B.E. Sem VIII Mechanical Engineering
Subject :- OR
Gujarat University
Question Bank

1.	Explain significance of any two assumptions of Linear Programming Problem (LPP).
2.	A small fabrication industry is faced with a problem of scheduling production and subcontracting for three products A, B and C. Each product requires casting, machining and assembly operations. Casting operation for product A and B can be subcontracted but product C requires special tooling hence it can not be subcontracted. Each unit of product A, B and C requires 6, 10 and 8 minutes of casting time in the foundry shop of a company. Machining times per unit of products A, B and C are 6, 3 and 8 minutes while assembly times are 3, 2 and 2 minutes respectively. The time available per week in foundry, machining and assembly shop are 8000, 12000 and 10000 minutes respectively. If product A, B and C are produced completely in the company, the overall profits per unit of product are Rs. 700, Rs. 1000 and Rs. 1100 respectively. When castings are obtained from subcontractors, the profit per unit of product A and B are Rs. 500 and 900 respectively. Formulate above problem as LPP so as to maximize the profit for company by scheduling its production and subcontracting.
3.	Solve the following LPP using Simplex method; $Maximize\ (Z) = 6x_1 + 4x_2$ subject to $2x_1 + 3x_2 \le 30;\quad 3x_1 + 2x_2 \le 24;\quad x_1 + x_2 \ge 3$ $x_1, x_2 \ge 0$

4.	A transport company has 5, 10, 7 and 3 trucks available at four different sites A, B, C and D. Its customers have requirement of 5, 8 and 10 trucks at three different destinations X, Y and Z respectively. The distance (in kms.) from an origin to destination is summarized in following table.

	Customers		
Sites	X	Y	Z
A	70	30	60
B	40	60	80
C	50	80	40
D	80	40	30

Formulate above problem as a transportation problem and determine strategy for a company using VAM. Test the optimality of VAM solution and determine optimum strategy for the transport company.

5.	What do you mean by Infeasibility and Unboundness in LPP? How are the following issues identified from the simplex tableau?

6.	Construct the dual of following Primal Problem;

$$Minimize\ (Z)=5x_1-6x_2+4x_3$$

subject to

$$3x_1+4x_2+6x_3 \geq 9; \quad x_1+3x_2+2x_3 \geq 5; \quad 7x_1-2x_2-x_3 \leq 10$$

$$x_1-2x_2+4x_3 \geq 4; \quad 2x_1+5x_2-3x_3 = 3; \quad x_1,x_2,x_3 \geq 0$$

7.	The captain of a cricket team has to allot five middle order batting positions to six batsmen available for selection. The average runs scored by each batsmen at these positions are summarized in a table below

	Batting Position				
Batsman	III	IV	V	VI	VII
A	40	40	35	25	50
B	42	30	16	25	27
C	50	48	40	60	50
D	20	19	20	18	25
E	58	60	59	55	53
F	45	52	38	50	49

Using Assignment model, determine the assignment of batsmen to positions which would give maximum runs in favor of team. Which batsmen will not qualify for selection based on the solution obtained?

| 8. | Following failure rates have been observed for certain type of light bulbs; |

Month	1	2	3	4	5
Percentage of items failing by end of month	10	25	50	80	100

There are total 1000 bulbs in use and it costs Rs. 10 to replace an individual bulb which has fused out. If all bulbs are replaced simultaneously, it would cost Rs. 4 per bulb. Two policies are being considered for replacement of bulbs; First, replace all bulbs simultaneously at fixed interval whether failed or not and do individual replacement in intermediate periods. Secondly, individual replacement of bulbs as and when it fails. Determine the optimum policy for replacement of bulbs based on above failure data and costs.

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9. 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.

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

    i. Draw the project network.
    ii. Find the expected duration and variance for each activity.
    iii. What is the expected project length and standard deviation?

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10. The time estimates and precedence relationships of different activities constituting a small construction project is given in following table;

Activity	A	B	C	D	E	F	G	H	I
Predecessor	-	-	B	B	A	A	F	C, E, G	F
Duration (days)	3	8	6	5	13	4	2	6	2

    i. Draw the project network.
    ii. Determine project completion time.
    iii. What is critical path?

11.	A solicitors' firm employs typists on hourly piece-rate basis for daily work. There are five typists available with hourly charges and speed mentioned in table below.

