LINEAR PROGRAMMING

4 Marks/6 marks

1) 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 as to produce as one of type A, and the company would have time to make a maximum of 2000 per day if it produces only the basic version. 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 company makes profit of Rs.3 and Rs.5 per doll, respectively, on doll A and B; how many each should be produced per day in order to maximize profit.

Ans: Type A = 1000, Type B = 500, Max. profit = Rs.5500

2) A dietician has to develop a special diet using two foods P and Q. Each packet (containing 30 g) of food P contains 12 units of calcium, 4 units of iron, 6 units of cholesterol and 6 units of vitamin A, while each packet of the same quality of food Q contains 3 units of calcium, 20 units of vitamin A. The diet requires atleast 240 units of calcium, atleast 460 units of iron and almost 300 units of cholesterol. How many packets of each food should be used to maximize the amount of vitamin A in the diet? What is the maximum amount of vitamin A?

Ans: 40 packets of food P and 15 packets of food Q Maximum at (40,15) = 285

3) An oil company has tow depots A and B with capacities of 7000L and 4000L respectively. The company is to supply oil to three petrol pumps D, E and F whose requirements are 4500L, 3000L and 3500L respectively. The distances (in km) between the depots and the petrol pumps is given in the following table:

	Distance in km	
From/To	A	B
D	7	3
E	6	4
F	3	2

Assuming that the transportation cost of 10 litres of oil is Rs.1 per km, how should the delivery be scheduled in order that the transportation cost is minimum.

Ans: From A : 500, 3000 and 3500 litres, From B : 4000, 0, 0 litres to D, E and F respectively. Minimum cost = Rs.4400

4) A firm makes two types of furniture : chairs and tables. The contribution to profit for each product as calculated by the accounting department is Rs.20 per chair and Rs.30 per table. Both products are to be processed on three machines M_1, M_2 and M_3. The time required in hours by each product and total time available in hours per week on each machine are as follows:

Machine	Chair	Table	Available Time
M_1	3	3	36
M_2	5	2	50
M_3	2	6	60

How should the manufacturer schedule his production in October to maximize profit.

Ans: 3 chairs and 9 tables.

5) A farmer has a supply of chemical fertilizer of type I which contains 10% nitrogen and 6% phosphoric acid and type II fertilizer which contains 5% nitrogen and 10% phosphoric acid. After testing the soil conditions of a field, it is found that atleast 14 kg of nitrogen and 14 kg of phosphoric acid is required for a good crop. The fertilizer type I costs Rs.2.00 per kg and type II costs Rs.3.00 per kg. How many kilograms of each fertilizer should be used to meet the requirement and the cost be minimum.

Ans: Minimum at (100,80) and is equal to Rs.440.

6) If a young man rides his motorcycle at 25 km/hr, he had to spend Rs.2 per km on petrol. If he rides at a faster speed of 40 km/hr, the petrol cost increases at Rs.5 per km. He has Rs.100 to spend on petrol and wishes to find what is the maximum distance he can travel within one hour. Express this as LPP and solve it graphically.

Ans: Maximum at $\left(\frac{50}{3}, \frac{40}{3}\right)$ and is equal to 30 km.

7) Solve the following LPP graphically. Maximize or minimize Z = 3x+5y subject to

$3x - 4y \geq -12$
$2x - y + 2 \geq 0$
$2x + 3y - 12 \geq 0$
$0 \leq x \leq 4$
$y \geq 2$

Ans: Min. value 19 at (3,2) and Max. value 42 at (4,6)

8) Solve the following LPP graphically. Minimize Z = 3x+5y subject to

$-2x + y \leq 4$
$x + y \geq 3$
$x - 2y \leq 2$
$x, y \geq 0$

Ans : Minimum value is $\frac{29}{3}$ at $\left(\frac{8}{3}, \frac{1}{3}\right)$

9) Determine graphically the minimum value of the objective function.

$Z = -50x + 20y$
Subject to constraints
$2x - y \geq -5$
$3x + y \geq 3$
$2x - 3y \leq 12$
$x \geq 0, y \geq 0$

10) Find the maximum and minimum values of 5x+2y subject to constraints

$-2x - 3y \leq -6$
$x - 2y \leq 2$
$6x + 4y \leq 24$
$-3x + 2y \leq 3$
$x \geq 0$ and $y \geq 0$

Ans : Max. value is 19 at $\left(\frac{7}{2}, \frac{3}{4}\right)$ and
Min. value is 4.85 at $\left(\frac{3}{13}, \frac{24}{13}\right)$