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T 3338

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Sixth Semester

Mechatronics Engineering

ME 1018 — OPERATIONS RESEARCH

(Regulation 2004)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the general methods to solve operations research models?

2. How do you identify infeasibility in LPP from the simplex table?

3. How do you resolve degeneracy in a transportation model?

4. Write the linear programming form of the assignment model.

5. What are the rules for constructing project network?

6. How uncertainty can be incorporated in PERT model?

7. Define Kendall's notation to specify the queuing system.

8. Write the elements of the following waiting line system: University. Assembly line.

9. Define economic life of an equipment.

10. Consider the following 2 machines and 5 jobs flow shop scheduling problem. Using Johnson's algorithm, obtain the optimal sequence which will minimize the makespan.

Job i	1	2	3	4	5
Machine 1	7	1	15	2	11
Machine 2	8	4	12	5	6

PART B — (5 × 16 = 80 marks)

11. (a) A company manufacturers and sells two products A and B. each unit of A requires 1 hour of machining and 2 hours of skilled labour, whereas each unit of B uses 2 hours of machining and 1 hour of labour. For the coming month the machine capacity is limited to 720 machine-hours and the skilled labour is limited to 780 hours. Not more than 320 units of B can be sold in the market during a month.

    (i) Develop a suitable model that will enable determination of the optimal product-mix. (6)

    (ii) Determine the optimal product mix and the maximum contribution. Unit contribution for A is Rs. 6 and from B is Rs. 4. (5)

    (iii) What will be the incremental contribution per unit of machine-hour, per unit of labour, per unit of A saleable? (5)

Or

(b) A toy company manufactures two types of doll, a basic version-doll A and a deluxe version-doll B. Each type of doll B takes twice as long to produce as one of type A, and the company would have time to make a maximum of 2000 per clay. The supply of plastic is sufficient to produce 1500 dolls per day of both A and B. The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs. 3 and Rs. 5 per doll, respectively on doll A and B, then how many of each doll should be produced per day in order to maximize the total profit. Formulate this problem as LPP and solve.

12. (a) A leading firm has three auditors. Each auditor can work up to 160 hours during the next month, during which time three projects must be completed. Project I will take 130 hours. Project 2 will take 140 hours, and project 3 will take 160 hours. The amount per hour that can be billed for assigning each auditor to each project is given in the following table:

Project (Rs.)

Auditor	1	2	3
1	1200	1500	1900
2	1400	1300	1200
3	1600	1400	1500

Formulate this as a transportation problem and find the optimal solution. Also find out the maximum total billings during next month.

Or

(b) A college is having a degree programme for which the effective semester time available is very easy and the programme requires filed work. Hence a few hours can be saved from the total number of class hours, and can be utilized for the field work. Based on the past experience, the college has estimated he number of hours required to teach each subject by each faculty. The course in its present semester has 5 subjects and the college has considered 6 existing faculty members to teach these courses. The objective is to assign the best 5 teachers out of these 6 faculty members to teach 5 different subjects so that the total number of class hours required is minimized. Solve the assignment problem optimally.

		Subject				
		1	2	3	4	5
	1	30	39	31	38	40
	2	43	37	32	35	38
Faculty	3	34	41	33	41	34
	4	39	36	43	32	36
	5	32	49	35	40	37
	6	36	42	35	44	42

13. (a) Consider the details of a distance network as shown below :

Arc	1–2	1–4	1–5	2–3	2–4	3–4	3–6	4–5	4–6
Distance	4	2	3	6	6	5	9	4	8

Arc	4–7	5–7	5–8	6–7	6–10	7–8	7–9	8–9	9–10
Distance	10	5	7	3	6	1	3	2	5

(i) Construct the distance network

(ii) Find the minimum spanning tree.

Or

(b) A project has twelve distinct activities which are to be further analyzed by using PERT. The following relevant information is also given in tabular form :

Activity	Predecessor activity	Most optimistic time (days)	Most likely time (days)	Most pessimistic time (days)
A	–	2	2	2
B	–	1	3	7
C	A	4	7	8
D	A	3	5	7
E	B	2	6	9
F	B	5	9	11
G	C, D	3	6	8
H	E	2	6	9
I	C, D	3	5	8
J	G, H	1	3	4
K	F	4	8	11
L	J, K	2	5	7

(i) Present these activities on PERT network

(ii) Find out expected total float for each activity and determine the critical path.

(iii) Within how many days would you expect the project to be completed with 99% chance?

14. (a) An electronic equipment contains 1000 resistors. When any resistor fails, it is replaced. The cost of replacing a resistor individually is Rs. 8. If all the resistors are replaced at the same time; the cost per resistor is Rs. 2. The percent surviving, $S(i)$ at the end of month i is given below.

i	0	1	2	3	4	5	6
$S(i)$	100	96	89	68	37	13	0

What is the optimum replacement plan?

Or

(b) Consider the following flow shop scheduling problem :

Job	Processing time		
	m/c–1	m/c–2	m/c–3
1	3	4	10
2	11	1	5
3	7	9	13
4	10	12	2

What is the optimal schedule and the corresponding makespan? Draw Gantt chart for the optimal schedule.

15. (a) In a transport company, trucks of the company arrive at a transshipment yard for unloading in a pattern which is characterized by the Poisson distribution. The average rate of arrivals is 5 per hour. A batch of loadmen unloads the parcels from the trucks and the level of service is 8 trucks per hour on an average. The driver is paid Rs. 100 per shift of 8 hours and the batch of loadmen are paid Rs.72 per shift of 8 hours.

(i) How much expense on average incurred by the company for idle time on the part of each driver each time he is at the transshipment yard?

(ii) Find the optimal number of batches of loadmen to be employed for transshipment.

Or

(b) On an average 96 patients per 24-hour day require the service of an emergency clinic. Also on average, a patient requires 10 minutes of active attention. Assume that the facility can handle only one emergency at a time. Suppose that it costs the clinic Rs.100 per patient treated to obtain an average servicing time of 10 minutes, and that each minute of decrease in this average time would cost Rs. 10 per patient treated. How much would have to be budgeted by the clinic to decrease the average size of the queue to $\frac{1}{2}$ patient?