Typist	A	B	C	D	E
Rate per hour (Rs.)	5	6	3	4	4
No. pages typed/hour	12	14	8	10	11

There are five jobs available to the firm and it wishes to allocate one job to one typist only. The typist is paid for full hour even if he works for fraction of an hour. The details of job are given in table below.

Job	P	Q	R	S	T
No. of Pages	199	175	145	298	178

Find least cost allocation for the firm using Assignment model.

12.	Discuss the Various phases in solving an Operation Research model
13.	Use the graphical method to solve the following LP problems

Maximize $Z = 2X_1 + X_2$

Subject to the constraints:

$X_1 + 2X_2 <= 10$

$X_1 + X_2 <= 6$

$X_1 - X_2 <= 2$

$X_1 - 2X_2 <= 1$

and $X_1, X_2 >= 0$

14.	An advertising company wishes to plan an advertising campaign in three different media: television, radio and a magazine. The purpose of the advertising is to reach as many potential customers as possible.Following are the result of a market study:

	Television		Radio Rs.	Magazine Rs.
	Prime Day Rs.)	Prime Time Rs.		
Cost of an advertising unit	40,000	75,000	30,000	15,000
Nuber of potential customers reached /unit	4,00,000	9,00,000	5,00,000	2,00,000
Number of Women customers reached /unit	3,00,000	4,00,000	2,00,000	1,00,000

The company does not want to spend more than Rs.8,00,000 on advertising. It is further required that
(i) at least 20,00,000 exposures take place among women
(ii) advertising on television be limited to Rs. 5,00,000
(iii) at least 3 advertising units be bought on prime day and two units during prime time; and (iv) the number of advertising units on radio and magazine should each be between 5 and 10. Formulate this problem as an L.P. model to maximize potential customer reach

15.	State the general rules for formulating a dual LP problem from its primal Write the dual to the following LP problem.

Maximize $Z = X_1 - X_2 + 3X_3$
Subject to Constraints
$X_1 + X_2 + X_3 \leq 10$
$2X_1 - 0X_2 - X_3 \leq 2$
$2X_1 - 2X_2 - 3X_3 \leq 6$
and $X_1, X_2, X_3 \geq 0$

16.	Use the simplex method to solve the following L.P. problem Max (Total Profit) $Z = 4X_1 + 3X_2$ Subject to Constraints $2X_1 + X_2 \le 1000$ $X_1 + X_2 \le 800$ $X_1 \le 400$ $X_2 \le 700$ and $X_1, X_2 \ge 0$
17.	Explain in brief the main characteristics of the queuing system
18.	A computer centr has three expert programmers. The centre wants three application programmes to be developed. The head of the computer centre, after studying carefully the programmes to be developed,estimates the computer time in minutes required by the experts for the application programmes as follows.

Programmes	Programmers		
	A	B	C
1	120	100	80
2	80	90	110
3	110	140	120

Assign the programmers to the programmes in such a way that the total computer time is minimum

19.	A firm is considering replacement of a machine, whose cost price is Rs. 12,200 and the scrap value Rs. 200. The running costs are found from experience to be as follows.

Year	1	2	3	4	5	6	7	8
Running Cost Rs.	200	500	800	1,200	1,800	2,500	3,200	4,000

When should the machine be replaced?

20.	What is degeneracy in transportation problems? Explain how to resolve degeneracy in a transportation problem

| 21. | A company has factories at F1, F2 and F3 which supply to warehouses at W1, W2, W3. Weekly factory capacities are 200 ,160 and 90 units, respectively. Weekly warehouses requirement are 180,120 and 150 units, respectively. Unit shipping costs(in Rs.) are as follows. Determine the optimal distribution to minimize total transportation cost |

Factory	Warehouse			
	W1	W2	W3	Supply
F1	16	20	12	200
F2	14	8	18	160
F3	26	24	16	90
Demand	180	120	150	450

| 22. | Listed in the table are the activities and sequencing necessary for a maintenance job on the heat exchangers in a refinery. Draw a network diagram for the project. |

Activity	Description	Predecessor Activity
A	Dismantle pipe connections	-
B	Dismantle heater ,closure, and floating front	A
C	Remove tube bundle	B
D	Clean bolts	B
E	Clean heater and floating head front	B
F	Clean tube bundle	C
G	Clean shell	C
H	Replace tube bundle	F, G
I	Prepare shell pressure test	D,E,H
J	Prepare tube pressure test and reassemble	I

23.

