Ex/PG/ME/T/113H/24/2017

M. MECH. ENGG. 1ST SEM. EXAM. - 2017

Industrial Operations Research **Time: Three hours** **Full marks: 100**

Answer any five questions.

1. (a) The R &D department is planning to bid on a large project for the development of a new communication system for commercial planes. The accompanying table shows the activities, times, and sequence required.

Activity	A	B	C	D	E	F	G	H	I
Immediate Predecessor(s)	----	A	A	A	B	C,D	D,F	D	E,G,H
Time(weeks)	3	2	4	4	6	6	2	3	3

i. Draw the network based on activity-on-arrow.
ii. Determine the critical path.
iii. Suppose you want to shorten the completion time as much as possible, and have the option of shortening any or all of B, C, D, and G each two weeks. Which would you shorten?
iv. What is the new critical path and earliest completion time?

(b) Explain crash limit and reduction limit in network analysis. [14+6]

2. (a) Use the VAM, the lowest-cost method and the northwest-corner method to obtain the initial solution of the following transportation problem.

		To			Supply
		A	B	C	
From	X	6	18	8	100
	Y	17	13	19	60
	Z	20	10	24	40
Demand		50	80	70	

(b) Using stepping-stone method, find one improved solution to the solution of the northwest-corner method. [15+5]

3. (a) In an election campaign, the strategies adopted by the ruling party and opposition party along with payoffs ruling party's % share in votes polled are given below.

Ruling Party's strategies	Opposition Party's strategies		
	X	Y	Z
A	55	40	35
B	70	70	55
C	75	55	65

Assuming a zero-sum game, find the optimum strategies for both parties and expected payoff to the ruling party.

(b) Solve the following game.

$$\begin{array}{c} \\ A \end{array}\begin{array}{c} \begin{array}{cccc} B & & & \end{array} \\ \begin{bmatrix} 2 & 4 & 3 & 8 & 4 \\ 5 & 6 & 3 & 7 & 8 \\ 6 & 7 & 9 & 8 & 7 \\ 4 & 2 & 8 & 4 & 3 \end{bmatrix} \end{array}$$

[12+8]

4 (a) A manufacturing company is engaged in producing three types of products: A, B and C. The production department daily produces components sufficient to make 50 units of A, 25 units of B and 30 units of C. The management is confronted with the problem of optimizing the daily production of products in assembly department where only 100 man-hours are available to assemble the products. The following additional information is available.

Type of product	Profit contribution per unit of product (Rs.)	Assemble time per products (hrs)
A	12	0.8
B	20	1.7
C	45	2.5

The company has a daily commitment for 20 units of product A and a total of 15 units of B and C product. Formulate this problem as LP model.

(b) Find only the initial basic feasible solution (first tableau) of the above problem using Simplex algorithm.

(c) What is the use of the artificial variable in linear programming problem? [10+5+5]

5. (a) A service station has one gasoline pump. There is a room at the station for only three cars, including the car at the pump. Cars arriving when there are already three cars at the station drive on to another station. Use the following probability distributions to simulate the arrival of five cars to the service station.

Inter-arrival time (mins)	p(x)	Service time (mins)	p(x)
10	0.40	5	0.45
20	0.35	10	0.30
30	0.20	15	0.20
40	0.05	20	0.05

Use the random numbers sequence: 99, 73, 20, 85, 74, 41, 12, 13, 7, and 52. How many cars go to another station? What is the average time a car spends at the station?

(b) State three major reasons for using simulation in optimization problems. Generate three random numbers using arithmetic method based on recursion relation. [14+6]

6. (a) Two manufacturers A and B are competing with each other in a restricted market. Over the year, A's customers have exhibited a high degree of loyalty as measured by the fact that customers are using A's product 80 per cent of the time. Also former customers purchasing the product from B have switched back to A's product 60 per cent of the time.

i. Construct the state transition matrix.
ii. Calculate the probability of a customer purchasing A's product at the end of the second period.
iii. What will be the distribution of customers at equilibrium?

(b) What are the steps of MODI method in transportation problem? [10+10]

7. (a) A department has six employees with six jobs to be performed. The time (in hrs) each man will take to perform each job is given in the following matrix.

		Employees					
		1	2	3	4	5	6
Jobs	A	21	5	21	15	15	28
	B	30	11	16	8	16	4
	C	28	2	11	16	25	25
	D	19	16	17	15	19	8
	E	26	21	22	28	29	24
	F	3	21	21	11	26	26

How should jobs be allocated, one per employee, so as to minimize the total man-hours? Use Hungarian penalty method.

(b) Find the range of values for "p" and "q" that will render the entry (2, 2) a saddle point in the following game.

$$\begin{array}{c} \\ A \end{array} \begin{array}{c} \begin{array}{ccc} B & & \end{array} \\ \begin{pmatrix} 2 & 4 & 5 \\ 10 & 7 & q \\ 4 & p & 6 \end{pmatrix} \end{array}$$

[15+5]

END