MANIPAL INSTITUTE OF TECHNOLOGY
A Constituent Institute of Manipal University, Manipal

VI SEMESTER B.TECH (MECHANICAL ENGG.) END SEMESTER EXAMINATIONS, JUNE 2017

SUBJECT: PROGRAM ELECTIVE IV, OPERATIONS RESEARCH [MME 4026]
REVISED CREDIT SYSTEM

Time: 3 Hours   MAX. MARKS: 50

Instructions to Candidates:
❖ Answer **ALL** the questions.
❖ Missing data may be suitably assumed.

1A. A manufacturer has 5 lathes and 3 milling machines in his workshop and produces an assembly that consists of 2 units of part A and 3 units of part B. The processing time for each part are as follows

Part	Processing time (minutes)	
	Lathe	**Milling machine**
A	10	18
B	25	12

In order have a uniform workload on the machines, the manufacturer has decided that no type of machine should run more than 40 minutes per day longer than other. Formulate the problem as LPP if the objective is to produce the maximum number of assemblies in any 8 hour working day. **(5)**

1B. A retailer deals in a perishable commodity. The daily demand and supply are available. The data for the past 500 days shows demand and supply as shown in table below.

Supply		Demand	
Availability (kgs)	No. of days	Availability (kgs)	No. of days
10	40	10	50
20	50	20	110
30	190	30	200
40	150	40	100
50	70	50	40

The retailer buys the commodity at ₹20 per kg and sells at ₹30 per kg. Any unsold commodity at the end of the day has no saleable value. Moreover, the loss on any unsatisfied demand is ₹8 per kg. Given the following random numbers, simulate the sales, demand and profit for six days. The random numbers 18, 84, 79, 32, 75, 27 are pertaining to supply and the random numbers 31, 63, 15, 07, 43, 81 are pertaining to demand.

(5)

2A. Solve the following LPP:

Max. $Z= 5x_1 - 4x_2 + 3x_3$

s.t $\quad 2x_1 + x_2 - 6x_3 = 20$

$\quad 6x_1 + 5x_2 + 10x_3 \leq 76$

$\quad 8x_1 - 3x_2 + 6x_3 \leq 50$

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

(7)

2B. Solve the game for the pay-off given below.

		Player B		
		b_1	b_2	b_3
Player A	a_1	1	-1	-1
	a_2	-1	-1	3
	a_3	-1	2	-1

(3)

3A. A marketing manager wants to visit cities A,B,C and D. He does not want to visit any city twice before completing the tour of all the cities and wishes to return to his home city A. Costs in ₹ thousands of going from one city to another as per the average of previous visits is given in table below. How should he plan his journey? Use an appropriate algorithm to solve.

		To city			
		A	B	C	D
From city	A	-	3	8	5
	B	4	-	14	3
	C	4	5	-	2
	D	7	8	13	-

(5)

3B. Write the dual of the LPP given below. Do not solve.

Min $Z = 4x_1 + 12x_2 + 7x_3$

s.t., $x_1 - x_2 \geq 4$

$2x_1 + 4x_2 \geq 12$

$4x_1 - x_2 - x_3 = 15$

$x_1 + x_2 + x_3 \leq 7$

$x_1, x_3 \geq 0$ & x_2 is unrestricted in sign.

(5)

4A. The list of activities pertaining to a project is given below along with relevant details. The indirect cost is ₹2400 per week. Find the minimum possible duration of the completion of the project and the associated cost.

Activity	Predecessor	Normal Cost (₹)	Crash Cost (₹)	Normal duration (weeks)	Crash duration (weeks)
A	-	20000	30000	10	7
B	-	15000	20000	8	6
C	B	8000	14000	5	4
D	B	11000	15000	6	4
E	B	9000	15000	8	5
F	E	5000	8000	5	4
G	A,D,C	3000	4000	12	8

(5)

4B. A departmental store wishes to purchase the following quantities of the outfits from the various designers.

Type	A	B	C	D	E
Quantity	150	100	75	250	200

The designers have the different supply capacities as shown below:

Designers	W	X	Y	Z
Quantity	300	250	150	200

The store estimates that its cost (in ₹ 00's) per outfit will vary with the designers as shown in the matrix below. How should orders be placed in order to optimize the costs?

		Outfit				
		A	B	C	D	E
Designer	W	2.75	3.5	4.25	2.25	1.5
	X	3	3.25	4.5	1.75	1
	Y	2.5	3.5	4.75	2	1.25
	Z	3.25	2.75	4	2.5	1.75

(5)

5A. Five employees of a company are to be assigned to five jobs, which can be done by any of them. The workers get different wages per hour. These are ₹ 50 per hour for A, B and C each and ₹ 30 per hour for D and E. The time taken in hours by each employee to do a given job is given in table below. Determine the assignment pattern that minimizes the total cost of getting the five jobs done.

		Employee				
		A	B	C	D	E
Job	1	7	9	3	3	2
	2	6	1	6	6	5
	3	3	4	9	10	7
	4	1	5	2	2	4
	5	6	6	9	4	2

(5)

5B. The precedence relations and other information of a project are given in table below.

Activity	Predecessor	Duration in weeks		
		T_O	T_m	T_p
A	-	1	1	7
B	-	1	4	7
C	-	2	2	8
D	A	1	1	1
E	B	2	5	14
F	C	2	5	8
G	D,E	3	6	15

Construct the network and determine the critical path and project completion time. Determine the probability of completion of the project in 20 weeks. What is the expected duration of the project with 50% chance of completion?

(5)