MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL (*A constituent unit of MAHE, Manipal*)

VI SEMESTER B. TECH (INDUSTRIAL AND PRODUCTION ENGG.)

END SEMESTER MAKEUP EXAMINATIONS, JUNE 2018

SUBJECT: OPERATIONS RESEARCH [MME 3211]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

3

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Instructions to Candidates:

- Answer ALL the questions.
 - Use of normal tables is permitted
- 1A In the graphical solution of a LPP, what is the feasibility region? Is it necessary that it should always be a convex set? 2
- 1B Solve the following game graphically



1C An airline that operates between Delhi (A) and Kolkata (B) has the timetable as shown in table 4.167. Crew must have a minimum layover of 5 hours between flights. Obtain the pairing of flights that minimizes layover time away from home. Note that crew flying from A to B and back can be based either at A or at B. For any given pairing, they will be based at the city that results.

Delhi - Kolkata							
Fight Number	Departure	Arrival					
1	6.00 A.M.	7.00 A.M					
2	7.30 A.M.	8.30 A.M.					
3	10.30 A.M.	11.30 A.M					
4	2.00 P.M	3.00 P.M					
5	6.00 P.M.	7.00 P.M.					
6	11.30 P.M.	0.30 A.M.					

Kolkata-Delhi							
Fight Number	Departure	Arrival					
101	8.00 A.M.	9.15 A.M					
102	9.00 A.M.	10.15 A.M.					
103	11.30 A.M.	0.45 P.M.					
104	3.00 P.M	4.15 P.M.					
105	7.30 P.M.	8.45 P.M.					
106	10.00 P.M.	11.15 P.M.					

- 2A Discuss the various method of finding initial feasible solution of a transportation problem and state the advantages and limitations.
- 2B A dentist schedules all her patients for 30 minutes appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following summary shows the various categories of work, their probabilities and the time needed to complete the work.

	Time	Probability
Category	required	of
5,	(minutes)	category
Filling	45	0.40
Crown	60	0.15
Cleaning	15	0.15
Extraction	45	0.10
Checkup	15	0.20

Simulate the dentist's clinic for four hours and determine the average waiting time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic at exactly their scheduled arrival times, starting at 8 A.M. Use the following random numbers for handling the above problem: 40, 82, 11, 34, 25, 66, 17 and 79.

2C A LPP is formulated as

Min $Z = 10y_1 + 72y_2 + 60y_3$

S.t.

$$2y_1 + 4y_2 + 3y_3 \le 5$$

 $4y_1 + 4y_2 + 5y_3 \le 10$

 $5y_1 + 4y_2 + 2y_3 \le 8$

 $y_1, y_2, y_3 \ge 0$

- i. The partially completed optimal table of the Dual of the LPP is given below.
- ii. Complete the table and conduct sensitivity of the RHS constraints and Objective function coefficients.
- iii. Is the solution unique?

		Cj	5	10	8	0	0	0
Basis	Qty		X1	X2	Х3	S1	S2	S3
X2	8	10	1/3			1/3	-1/6	
X3	10	8	2/3			-1/3	5/12	
S3	18	0	-8/3			1/3	-17/12	

- 3A What are the major limitations of Game Theory?
- 3B Vehicles pass through a toll gate at a rate of 90 per hour. The average time to pass through the gate is 36 seconds. The arrival rate and service rate follow Poisson distribution. There is a complaint that the vehicles wait for long duration. The authorities are willing to install one more gate to reduce the average time to pass through the toll gate to 30 seconds if the idle time of the toll gate is less than 10% and the average queue length at the gate is more than 5 vehicles. Check whether the installation of the second gate is justified.
- 3C An oil company produces two grades of gasoline P and Q which it sells at Rs.30 and Rs.40 per litre. The company can buy four different crude oils with the following constituents and costs:

Crude Oil	Со	nstitue	Price/litre	
	А	В	(`)	
1	0.75	0.15	0.10	20.00
2	0.20	0.30	0.50	22.50
3	0.70	0.10	0.20	25.00
4	0.40	0.10	0.50	27.50

Gasoline P must have at least 55 percent of constituent A and not more than 40 percent of C. Gasoline Q must not have more than 25 percent of C Determine how the crudes should be used to maximize the profit.

4A Alpha logistic company has to load a cargo out of four items whose details are shown in Table 8.15. The maximum weight of the cargo is 7 tons. Find the optimal cargo loading using dynamic programming method such that the total return is maximized.

Item	1	2	3	4
Weight, w ₁ /unit (in tons)	2	1	4	3
Return,r ₁ /unit (in rupees)	1000	400	2100	1400

4B A company has 3 factories manufacturing the same product and 5 sale agencies in different parts of the country. Production costs differ from factory to factory and the sales prices from agency to agency. The shipping cost per unit product from each factory to each agency is known. Given the following data, find the production and distribution schedules most profitable to the company.

Factory	Production	Max.capacity (No.of units)
	Cost/unit (`.)	
1	18	140
2	20	190
3	16	115

Factory	1	2	2	6	10	5
	2	10	8	9	4	7
	3	5	6	4	3	8
Agency		1	2	3	4	5
Demand		74	94	69	39	119
Sales price (`)		35	37	36	39	34

How is Dynamic Programming different from Linear Programming? 5A

Construct the dual of the problem 5B

$$Max \ Z = 3x_1 + 10x_2 + 2x_3$$

S.t.
$$2x_1 + 3x_2 + 2x_3 \le 7$$

$$3x_1 - 2x_2 + 4x_3 = 3$$

$$x_1, x_2, x_3 \ge 0$$

5C The following table gives the activities in a construction project and other relevant information:

Activity	Immediate Predecessor(s)	Time	(days)	Direct C	Cost (`)
		Normal	Crash	Normal	Crash
А		4	3	60	90
В		6	4	150	250
С		2	1	38	60
D	A	5	3	150	250
E	С	2	2	100	100
F	A	7	5	115	175
G	D,B,E	4	2	100	240

Indirect costs vary as follows:

Days	15	14	13	12	11	10	9	8	7	6
Cost (Rs)	600	500	400	250	175	100	75	50	35	25

- (a) Draw an arrow diagram for the project(b) Determine the project duration which will return in minimum total project cost.