

(7 pages)

MAY 2012

P/ID 37508/PBAH

Time : Three hours

Maximum : 80 marks

PART A — (5 × 5 = 25 marks)

Answer any FIVE questions.

All questions carry equal marks.

1. List and explain the assumptions of operations research.
2. Give the mathematical model for the transportation problem.
3. Explain the cost trade-off in network crashing.
4. What is queueing system? Explain its components.
5. Consider the following payoff matrix with respect to Player A and solve it optimally.

		B	
		1	2
A	1	10	8
	2	6	12

6. Discuss the cost trade-off in determining the economic life of an asset.
7. A small manufacturer employs 5 skilled men and 10 semi-skilled men for making a product in two qualities: a deluxe model and an ordinary model. The production of a deluxe model requires 2-hour work by a skilled man and 2-hour work by semi-skilled man. The ordinary model requires 1-hour work by a skilled man and 3-hour work by a semi-skilled man. According to worker's union rules, no man can work more than 8 hours per day. The profit of the deluxe model is Rs.1000 per unit and that of the ordinary model is Rs.800 per unit. Formulate a linear programming model for this manufacturing situation to determine the production volume of each model such that the total profit is maximized.
8. Beta industry estimates that it will sell 24,000 units of its product for the forthcoming year. The ordering cost is Rs.150 per order and the carrying cost per unit per year is 20% of the purchase price per unit. The purchase price per unit is Rs.50. Find the economic order size, the number of orders per year and the time between successive orders.

PART B — (4 × 10 = 40 marks)

Answer any FOUR questions.

All questions carry equal marks.

9. Solve the following LP problem using Simplex method.

$$\text{Maximize } Z = 3x_1 + 2x_2 + 5x_3$$

Subject to

$$x_1 + x_2 + x_3 \leq 9$$

$$2x_1 + 3x_2 + 5x_3 \leq 30$$

$$2x_1 - x_2 - x_3 \leq 8$$

$$x_1, x_2 \text{ and } x_3 \geq 0$$

10. A college is having an undergraduate programme for which the effective semester time available is very less and the degree course requires field work. Hence, the savings in the total number of class hours handled can be utilized for such field work. Based on past experience, the college has established the number of hours required by each faculty to teach each subject. The course in its present semester has 4 subjects and the college has considered 6 existing faculty to teach these courses. The objective is to assign the best 4 teachers out of these 6 faculty to teach 4 different

subjects such that the total number of class hours required is minimized. The data for this problem is summarized below. Solve and optimize the assignment problem.

		Subject			
		1	2	3	4
Faculty	1	25	44	33	35
	2	33	40	40	43
	3	40	35	33	30
	4	44	45	28	35
	5	45	35	38	40
	6	40	49	40	46

11. Consider the following data of a project.

		Duration (weeks)		
Activity	Predecessor(s)	<i>a</i>	<i>m</i>	<i>b</i>
A	–	3	5	8
B	–	6	7	9
C	A	4	5	9
D	B	3	5	8
E	A	4	6	9
F	C,D	5	8	11
G	C,D,E	3	6	9
H	F	1	2	9

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[P.T.O.]

- (a) Construct the project network.
- (b) Find the expected duration and variance of each activity.
- (c) Find the critical path and expected project completion time.
- (d) What is the probability of completing the project on or before 30 weeks?

12. Following table gives the operation cost, maintenance cost and salvage value at the end of every year of a machine whose purchase value is Rs.20,000. Find the economics life of the machine assuming interest rate, $i = 15\%$.

End of year (n)	Operation cost at the end of year (Rs.)	Maintenance cost at the end of year (Rs.)	Salvage value at the end of year (Rs.)
1	2000	200	10000
2	3000	300	9000
3	4000	400	8000
4	5000	500	7000
5	6000	600	6000
6	7000	700	5000
7	8000	800	4000

End of year (n)	Operation cost at the end of year (Rs.)	Maintenance cost at the end of year (Rs.)	Salvage value at the end of year (Rs.)
8	9000	900	3000
9	10000	1000	2000
10	11000	1100	1000

13. Consider the following 3 machines and 5 jobs flow shop problem. Check whether Johnson's rule can be extended to this problem. If so, what is the optimal schedule and the corresponding makespan?

Job	Machine 1	Machine 2	Machine 3
1	11	10	12
2	13	8	20
3	15	6	15
4	12	7	19
5	20	9	7

14. Solve the following LP problem graphically.

$$\text{Maximize } Z = 20x_1 + 80x_2$$

Subject to

$$4x_1 + 6x_2 \leq 90$$

$$8x_1 + 6x_2 \leq 100$$

$$5x_1 + 4x_2 \leq 80$$

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

PART C — (1 × 15 = 15 marks)

Compulsory.

15. The arrival rate of breakdown machines at a maintenance shop follows Poisson distribution with a mean of 6 per hour. The service rate of machines by a maintenance mechanic also follows Poisson distribution with a mean of 4 per hour. The downtime cost per hour of a breakdown machine is Rs.300. The labour hour rate is Rs.60. Determine the optimal number of maintenance mechanics to be employed to repair the mechanics such that the total cost is minimized.
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