

M. E. (ME) 2nd Semester Examination, 2014
Subject: Operation Research in Production Management

(ME-1017)

Time: 3 Hours

Full Marks: 70

Answer any Five questions
The questions are of equal value

1. Solve the following L.P. Problems and determine whether the solution is infeasible, alternate, degenerate, unbounded or not a unique optimal one.

(a) Maximize, $Z = 3x_1 + 2x_2$

$$\begin{aligned} \text{S.t.,} \quad & x_1 + 2x_2 \leq 5 \\ & x_1 + x_2 - x_3 \leq 2 \\ & 7x_1 + 3x_2 - 5x_3 \leq 20 \end{aligned}$$

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

(b) Maximize, $Z = 2x_1 + 3x_2$

$$\begin{aligned} \text{S.t.,} \quad & x_1 - x_2 \leq 2 \\ & -3x_1 + x_2 \leq 4 \end{aligned}$$

$$x_1, x_2 \geq 0$$

(c) Maximize, $Z = 3x_1 + 6x_2$

$$\begin{aligned} \text{S.t.,} \quad & 2x_1 + x_2 \leq 2 \\ & 3x_1 + 4x_2 \geq 12 \\ & x_1, x_2 \geq 0 \end{aligned}$$

2. (a) What do you mean by 'concept of duality'? Write the dual of the following primal problem:

Maximize, $Z = 4x_1 + 3x_2 + 9x_3$

$$\begin{aligned} \text{S.t.,} \quad & x_1 + 3x_2 - 8x_3 \leq 15 \\ & 2x_1 - 2x_2 + 6x_3 \leq 18 \\ & 7x_1 + 5x_2 - 2x_3 \geq 20 \end{aligned}$$

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

(c) Solve the following problem using dual Simplex method

(i) Minimize, $Z = 10x_1 + 15x_2 + 30x_3$

$$\begin{aligned} \text{S.t.,} \quad & x_1 + 3x_2 + x_3 \geq 90 \\ & 2x_1 + 5x_2 + 3x_3 \geq 120 \\ & x_1 + x_2 + x_3 \geq 60 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

3. Maximize, $Z = -x_1 + x_2 - 2x_3$

$$\begin{aligned} \text{S.t.,} \quad & 3x_1 - x_2 + 2x_3 \leq 7 \\ & -2x_1 + 4x_2 \leq 12 \\ & -4x_1 + 3x_2 + 7x_3 \leq 10 \end{aligned}$$

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

- (i) Solve the above L.P. problem and find its solution.
- (ii) Find the changes in optimality when resource 1 availability changes from 7 to 8
- (iii) Find sensitivity of the solution when the objective function changes to
 - (a) $-x_1 + 3x_2 - 2x_3$

4. (a) A company has three factories at locations Belgharia, Panihati, and Sodepur which supplies to four warehouses at located Dunlop, Naihati, Kamarhati and Barrackpore. Monthly factory capacities are 15, 13, 19 units respectively.

Monthly warehouse requirements are 6, 10, 12 and 15 units, respectively. Unit shipping costs in Rs. are given below.

	Dunlop	Naihati	Kamarhati	Barrackpore
Belgharia	21	16	25	13
Panihati	17	18	14	23
Sodepur	32	27	18	41

Determine the optimal distribution for the company.

(b) Solve the above problem considering maximization when demand of warehouse at Dunlop is 10 units.

5. Apply the Gomory Cutting Plane algorithm to solve the following Integer linear programming problem.

$$\begin{aligned} & \text{Maximize, } Z = 2x_1 + 2x_2 \\ \text{S.t., } & -5x_1 + 3x_2 \leq 8 \\ & x_1 + 2x_2 \leq 4 \end{aligned}$$

$x_1, x_2 \geq 0$; x_1, x_2 are non-negative and integer value.

6. (a) What is integer, pure integer and mixed integer linear programming problem.

(b) Consider the project network diagram (Figure 1) consisting of 6 nodes 9 activities given below, where activity durations are given in days. Find its critical path of this project with the help of Network Flow method. Formulate the primal and dual problems, and obtain the parametric solution by examination of the two problems.

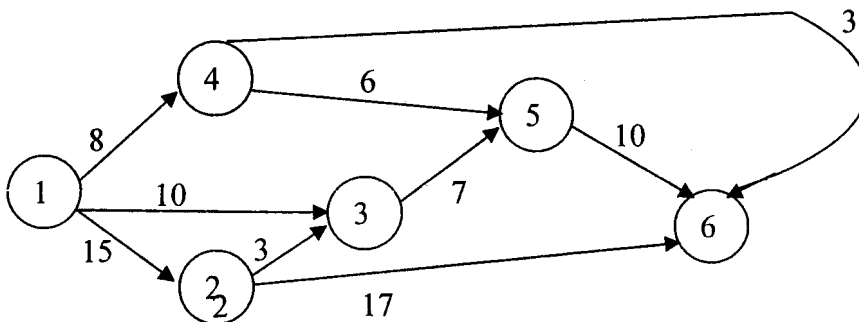


Figure 1: Network Flow Diagram

7. (a) In a machine shop, there are four workers and four tasks to be performed in the four machines. The workers differ in efficiency and the tasks differ in their intrinsic difficulty. The estimate of time each worker would take to perform each task is given in the matrix below. How should the tasks be assigned one to a worker so as to minimize the total manhours?

	Machine 1	Machine 2	Machine 3	Machine 4
Worker 1	18	26	17	11
Worker 2	13	28	14	26
Worker 3	38	19	18	15
Worker 4	19	26	24	10

Determine the optimal locations for the machines.

(b) Suppose a new machine is added in the machine shop. Production costs at the new machine are (18, 7, 15, 10). Find the optimal allocation.