Enrollment No.: _____

Darshan Institute of Engineering & Technology
B.Tech. | Sem-7 | Winter-2024

Course Code	:	2101CS733	**Date**	:	24-10-2024
Course Name	:	Operation Research	**Duration**	:	150 Minutes
			Total Marks	:	70

Instructions:
1. Attempt all the questions.
2. Figures to the right indicates maximum marks.
3. Make suitable assumptions wherever necessary.

Q.1 **(A)** Explain different phases of Operations Research. **4**

(B) Explain the set of assumptions for Linear Programming Problem. **3**

OR

Explain any three applications of Operation Research in brief.

(C) Use Simplex method to solve the following linear programming problem: **7**

Maximize, $Z = 4x_1 + 3x_2$

Subject to the constraints, $2x_1 + x_2 \leq 1000,$
$x_1 + x_2 \leq 800,$
$x_1 \leq 400,$
$x_2 \leq 700,$
$x_1, x_2 \geq 0.$

OR

Use Big-M method to solve the following linear programming problem:

Minimize, $Z = 3x_1 + 8x_2$

Subject to the constraints, $x_1 + x_2 = 200,$
$x_1 \leq 80$
$x_2 \geq 60,$
$x_1, x_2 \geq 0.$

Q.2 **(A)** A firm owns facilities at seven places. It has manufacturing plants at places A, B and C with daily output of 500, 300 and 200 units of an item respectively. It has warehouses at places P, Q, R and S with daily requirements of 180, 150, 350 and 320 units respectively. Per unit shipping charges on different routes are given below: **4**

To:	**P**	**Q**	**R**	**S**
From A:	12	10	12	13
From B:	7	11	8	14
From C:	6	16	11	7

The firm aims to minimize transportation costs when sending output from plants to warehouses. Obtain Initial Feasible Solution by Least Cost Method.

(B) Explain a linear programming model of the transportation problem. **3**

OR

Explain degeneracy in transportation problem? How can you solve it?

(C) Agro-product collection centers A, B, C and D stock wheat. The stock levels at A, B, C and D are 100, 150, 200, 150 tonnes respectively. The requirement of wheat at three distribution center X, Y and Z is 150, 250 and 200 tonnes respectively. The costs of transportation from collection center to distribution center in Rs. per tonne of wheat are: **7**

CAX = 10, CAY = 15, CAZ = 15, CBX = 15, CBY = 15, CBZ = 10
CCX = 12, CCY = 10, CCZ = 13, CDX = 10, CDY = 15, CDZ = 12
Obtain optimal solution by Modified Distribution Method.

OR

Find the optimum solution to the following transportation problem in which the cells contain the transportation cost in rupees.

	W_1	W_2	W_3	W_4	W_5	Available
F_1	7	6	4	5	9	40
F_2	8	5	6	7	8	30
F_3	6	8	9	6	5	20
F_4	5	7	7	8	6	10
Required	30	30	15	20	5	

Q.3 **(A)** A project manager needs to assign four critical tasks to four software engineers. Each engineer can be assigned only one task. The time required by each engineer to complete each task is given in a matrix in hours. The objective is to assign the tasks to the engineers in a way that minimizes the total completion time. **4**

Engineers	Tasks			
	1	**2**	**3**	**4**
1	15	13	14	17
2	11	12	15	13
3	13	12	10	11
4	15	17	14	16

(B) How would you deal with assignment problems, where (a) the objective function is to be maximized? (b) Some assignments are prohibited? **3**

OR

Distinguish between Transportation model and Assignment model.

(C) Five wagons are available at stations 1, 2, 3, 4 and 5. These are required at five stations I, II, III, IV and V. The mileages between various stations are given by the Table 2. How should the wagons be transported so as to minimize the total mileage covered? **7**

	I	**II**	**III**	**IV**	**V**
1	10	5	9	18	11
2	13	9	6	12	14
3	3	2	4	4	5
4	18	9	12	17	15
5	11	6	14	19	10

OR

A travelling salesman has to visit five cities. He wishes to start from a particular city, visits each city once and then returns to his starting point. The travelling time (in hrs.) for each city from a particular city is given in table. What is the sequence of visits of the salesman, so that total travel time is minimum?

From	To				
	A	**B**	**C**	**D**	**E**
A	∞	4	7	3	4
B	4	∞	6	3	4
C	7	6	∞	7	5
D	3	3	7	∞	7
E	4	4	5	7	∞

Q.4 **(A)** Find optimal strategies and value of the game in the following pay-off matrix: **4**

		Y			
		A	B	C	D
X	I	3	4	2	9
	II	7	8	6	10
	III	6	2	4	-1

(B) What is strategy, pure strategy and mixed strategy? **3**

OR

Draw a basic queuing system diagram and label its key elements.

(C) Find optimal strategies and value of the game in the following pay-off matrix: **7**

		B	
		I	II
A	I	-2	3
	II	4	-1

OR

A self-service store employs one cashier at its counter, 9 customers arrive on an average every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service time, find

1. Average number of customers in the system.
2. Average number of customers in the queue.
3. Average time a customer spends in the system.
4. Average time a customer waits before being served.

Q.5 **(A)** Draw a network corresponding to the following information. **4**

Activity	Predecessors	Description
A	-	Locate facility
B	A	Order furniture
C	F	Interview
D	-	Hire & Train
E	A	Remodel
F	B	Furniture setup
G	D,E,F	Move in

(B) Discuss the differences between PERT and CPM. **3**

OR

Discuss the 3 time estimates used with reference of PERT. How are the expected duration of a project, and its standard deviation calculated?

(C) A small project is composed of 7 activities whose time estimates are listed in the table below. Activities are identified by their beginning and ending node numbers. **7**

Activity		1-2	1-3	1-4	2-5	3-5	4-6	5-6
Time Estimates (Weeks)	Optimistic	1	1	2	1	2	2	3
	Most Likely	1	4	2	1	5	5	6
	Pessimistic	7	7	8	1	14	8	15

1. Draw the project network.
2. Find the expected duration and variance for each activity.
3. What is the expected project length and standard deviation?

OR

Tasks A, B, C,…..,H, I constitute a project. The precedence relationships are

$$\boldsymbol{A < D};\ \boldsymbol{A < E};\ \boldsymbol{B < F};\ \boldsymbol{D < F};\ \boldsymbol{C < G};\ \boldsymbol{C < H};\ \boldsymbol{F < I};\ \boldsymbol{G < I}.$$

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

***