B. E. PRODUCTION ENGG. 3RD YEAR 1ST SEMESTER EXAMINATION 2019
OPERATIONS RESEARCH

Time : **Three hours**   Full marks: **100**

Question *No. 1* is compulsory. Answer any four from the rest.

1.(a)   Using a developed flowchart, explain the simplex method for solving LP problems.   (8)

(b)   Let there are two players (A and B) playing a game problem. Player A has 3 strategies and player B has 4 strategies. Develop a fair game for them. (You can assume any data).   (4)

(c)   State the limitations of a standard transportation model.   (4)

(d)   Enumerate the advantages and disadvantages of the Monte Carlo simulation model.   (4)

2.(a)   The security and traffic force, on the eve of Republic Day, must satisfy the staffing requirements as shown in the table. Officers work 8-hour shifts at each of the 4-hour intervals, as shown below. How many officers should report for duty at the beginning of each time period in order to minimize the total number of officers needed to satisfy the requirements? Formulate this problem as an LP model so as to determine the minimum number of officers required at beginning of each time period.   (6)

Time	0:01-4:00	4:01-8:00	8:01:12:00	12:01:16:00	16:01:20:00	20:01:24:00
No. of officers requirement	5	7	15	7	12	9

(b)   A company produces three products A, B and C. These products require three ores O_1, O_2 and O_3. The maximum quantities of the ores O_1, O_2 and O_3 available are 22, 14 and 14 tonnes, respectively. For one tone of each of these products, the ore requirements are:

	A	B	C
O_1	3	-	3
O_2	1	2	3
O_3	3	2	3
Profit per tonne (Rs. In thousands)	1	4	5

How many tones should the company produce in order to maximize its profit?   (14)

3.(a)   A and B play a game as follows: They simultaneously and independently write one of the three numbers 1,2 and 3. If the sum of the numbers written is even, B pays to A this sum in rupees. If it is odd, A pays the sum to B in rupees. Form the game problem and solve it.   (8)

(b)   A grocery with a bakery department is faced with the problem of deciding how many cakes it should buy in order to meet the day's demand. The grocer prefers not to sell day-old goods in competition with fresh products; leftover cakes are, therefore, a complete loss. On the other hand, if a customer desires a cake and all of them have been sold, the disappointed customer will buy from elsewhere and the sales will be lost. The grocer has, therefore, collected information on the past sales on a selected 100-day period as shown in table below:

Sales per day	No. of days	Probability
25	10	0.10
26	30	0.30
27	50	0.50
28	10	0.10

[Turn over

Construct the payoff table and the opportunity loss table. What is the optimal number of cakes that should be bought each day? Also find and interpret EVPI. One cake costs Rs. 4.80 and sells for Rs. 5. (12)

4.(a) State how a primal LP problem can be converted into a dual LP problem. (4)

(b) Write a short note on network analysis. (4)

(c) Solve the following all integer programming problem using the branch and bound method. (12)

Maximize $Z = 2x_1 + 3x_2$

Subject to the constraints

(i) $6x_1 + 5x_2 \leq 25$, (ii) $x_1 + 3x_2 \leq 10$ and $x_1, x_2 \geq 0$ and integers.

5.(a) A company has factories at F_1, F_2 and F_3 that supply products to warehouses at W_1, W_2 and W_3. The weekly capacities of the factories are 200, 160 and 90 units, respectively. The weekly warehouse requirements are 180, 120 and 150 units, respectively. The unit shipping costs (in Rs.) are as follows: (14)

Factory	Warehouse			Supply
	W_1	W_2	W_3	
F_1	16	20	12	200
F_2	14	8	18	160
F_3	26	24	16	90
Demand	180	120	150	450

Determine the optimal distribution for this company in order to minimize its total shipping cost.

(b) A warehouse has only one loading dock manned by a three person crew. Trucks arrive at the loading dock at an average rate of 4 trucks per hour and the arrival rate is Poisson distributed. The loading of truck takes 10 minutes on an average and can be assumed to be exponentially distributed. The operating cost of a truck is Rs. 200 per hour and the members of the loading crew are paid Rs. 60 each per hour. Would you advise the truck owner to add another crew of three persons? (6)

6.(a) A market survey is made on three brands of breakfast foods X, Y and Z. Every time the customer purchases a new package, he may buy the same or switch to another brand. The following estimates are obtained, expressed as decimal fractions: (14)

Present brand	Brand just purchased		
	X	Y	Z
X	0.7	0.2	0.1
Y	0.3	0.5	0.2
Z	0.3	0.3	0.4

At this time, it is estimated that 30% of the people buy brand X, 20% brand Y and 50% brand Z. What will be the distribution of customers, two time periods late, and at equilibrium?

(b) Citing real time examples, classify different types of integer programming problem. (6)

7. Two persons X and Y work on a two-station assembly line. The distributions of activity at their stations are: (20)

Time (in sec.)	Time frequency for X	Time frequency for Y
10	4	4
20	7	6
30	10	12
40	15	16
50	35	24
60	18	18
70	8	14
80	3	6

(a) Simulate operation of the line for eight items.

(b) Assuming Y must wait until X completes the first item before starting work, will he has to wait to process any of the other seven items? What is the average waiting time of the items? Use the following random numbers:

For X	83	70	06	12	59	46	54	04
For Y	51	99	84	81	15	36	12	54

(c) Determine the inventory of items between the two stations.

(d) What is the average production rate?