

Note: Attempt any six questions. Non-Programmable Scientific Calculators are allowed.

1. A company is producing a product which requires three parts at the final assembly stage. These three parts can be produced by two different departments as detailed below.

	Production rate (units/hr)			Cost (£/hr)
	Part 1	Part 2	Part 3	
Department 1	7	6	9	25.0
Department 2	6	11	5	12.5

In one week, 1050 finished (assembled) products are needed (but up to 1200 can be produced if necessary). If department 1 has 100 working hours available, but department 2 has 110 working hours available, FORMULATE the problem for minimizing the cost of producing the finished (assembled) products needed in one week as an LPP, subject to the constraint that limited storage space means that a total of only 200 unassembled parts (of all types) can be stored at the end of the week. (6)

2. Solve following problem by 2 Phase Method

$$\begin{aligned} \text{Max } Z &= -2x_1 - 4x_2 - x_3 \\ \text{s. t. } x_1 + 2x_2 - x_3 &\leq 5 \\ 2x_1 - x_2 + 2x_3 &= 2 \\ -x_1 + 2x_2 + 2x_3 &\geq 1 \\ x_1, x_2, x_3 &\geq 0 \end{aligned} \quad (6)$$

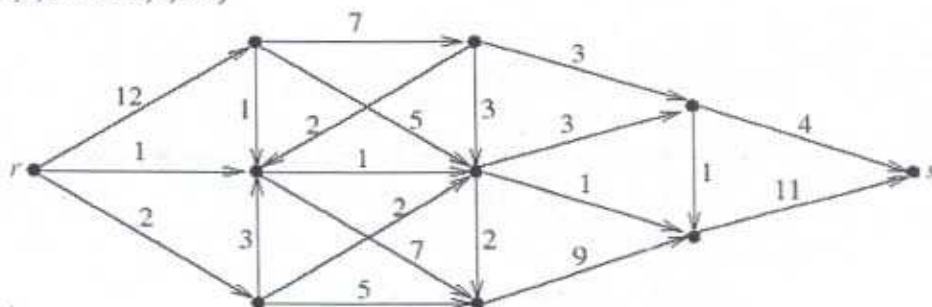
3. Solve following problem by Revised Simplex Method

$$\begin{aligned} \text{Max } Z &= 5x_1 - 4x_2 + 3x_3 \\ \text{s. t. } 2x_1 + x_2 - 6x_3 &= 20 \\ 6x_1 + 5x_2 + 10x_3 &\leq 76 \\ 8x_1 - 3x_2 + 6x_3 &\geq 22 \\ x_1, x_2, x_3 &\geq 0 \end{aligned} \quad (6)$$

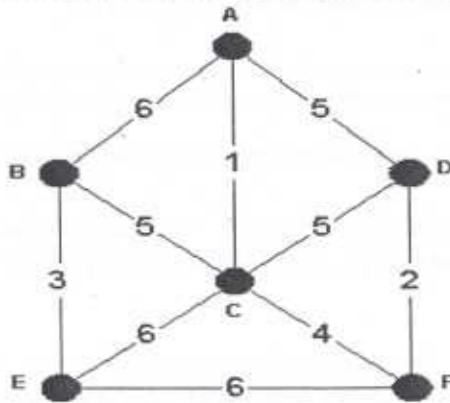
4. For (M/M/c):(GD/∞/∞) model, Given that $\lambda = 15, \mu = 5$ and $c = 4$

Calculate P_3, P_0, L_s, L_q, W_s and W_q . (6)

- 5(i) Find maximum flow from r to s for following graph (name the vertices yourself as 1,2,3... or a,b,c...)

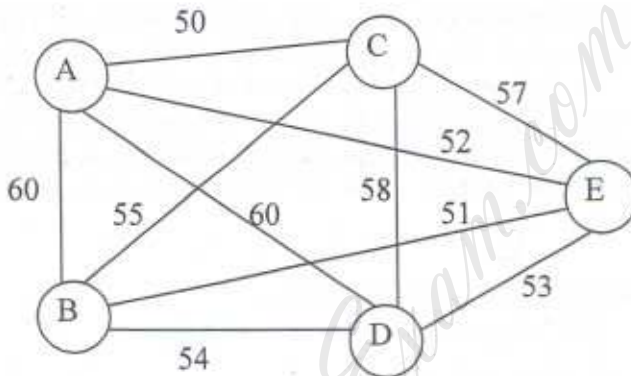


(ii) Find shortest paths from Node 'A' to all other nodes.

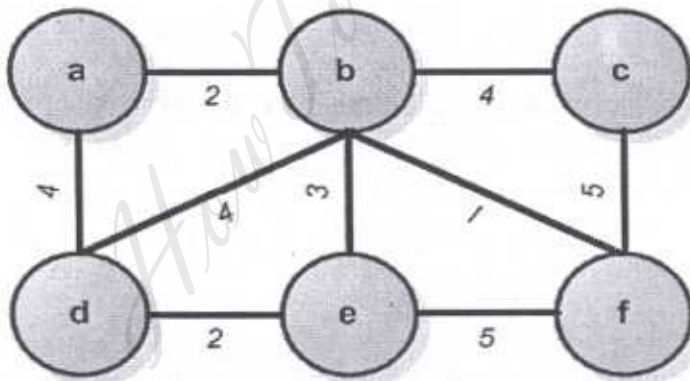


(4+2)

6(i) Solve following Traveling Salesman Problem:



(ii) Find Minimal Spanning Tree for following Graph



(4.5+1.5)

7. Solve the following problem by Generalized Simplex Method:

$$\text{Min } Z = 5x_1 + 6x_2 - 3x_3$$

$$\text{s. t. } 5x_1 + 5x_2 + 3x_3 \geq 50$$

$$x_1 + x_2 - x_3 \geq 20$$

$$7x_1 + 6x_2 - 9x_3 \geq 30$$

$$x_1, x_2, x_3 \geq 0$$

(6)

8. (a) Solve the following constrained Non-Linear Programming Problem

$$\text{Min } Z = 3x_1^2 + 2x_2^2 + 5x_3^2$$

$$\text{s. t. } g_1(X) = 2x_1 + 3x_2 + x_3 - 5 = 0$$

$$g_2(X) = 3x_1 + 5x_2 + 7x_3 - 2 = 0$$

(b) Write generalized KKT conditions for generalized Non-Linear problems of Maximization nature.

(5+1)