DECEMBER 2015

P/ID 77508/PMBH/ PMB1H/PMBSJ

Time : Three hours Maximum : 100 marks

PART A — (5 × 6 = 30 marks)

Answer any FIVE questions.

1. Give the applications of operations research.

2. Explain the following :

   (a) Artificial variable

   (b) Surplus variable

   (c) Unbounded solution in LPP.

3. 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.

4. Distinguish between CPM and PERT.

5. The arrival rate of customers at a banking counter follows Poisson distribution with a mean of 35 per hour. The service rate of the counter clerk also follows Poisson distribution with a mean of 50 per hour.

   (a) What is the probability of having 0 customer in the system (p_0)?

   (b) What is the probability of having 7 customers in the system (p_7)?

6. Discuss the applications of OR models in marketing.

7. List and explain the cost components of inventory control.

8. Find the optimum strategies of the players in the following game.

		Player B		
		1	2	3
Player A	1	35	20	45
	2	55	55	60
	3	60	30	50

PART B — (5 × 10 = 50 marks)

Answer any FIVE questions.

9. The manager of an oil refinery has to decide on the optimal mix of two possible blending processes. The inputs and outputs per production run of the blending process are as follows.

Process	Input		Output	
	Crude A	Crude B	Gasoline G_1	Gasoline G_2
1	5	3	5	8
2	4	5	4	4

The maximum amounts of availability of crude A and B are 200 units and 150 units, respectively. Market requirements show that at least 100 units of gasoline G_1 and 80 units of gasoline G_2 must be produced. The profits per production run from process 1 and process 2 are Rs. 3,00,000 and Rs. 4,00,000 respectively. Formulate this problem as a LP model to determine the number of production runs of each process such that the total profit is maximized.

10. A manufacturing company has three factories F1, F2 and F3 with monthly manufacturing capacities of 7000, 4000 and 10,000 units of a product. The product is to be supplied to seven stores. The manufacturing costs in these factories are slightly different but the important factor is the shipping cost from each factory to a particular store. The following table represents the factory capacities, store requirements and unit cost (in rupees) of shipping from each factory to each store. Here, slack is the difference between the total capacity and the total requirement. Find the optimal transportation plan so as to minimize the transportation cost.

		Stores							Factory capacity
		S1	S2	S3	S4	S5	S6	S7	
Factory	F1	5	6	4	3	7	5	4	7000
	F2	9	4	3	4	3	2	1	4000
	F3	8	4	2	5	4	8	3	10000
Store demand		1500	2000	4500	4000	2500	3500	3000	

11. 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 filed 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

12. Consider the details of a project as shown in the table :

Activity :	A	B	C	D	E	F	G	H	I	J
Immediate Predecessor (s)	–	–	–	A	A	B	B	C	C	D
Duration (months) :	4	8	5	4	5	7	4	8	3	6

Activity :	K	L	M	N	O	P	Q
Immediate Predecessor (s)	E	F	G	H	I	J, K, L	M, N, O
Duration (months) :	5	4	12	7	10	5	8

(a) Construct the network.

(b) Determine the critical path.

13. 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.

14. 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

15. The failure rate of 1000 bulbs in a colony are summarized in the following table :

End of month :	1	2	3	4	5	6
Probability of failure to date :	0.05	0.20	0.40	0.65	0.85	1.00

The cost of replacing an individual bulb is Rs. 60/-. If all the bulbs are replaced simultaneously it would cost Rs. 25/- per bulb. Any one of the following two options can be followed to replace the bulbs.

(a) Replace all bulbs individually when they fail (Individual replacement policy).

(b) Replace all the bulbs simultaneously at fixed intervals and replace the individual bulbs when they fail in service during the fixed interval (Group replacement policy).

Find out the optimal replacement policy, i.e. individual replacement or group replacement policy? If group replacement policy is optimal, then find at what equal intervals should all the bulbs be replaced?

16. Consider the following 4 × 4 game played by Players A and B and solve it optimally.

		Player B			
		1	2	3	4
Player A	1	12	4	8	16
	2	4	–2	2	24
	3	4	6	6	18
	4	10	4	12	20

PART C — (20 marks)

Compulsory

17. Consider the data of project as shown in the following table. If the indirect cost per week is Rs. 300, find the optimal crashed project completion time

Activity	Normal Time (weeks)	Normal cost (Rs.)	Crash Time (weeks)	Crash cost (Rs.)
1-2	8	800	5	950
1-3	5	500	3	700
1-4	9	600	6	1050
2-5	10	900	8	1300
3-5	5	700	3	1100
3-6	6	1200	5	1500
4-6	7	1300	5	1400
5-7	2	400	1	500
6-7	4	500	2	900