Ex/PG/ME/T/113H/24/2018

M. MECH. ENGG. 1ST SEM. EXAM. - 2018 ,

Industrial Operations Research Time: Three hours Full marks: 100

Answer any four 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	3	4	6	7	3	4	3	4

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 the activity(s) each two weeks. Which would you shorten?
iv. What is the new critical path and earliest completion time?

(b) What are the probability distributions used in PERT analysis and why? [17+8]

2. (a) Use the VAM to obtain the initial solution of the following transportation problem.

		To			Supply
		A	B	C	
From	X	16	18	8	100
	Y	17	13	12	60
	Z	10	10	24	40
Demand		50	80	70	

(b) Using MODI method, find the optimal solution to the solution of the northwest-corner method.

(c) Explain degeneracy in a transportation problem. [10+10+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	45	40	35
B	65	60	55
C	75	55	70

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

(b) Solve the following game.

$$\begin{array}{c} \\ A \end{array}\begin{array}{c} \begin{array}{ccccc} & & B & & \end{array} \\ \begin{bmatrix} 2 & 5 & 3 & 8 & 4 \\ 5 & 6 & 3 & 6 & 8 \\ 6 & 7 & 10 & 8 & 7 \\ 4 & 2 & 8 & 4 & 3 \end{bmatrix} \end{array}$$

(c) Explain saddle point, mixed strategy and value of the game in game theory. [10+9+6]

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 and determine the entering and leaving variables. Complete solution is not required.

(c) Determine the dual of the following LPP.

Min $Z = x1 + x2 + x3$

Subject to: $x1 - 3x2 + 4x3 = 5$; $x1 - 2x2 \leq 3$; $2x2 - x3 \geq 4$

And $x1, x2 \geq 0$, $x3$ is unrestricted. [10+5+10]

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	0.40
20	0.30	10	0.35
30	0.25	15	0.20
40	0.05	20	0.05

Use the random numbers sequence: 50, 43, 20, 75, 64, 31, 12; 13, 57 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. [15 + 10]

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 70 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 stepping stone method in transportation problem?
   (c) What is iso-profit function approach in LPP? [15+5+5]

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) The following is a cost matrix for 3 strategies and 3 states of nature:

Strategy	States of Nature		
	N1	N2	N3
S1	40	60	20
S2	10	20	80
S3	-40	100	50

Select a strategy using the following criteria: (i) optimistic, (ii) pessimistic, (iii) minimax regret and (iv) Hurwicz criterion. [13+12]

END