has the choice of producing 4 similar products in any combination. These products have profit rates of Rs.70, 65, 80 & 75 respectively. They all require two types of raw materials R1 & R2 & two types of labour L1 & L2. The per unit requirements & the availability of the resources every week is given in the following table.

Resource	Per unit requirement				Availability (Hrs.)
	P_1	P_2	P_3	P_4	
R_1	4	4	3	7	90
R_2	6	3	5	4	120
L_1	5	2	3	3	60
L_2	6	5	1	2	100

(4)

Determine the optimal product mix for the firm and carry out the sensitivity analysis, for the changes in objective function coefficient and RHS values of constraints.

B) Define following terminology in Game theory.

a. Saddle Point

b. Value of Game

c. Mixed and Pure Strategy (3)

C) Solve the following LPP using Big M method. (3)

Max $Z = 3x_1 - x_2$

S.t.

$2x_1 + x_2 \leq 2$

$x_1 + 3x_2 \geq 3$

$x_2 \leq 4$

$x_1, x_2 \geq 0$

3) Following table shows the normal time, crash time, normal cost, and crash cost of each activity of a project. If the Indirect cost per day is 200 rupees, find the optimal crashed project completion time.

A)

Activity	Normal Time (days)	Normal coat (Rs)	Crash Time (days)	Crash Cost (Rs)
1-2	7	700	4	850
1-3	5	500	3	700
1-4	8	600	5	1200
2-5	9	800	7	1250
3-5	5	700	3	1000
3-6	6	1100	5	1300
4-6	7	1200	5	1450
5-7	2	400	1	500
6-7	3	500	2	850

(4)

B) A production supervisor is considering how he should assign the four jobs that are to be performed to four of the workers. He wants to assign jobs to workers such that the aggregate time to perform the jobs is the least. The cost of doing various jobs by each worker is given below.

worker	Job(cost in 000's)			
	1	2	3	4
A	45	40	51	67
B	57	42	63	55
C	49	52	48	64
D	41	45	60	55

(3)

C) Find the initial basic feasible solution of the below problem using Least cost method and Vogels Approximation Method.

		To Market				Supply
		M_1	M_2	M_3	M_4	
From Plant	P_1	6	4	9	1	40
	P_2	20	6	11	3	40
	P_3	7	1	0	14	50
	P_4	7	1	12	6	90
Demand		90	30	50	30	

(3)

4) A) A firm owns facilities at six places. It has manufacturing plants at places A, B and C with daily production of 50, 40, 60 units respectively. At point D, E and F it has three warehouses with daily demands of 20, 95 and 35 units respectively. Per unit shipping costs are given in the following table. If the firm wants to minimize its total travelling cost, how should it route its products? (5)

		Warehouse		
		D	E	F
Plant	A	6	4	1
	B	3	8	7
	C	4	4	2

Use NWC method for the initial basic feasible solution and MODI method for the optimum solution.

B) Solve the following Game:

		Player B			
		B_1	B_2	B_3	B_4
Player A	A_1	3	7	3	4
	A_2	5	6	4	3
	A_3	6	2	2	-3

(3)

C) A company has three operational departments (weaving, processing and packing) with capacity to produce three different types of clothes viz. suitings, shirtings, and wollens yielding a profit of Rs.2, Rs.4, and Rs.3 per metre respectively. One metre of suiting requires 3 minutes in weaving, 2 minutes in processing and 1 minute in packing. Similarly one metre of shirting requires 4 minutes in weaving, 1 minute in processing and 3 minutes in packing. One metre of woolen requires 3 minutes in each department. In a week, total run time of each department is 60, 40 and 80 hours for weaving, processing and packaging respectively. Formulate the LPP to find the product mix to maximise the profit. (2)

5) Information on the activities required for a project is as follows:

A)

Name	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
Activity Node	1-2	1-3	1-4	2-5	3-5	3-6	3-7	4-6	5-7	6-8	7-8
Duration (days)	2	7	8	3	6	10	4	6	2	5	6

(4)

Draw the network and calculate earliest start (ES), earliest finish (EF), latest start (LS) and latest finish (LF) time for each of the activities. Calculate all float times.

B) A tailor specialises in ladies dresses. The number of customers approaching the tailor appears to be Poisson distributed with a mean of 6 customers per hour. The tailor attends the customers on a first come first served basis and the customers wait if need be. The tailor can attend to the customers at an average rate of 10 customers per hour with the service time exponentially distributed. Find:

a. The utilization factor.

b. The probability that the queuing system is idle.

c. The average time that the tailor is free on a 10-hour working day.

d. The probability associated with the number of customers (0 through 5) in the queuing system.

e. What is the expected number of customers in the tailor's shop?

f. What is the expected number of customers waiting for tailor's services?

g. What is the average length of queues that have at least one customer?

h. How much time should a customer expect to spend in the queue?

(4)

C) Explain the application of Monte Carlo simulation? (2)

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