(i) Find the maximum value of following LPP using graphical approach

$$Z = -x_1 + 2x_2$$
$$S/t, \; -x_1 + 3x_2 \le 10$$
$$x_1 + x_2 \le 6$$
$$x_1 - x_2 \le 2$$
$$x_1 \text{ and } x_2 \ge 0$$

24. Write note on scope of Operation research in the various sector.

25.	Solve following LPP using Penalty method
	$$\text{Maximize} \quad Z = 3x_1 - x_2$$ $$S/t, \quad 2x_1 + x_2 \le 2$$ $$x_1 + 3x_2 \ge 3$$ $$x_2 \le 4$$ $$x_1 \text{ and } x_2 \ge 0$$
26.	A firm manufactures two product A & B on which the profit earned per unit are Rs. 3 and Rs.4, respectively. Each product is processed on two machines M1 and M2. Product A requires one minute of processing time on M1 and two minutes on M2, while product B requires one minute of processing time on M1 and one minute on M2. Machine M1 is available for not more than 7 hrs and 30 minutes, while machine M2 is available for 10hrs during any working day. Find (i) Formulate the problem as LPP
27.	Find the optimal solution of the following Transportation problem using MODI method. Use VAM to find IBFS.

	M1	M2	M3	M4	Supply
F1	3	2	4	1	20
F2	2	4	5	3	15
F3	3	5	2	6	25
F4	4	3	1	4	40
Demand	30	20	25	25	

28.	A machine cost Rs 500. Operation and maintenance cost are zero for the first year and increases by Rs. 100 every year. If money is worth 5% every year, determine the best age at which the machine should be replaced. The resale value of the machine is negligibly small. What is the weighted average cost of owning and operating the machine?

29.	The details of activity in project management are given below.

Activity	Normal		Crash	
	Time (Days)	Cost (Rs.)	Time (Days)	Cost (Rs.)
1-2	3	300	2	400
2-3	6	480	4	520
2-4	7	2100	5	2500
2-5	8	400	6	600
3-4	4	320	3	360
4-5	5	500	4	520

Find (i) Critical path & Project duration
(ii) Optimum project cost with considering indirect cost is 100 Rs.er day.

30.	(I) The details of activity and duration are shown below.

Activity	Immediate predecessor activity	Duration (Days)
A	-	10
B	A	5
C	A	4
D	A	7
E	B, C	6
F	C, D	4
G	E, F	7

Find
(i)   Draw a network
(ii)   Find the critical path
(iii)   Project duration
(II)   What is the meaning float in project management? State the various types float.

31.	The DREAM - DRINK Company has to work out a minimum cost transportation schedule to distribute crates of drinks from three of its factories X, Y, and Z to its three warehouses A, B, and C. The required particulars are given below. Find the least cost transportation schedule.

Transportation cost in Rs per crate.

From / To	A	B	C	Crates Available.
X	75	50	50	1040
Y	50	25	75	975
Z	25	125	25	715
Crates required.	1300	910	520	2730

32.	Explain the procedure of getting basic feasible solution by using VAM.

33.	Explain the process of solving a transportation problem.
34.	How do you say that a transportation model has an alternate solution? In case it has an alternate optimal solution, how do you arrive at alternate solution?
35.	Explain the differences and similarities between Assignment problem and Transportation problem.
36.	Explain briefly the procedure adopted in assignment algorithm.
37.	Obtain the dual of the following linear programming problem. Maximize $Z - 2x + 5y + 6z$ s.t. $5x + 6y \quad 1z \leq 3$ $-1x + 1y + 3z \geq 4$ $7x - 2y - 1x \leq 10$ $1x - 2y + 5z \geq 3$ $4x + 7y - 2z = 2$ and x, y, z all ≥ 0
38.	Define and explain the significance of Slack variable, Surplus variable, Artificial variable in linear programming resource allocation model.
39.	What is replacement? Explain by means real world examples.
40.	What is a Operations Research model? Discuss the advantages of limitation of good Operations Research model.