Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VI SEMESTER B. TECH (MECHANICAL ENGG.) END SEMESTER EXAMINATIONS, JUNE 2019

SUBJECT: 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.
- Use of statistical table is permitted

1A. A company has two grades of inspectors I & II to undertake quality inspection. At least 1,500 pieces must be inspected in an 8 hour day. Grade I inspector can check 20 pieces in an hour with an accuracy of 96%. Grade II inspector can check 14 pieces in an hour with an accuracy of 92%. Wages of grade I inspector is ₹100 per hour while that of grade II inspector is ₹80 per hour. Any error made by an inspector costs ₹60 to the company. If there are, in all, 10 grade I inspectors and 15 grade II inspectors in the company, formulate the LPP as to have the optimal assignment of inspectors that minimizes the daily inspection cost. Do not solve. **(5)**

1B. Solve the game for the pay-off given below. **(5)**

		Player B		
		b_1	b_2	b_3
Player A	a_1	2	3	-3
	a_2	4	-1	2
	a_3	6	2	5

Evaluate the following:

- Value of the game.
- Strategies of the players.

2A. In planning a project, a company lists the following various activities, their normal times and costs along with crash details. The indirect cost is ₹4000 per day. Crash the network by 3 days and find the percentage of savings/increase in the cost. **(5)**

Activity	Predecessor	Normal Duration (days)	Crash Duration (days)	Normal Cost (₹)	Crash Cost (₹)
A	-	7	5	5000	9000
B	A	4	2	4000	6000
C	A	5	5	5000	5000
D	A	6	4	8000	10000
E	B,C	7	4	7000	10000
F	C,D	5	2	8000	14000
G	E,F	6	4	8000	16000

2B. Solve the LPP given below: **(5)**

Min. $Z = 12x_1 + 8x_2 + 8x_3$

S.t, $4x_1 + 4x_2 + 4x_3 \geq 3$

$3x_1 + x_2 - 9x_3 \geq 2$

$x_1, x_2, x_3 \geq 0$

3A. Write the dual of the LPP given below: **(5)**

Max. $Z = 8x_1 + 10x_2 + 5x_3$

S.t, $x_1 - x_3 \leq 4$

$2x_1 + 4x_2 \leq 12$

$x_1 + x_2 + x_3 \geq 2$

$3x_1 + 2x_2 - x_3 = 8$

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

3B. A marketing manager wants to visit cities A, B, C and D and 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. Profit earned in ₹ lakhs by selling the products travelling from one city to another as per the average of previous visits is given in table below. How should he plan his journey? Use suitable algorithm. **(5)**

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

4A. Solve the transportation problem for minimum cost. Cost coefficient, supply and demand are given in table below. **(5)**

	D1	D2	D3	D4	Supply
S1	4	5	1	6	70
S2	5	7	3	4	38
S3	4	5	1	6	32
Demand	40	28	30	42	

4B. An agency is booking four groups, each of which would give one performance on a particular day. Because of local preferences of the people, the audience is expecting different audience sizes for different groups. Five major cities are under consideration of the agency. Considering the estimates of sales (in lakhs of rupees) likely to be made, what group-city combination would you advice? **(5)**

Group	City				
	C1	C2	C3	C4	C5
G1	58	56	21	50	45
G2	16	34	18	25	15
G3	39	44	30	64	36
G4	82	102	71	110	73

5A. A single window counter opens at 9 am. Customers arrive randomly at the counter with varied inter-arrival times as shown in the table below. Details of the survey conducted for 50 customers are given in the table below. Prepare a simulation chart using Monte Carlo Simulation for arrival. Find the average waiting time of customers. **(5)**

Random numbers: 6, 96, 64, 49, 24, 55, 60, 73, 33, 46

Inter-arrival time (minutes)	Frequency of occurrence
2	20
3	15
4	10
5	5

5B. The data for a network is given in the following table. **(5)**

Activity	Time duration (days)		
	Optimistic	**Pessimistic**	**Most Likely**
1-2	2	6	4
1-3	6	6	6
1-4	6	24	12
2-3	2	8	5
2-5	11	29	14
3-4	15	45	24
3-6	3	9	6
4-6	9	27	15
5-6	4	22	10

- Estimate the expected duration of the project and corresponding variance.
- What is the probability that the project duration will exceed 60 days?
- What should be the duration to have 95% probability of completion?