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18MT821

Eighth Semester B.E. Degree Examination, July/August 2022
Operations Research

Time: 3 hrs.

Max. Marks: 100

Note: **1.** *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Missing data if any may be suitably assumed and specified.*

Module-1

1 a. Define operation research and state the applications of operation research. **(05 Marks)**

b. A toy company manufactures two types of doll, a basic version – doll A and a deluxe version doll B. Each doll of type 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 dya. The supply of plastic is sufficient to produce 1500 dolls per day (both A and B combined). The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs.3.00 and Rs.5.00 per doll respectively on doll A and doll B, then how many of each doll should be produced per day in order to maximize the total profit. Formulate this problem. **(08 Marks)**

c. Solve the following Linear programming (L.P.) problem graphically,

Maximize $Z = 3x_1 + 5x_2$,

Subjected to constraints,

$$x_1 + 2x_2 \leq 2000,$$
$$x_1 + x_2 \leq 1500,$$
$$x_2 \leq 600 \text{ and}$$
$$x_1 \geq 0, \ x_2 \geq 0$$

(07 Marks)

OR

2 a. Explain the steps involved in the solution of an operation research problem. **(06 Marks)**

b. Solve the following LPP by simplex method:

Maximize $z = 22x + 30y + 25z$

Constraints $2x + 2y \leq 100$
$$2x + y + z \leq 100$$
$$x + y + z \leq 100$$
$$x, y, z \geq 0$$

(14 Marks)

Module-2

3 a. List the various methods that can be used for obtaining an initial basic feasible solution for a transportation problem and describe any one of them. **(05 Marks)**

b. Determine the optimum basic feasible solution to the following transportation problem:

(15 Marks)

Warehouse→ Factory↓	W_1	W_2	W_3	W_4	Available
F_1	19	30	50	10	7
F_2	70	30	40	60	9
F_3	40	8	70	20	18
Warehouse requirement	5	8	7	14	

OR

4 a. What is degeneracy problem in transportation and explain how to resolve degeneracy during initial stage? **(04 Marks)**

b. A company has three plants A, B, and C and three warehouses X, Y, and Z. Number of units available at plants is 60, 70 and 80 respectively. Demands at X, Y and Z are 50, 80 and 80 respectively unit transportation costs are given in below Table Q4(b). What would be your transportation plan and find minimum distribution cost.

		Warehouse		
		X	Y	Z
	A	8	7	3
Plants	B	3	8	9
	C	11	3	5

Table Q4(b) **(16 Marks)**

Module-3

5 a. Explain Fulkerson's for node numbering with the suitable network. **(05 Marks)**

b. Task A, B, C - - - - - H, I constitute a project, the precedence relationship are $A < D$; $A < E$; $B < F$; $D < F$; $C < G$; $C < H$; $F < I$; $G < I$. Draw a network to represent the project and find the minimum time of completion of the project when time, in days of each task is as follows :

Task	A	B	C	D	E	F	G	H	I
Time	8	10	8	10	16	17	18	14	9

Calculate total float for each activity and identify critical path. **(15 Marks)**

OR

6 a. A project is represented by the network shown below Fig. Q6(a) and has the following data given below Table Q6(a). Determine expected time and their variance. Find the probability of node occurring at the proposed completion date if the original contract time of completing the project is 41.5 weeks, earliest expected to reach each node and slack.

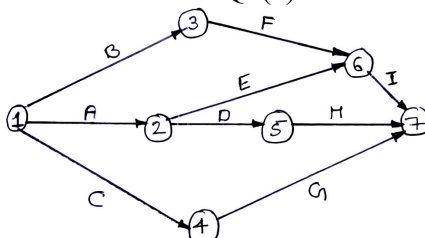| Task	A	B	C	D	E	F	G	H	I
Least time	5	18	26	16	15	6	7	7	3
Pessimistic time	10	22	40	20	25	12	12	9	5
Most likely time	8	20	33	18	20	9	10	8	4

Table Q6(a)

Fig.Q6(a) **(20 Marks)**

Module-4

7 a. Explain queuing system and its characteristics. **(07 Marks)**

b. Vehicles are passing through a toll gate at the rate of 70 per hour. The average time to pass through the gate in 45 seconds. The arrival rate and service rate follow the Poisson distribution. There is a complaint that the vehicles wait for a long duration. The authorities are willing to install one or more gate to reduce the average time to pass through the toll gate to 35 seconds. If the idle time of the toll gate is less than 9% and the average queue length at the gate is more than 8 vehicles, check whether the installation of 2nd gate justified? **(13 Marks)**

OR

8 a. TV repairman finds that the time spent on his jobs has an exponential distribution with mean 30 minutes. IF he repairs sets in the order in which they come in, and if the arrival of sets is approximately Poisson with an average rate of 10 per 8–hour day. What is repairman's expected idle time each day? How many jobs are ahead of the average set just brought in? **(10 Marks)**

b. At what average rate must a clerk at a super market work in order to ensure a probability of 0.90 that the customer will not have to wait longer than 12 minutes? It is assumed that there is only one counter to which customers arrive in Poisson fashion at an average rate of 15 per hour. The length service by the clerk has an exponential distribution. **(10 Marks)**

Module-5

9 a. Solve the following game, using the concept of dominance.

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="4">Player B</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td rowspan="4">Player A</td><td>1</td><td>3</td><td>2</td><td>4</td><td>0</td></tr>
<tr><td>2</td><td>2</td><td>4</td><td>2</td><td>4</td></tr>
<tr><td>3</td><td>4</td><td>2</td><td>4</td><td>0</td></tr>
<tr><td>4</td><td>0</td><td>4</td><td>0</td><td>9</td></tr>
</table>

(10 Marks)

b. Solve the following game by applying graphical method.

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="4">Player B</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td rowspan="2">Player A</td><td>1</td><td>2</td><td>2</td><td>3</td><td>−1</td></tr>
<tr><td>2</td><td>4</td><td>3</td><td>2</td><td>6</td></tr>
</table>

(10 Marks)

OR

10 a. The processing times of 6 jobs on 3 machines M_1, M_2 and M_3 are given below. Find the idle time for machines.

Job	1	2	3	4	5	6
M_1	3	12	5	2	9	11
M_2	8	6	4	6	3	1
M_3	13	14	9	12	8	13

(10 Marks)

b. Using the graphical method, determine the optical sequence needed to process jobs 1 and 2 on 5 machines A, B, C, D and E. For each machine find the job which should be done first. Also calculate the total time needed to complete both jobs.

Job 1	Sequence	A	B	C	D	E
	Time (Hrs)	1	2	3	5	1
Job 2	Sequence	C	A	D	E	B
	Time (Hrs)	3	4	2	1	5

(10 Marks)

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