

B. Mechanical Engineering 4th Year (2nd Semester) 2017

Operations Research (Elective III)

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

- Draw the network based on activity-on-arrow.
 - Determine the critical path.
 - 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?
 - What is the new critical path and earliest completion time?
- (b) What is the significance of a critical path in network analysis? [16+4]

2. A regional airline can buy its jet fuel from any one of three vendors. The airline's needs for the upcoming month at each of the three airports it serves are 100000 gal at airport 1, 180000 gal at airport 2, and 350000 gal at airport 3. Each vendor can supply fuel to each airport at a price (in cents per gallon) given by the following schedule.

	Airport 1	Airport 2	Airport 3
Vendor 1	92	89	90
Vendor 2	91	91	95
Vendor 3	87	90	92

Each vendor, however, is limited in the total number of gallons it can provide during any one month. These capacities are 320000 gal for vendor 1, 270000 gal for vendor 2, and 190000 gal for vendor 3. Use VAM to determine the total cost for a purchasing policy that will supply the airline's requirements at each airport. Test the optimality of the generated solution. [15 + 5]

3. (a) Consider a modified form of 'matching coins' game problem. The matching player is paid Rs 8, if the two coins turn both heads and Re 1 if the coins turn both tails. The non-matching player is paid Rs 3 when the two coins do not match. Given the choice of being a matching or non-matching player, which one would you choose and what would be your strategy?
- (b) Solve the following game.

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

[10+10]

4. (a) Consider the following linear programming problem:

$$\text{Maximize } Z = 30x_1 + 10x_2$$

$$\text{Subject to: } 3x_1 + x_2 \leq 300$$

$$x_1 + x_2 \leq 200$$

$$x_1 \leq 100$$

$$x_2 \geq 50$$

$$x_1 - x_2 \leq 0$$

$$\text{and } x_1, x_2 \geq 0$$

Solve the problem graphically. Is there more than one optimal solution? Justify.

- (b) Define the feasible region of a graphical LP problem

- (c) What is the use of an artificial variable in linear programming problem? [12+4+4]

5. (a) State three major reasons for using simulation in optimization problems.

- (b) Discuss Monte Carlo simulation with an example.

- (c) Generate three random numbers using arithmetic method based on recursion relation.

[5+10+5]

6. (a) Discuss Markov chains with an example.

- (b) Consider the queuing situation with one server in which arrivals occur at the rate $\lambda = 3$ per hour and service is performed at the rate $\mu = 8$ per hour. The probabilities p_n of n customers in the system are computed for the situation as given in the following table.

n	1	2	3	4	5	6	7	≥ 8
p_n	0.625	0.234	0.088	0.033	0.012	0.005	0.002	0

Compute the expected number in system and the expected number in the queue. [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?

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

$$A \begin{matrix} & \text{B} \\ \begin{pmatrix} 2 & 4 & 5 \\ 10 & 7 & q \\ 4 & p & 6 \end{pmatrix} \end{matrix}$$

[15+5]

8. (a) Discuss two criteria in decision making under uncertainty with the help of an example.

- (b) Discuss the decision tree with an example.

[10 + 10]

END