Lukhdhirji Engineering College, Morbi

Department of Mechanical Engineering

Assignment 1- Operation Research (CO1) and LPP CO2)

Subject: Operation Research (3151910) **Semester: 5th**

Year: 2022-23

1. Discuss the various phase of OR. (CO1)
2. Discuss the scope of OR in the various sectors. (CO1)
3. 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			
	Prime Day Rs.)	Prime Time Rs.	Radio Rs.	Magazine 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.

4. Explain significance of any two assumptions of Linear Programming Problem (LPP).

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

Vision of the Department:
To deliver quality engineering education for Mechanical Engineers with Professional competency, Human values and Acceptability in the society.

Mission of the Department:

- To nurture engineers with basic and advance mechanical engineering concepts
- To impart Techno-Managerial skill in students to meet global engineering challenges
- To create ethical engineers who can contribute for sustainable development of society

requires special tooling hence it cannot 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.

5. A company has to appoint grade A and grade B types of inspectors in the QC dept. Grade A inspector can check 40 pieces /hour with 95 % accuracy, while Grade B inspector can check 30 pieces /hour with 98% accuracy. At least 4500 pieces are required to be checked in an 8 hour shift per day. Inspectors of Grade A and Grade B are paid Rs 100 and Rs 120 per hour respectively. An error made by inspector cost Rs 15/per error to the company. Formulate the problem of assigning inspectors to minimize the overall cost per day considering that 20 grade A and 30 grade B inspectors are available to undertake inspection.

6. Use the graphical method to solve the following LP problems
Maximize $Z = 40X_1+35X_2$
Subject to the constraints:
$2X_1 + 3X_2 \leq 60$
$4X_1 + 3X_2 \leq 96$
And $X_1, X_2 \geq 0$

7. Use the graphical method to solve the following LP problems
Maximize $Z = 2X_1+X_2$
Subject to the constraints:
$X_1 + 2X_2 \leq 10$
$X_1 + X_2 \leq 6$
$X_1 - X_2 \leq 2$
$X_1 - 2X_2 \leq 1$
And $X_1, X_2 \geq 0$

8. Find the maximum value of following LPP using graphical approach
$Z = - X_1 + 2X_2$
Subject to the constraints:
$- X_1 + 3X_2 \leq 10$
$X_1 + X_2 \leq 6$
$X_1 - X_2 \leq 2$
And $X_1, X_2 \geq 0$

Vision of the Department:
To deliver quality engineering education for Mechanical Engineers with Professional competency, Human values and Acceptability in the society.
Mission of the Department:
- To nurture engineers with basic and advance mechanical engineering concepts
- To impart Techno-Managerial skill in students to meet global engineering challenges
- To create ethical engineers who can contribute for sustainable development of society

9. Use graphical method to solve the following LPP.
Maximize $Z=17\ X_1 +15\ X_2$
Subject to: $15\ X_1 +25\ X_2 \leq 375$
$24\ X_1+11\ X_2 \leq 265$
All $X_1, X_2 \geq 0$

10. 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
$X_1 + X_2 + X_3 \leq 10$
$2X_1 - 0X_2 - X_3 \leq 2$
$2X_1 -2X_2 -3\ X_3 \leq 6$
and $X_1 , X_2 , X_3 \geq 0$

11. Minimize $z = -3X_1 + X_2 – 2X_3$
Subject to
$X_1 + 3X_2 + X_3 \leq 5$
$2X_1 – X_2 + X_3 \geq 2$
$4X_1 + 3X_2 – 2X_3 = 5$
$X_1, X_2, X_3 \geq 0$

12. Solve the following LPP by simple method :
Maximize $Z = 3X_1 + 2X_2$
subject to $2X_1 + X_2 \leq 5$,
$X_1 + X_2 \leq 3$ and $X_1$and $X_2 \geq 0$

13. Use the simplex method to solve the following L.P. problem
Max (Total Profit) $Z= 4X_1+ 3X_2$
Subject to Constraints
$2X_1 + X_2 \leq 1000$
$X_1 + X_2 \leq 800$
$X_1 \leq 400$
$X_2 \leq 700$
and $X_1 , X_2 \geq 0$

14. Solve the following LPP with simplex method;
Maximize $Z=6X_1+ 4X_2$
Subject to
$2X_1 + 3X_2 \leq 30$
$3X_1 + 2X_2 \leq 24$
$X_1 + X_2 \geq 3$
and $X_1 , X_2 \geq 0$

Vision of the Department:
To deliver quality engineering education for Mechanical Engineers with Professional competency, Human values and Acceptability in the society.
Mission of the Department:
- To nurture engineers with basic and advance mechanical engineering concepts
- To impart Techno-Managerial skill in students to meet global engineering challenges
- To create ethical engineers who can contribute for sustainable development of society

15. 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
(ii) Solve the above LPP using Simplex method

16. Write the dual of the following linear programming problem.
Minimize, $Z = 20X_1 + 23X_2$
Subjected to,
$-4X_1 - X_2 \leq -8$
$5X_1 - 3X_2 = -4$, $X_1, X_2 \geq 0$
Solve the Dual problem using simplex method and predict the value of variables X_1, X_2 from the solution of dual linear programming problem.

****

Vision of the Department:
To deliver quality engineering education for Mechanical Engineers with Professional competency, Human values and Acceptability in the society.

Mission of the Department:

- To nurture engineers with basic and advance mechanical engineering concepts
- To impart Techno-Managerial skill in students to meet global engineering challenges
- To create ethical engineers who can contribute for sustainable development of society