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5ʳᵈ SEMESTER **Course: B.Tech**

Delhi Technological University

END SEMESTER EXAMINATION (Supplementary)
FEB-2019

AE-309, Operations Research (Elective)

Time: 3:00 Hours   Max. Marks: 40

Note : Answer any FIVE questions.
All questions carry equal marks.
Assume suitable missing data, if any.

                                                    [2+2+4]

1. Write the dual of

(a) Maximize $Z = 3X_1 + 2X_2$
Subject to

$X_1 + X_2 \geq 1$
$X_1 + X_2 \leq 7$
$X_1 + 2X_2 \leq 10$
$X_2 \leq 3\; X_1, X_1, X_2 \geq 0$

(b) Maximize $Z = 5X_1 - 6X_2 + 4X_3$
Subject to

$3X_1 + 4X_2 + 6X_3 \geq 9$
$X_1 + 3X_2 + 2X_3 \geq 5$
$-7X_1 + 2X_2 + X_3 \geq -10$
$X_1 - 2X_2 + 4X_3 \geq 4$
$X_1, X_2, X_3 \geq 0$

(c) Solve the following LPP using simplex technique
Maximize $Z = 100X1 + 50X2 + 50X3$
Subject To

$4X_1 + 3X_2 + 2X_3 \leq 1000$
$3X_1 + 8X_2 + X_3 \leq 800$
$4X_1 + 2X_2 + X_3 \leq 600$
$X_1, X_2, X_3 \geq 0$

2. (a) When is dummy required in transportation problem? Find the basic feasible solution and its cost by i) northwest corner method, ii) Least cost method and iii) Vogel's approximation method for the following transportation table which shows cost in rupees for transporting 1 unit from factories to warehouses.

(b) A small project is composed of 7 activities whose time estimates are listed in the table below.

| Activity | Estimated duration (weeks) | | |
(i-j)	Optimistic	Most likely	pessimistic
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

(i)   Draw the network diagram of activities in the project.
(ii) Find the expected duration and variance of each activity.
      What is the expected project length?
(iii) Calculate the variance and standard deviation of the project length.

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(b) Consider the assignment problem shown in table below. In the problem 5 different jobs are to be assigned to 5 different machines such that the total processing time is to be minimized. The matrix entries represent processing times in hours. Solve above problem with Hungerian method. [4+4]

	1	2	3	4	5
1	20	24	30	24	16
2	14	32	28	28	22
3	26	28	14	18	18
4	24	20	22	26	20
5	16	26	30	22	30

Factories	Warehouses				
	A	B	C	D	Supply
X	2	3	11	7	6
Y	1	0	6	1	1
Z	5	8	15	9	10
Requirement	7	5	3	2	

3. (a) Explain the terms w.r.t. queuing theory i) Balking ii) Reneging iii) Jockeying.

(b) At a reservation counter, 20 customers arrive on average every 10 minutes. The clerk can serve 22 customers in 10 minutes. Find i) average number of customers in the system ,ii) average queue length and iii) average time a customer waits before being served. State assumption made for the probability distribution. [4+4]

4. (a) Solve the below game theory problem with the concept of dominance method.

PLAYER A	PLAYER B			
	I	II	III	IV
I	3	5	4	12
II	5	6	2	4
III	2	1	4	0
IV	3	3	5	2

(b) Determine the solution of game for the pay-off matrix given below using graphical technique. [4+4]

PLAYER A	PLAYER B		
	I	II	III
I	1	-3	7
II	4	-1	-2

5. (a) The initial cost of a machine is Rs 71000 and scrape value is Rs. 1000. The maintenance costs found from experience are as below. Find when should the machine be replaced?

Year	1	2	3	4	5	6	7	8
Maintenance	2000	3500	5000	7000	10000	13000	17000	21000

(b) What is the need for Replacement of any machine? A machine was purchased with initial investment of Rs 40000. The following is the data available.

Year	1	2	3	4	5	6
Operating & Maintenance cost per year in Rs	1400	1450	1510	1600	1720	1900
Salvage Value in Rs	35000	34000	32500	30500	28000	25000

What will be the expected life as per optimum replacement policy and the average annual cost during this period? [4+4]

6. (a) The following table gives the duration in days and the predecessor for the various tasks. Draw the AON diagram and find the minimum time for completion of the project. Also find the total float for each activity.

Task	A	B	C	D	E	F	G	H	I
Time(days)	8	10	8	10	16	17	18	14	9
predecessor	-	-	-	A	A	A	B,D	C	E,G