Indian Statistical Institute, Bangalore
M.S. (QMS) First Year
First Semester – Operations Research I

Semestral Exam Duration: 3 Hrs Date: November 20, 2017 Max Marks: 100

Answer as many Questions as you can. The maximum marks you can score is 100.

1. Write TRUE or FALSE for each of the following statement. Justification not required. [8]

(i) In an LP model, feasible solution space can be changed when nonbinding constraints are deleted.
(ii) The optimality condition always guarantees that the next solution will have a better objective value than in the immediately preceding iteration.
(iii) Redundant constraints represent abundant resources.
(iv) The Simplex method may not move to an adjacent extreme point if the current iteration is degenerate.
(v) A balanced transportation model may not have any feasible solution.
(vi) A basic requirement for using transportation technique is that the transportation model be balanced.
(vii) Every basic solution in the assignment problem is degenerate.
(viii) If the primal is infeasible, the dual always has unbounded optimum.

2. A manufacturing company wishes to develop a monthly production schedule for the next three months. Depending upon the sales commitments, the company can either keep the production constant, allowing fluctuation in the inventory,or inventories can be maintained at a constant level, with fluctuation in production. Fluctuating production makes overtime work necessary, the cost of which is estimated to be double the normal production cost of Rs.12 per unit. Fluctuating inventories results in an inventory holding cost of Rs.2 per unit/month. If the company fails to fulfil its sales commitment, it incurs a shortage cost of Rs.4 per unit/month (i.e., unfulfilled orders in a month can be made in subsequent month(s), with this additional shortage cost.) The production capacities & the demand for the next three months are shown in the following table. Formulate this problem as an LP model.

Month	Production capacity		Demand
	Regular	Overtime	
1	50	30	60
2	50	0	120
3	60	50	40

(b) A company produces two types of sauces: A and B. These sauces are both made by blending two ingredients X and Y. A certain level of flexibility is permitted in the formulae of these products. Indeed, the restrictions are that (i) B must contain no more than 75% of X, and (ii) A must contain no less than 25% of X and no less than 50% of Y. Up to 400 kg of X and 300 kg of Y could be purchased. The company can sell as much of these sauces as it produces at a price of Rs.18 for A and Rs.17 for B. The X and Y cost Rs.1.60 and 2.05 per kg, respectively. The company wishes to maximize its net revenue from the sale of these sauces. Formulate this problem as a LP Model.

[12 + 12 = 24]

3. Consider the following LP model: [8]

$$\text{Maximize } z = x_1 + 5x_2 + 3x_3$$

$$\text{Subject to: } x_1 + 2x_2 + x_3 = 3$$
$$2x_1 - x_2 = 4$$
$$x_1, x_2, x_3 \geq 0$$

The starting solution consists of x_3 in the first constraint and an artificial x_4 in the second constraint with M = 100. The **optimal tableau** is given as:

Basic	x_1	x_2	x_3	x_4	Solution
z	0	2	0	99	5
x_3	1	2.5	0	– .5	1
x_1	0	– .5	1	.5	2

Write the associated dual problem and determine its optimal solution using primal-dual relationship.

4. Convert the following LP Problem toits**Dual**Problem & solve this Dual Problem by **Dual-Simplex** Algorithm. [22]

Maximize $Z = 3x_1 + 2x_2 + x_3 + 2x_4$

Subject to

$$x_1 + 2x_2 + x_3 + 3x_4 \leq 6$$
$$3x_1 + 4x_2 + 2x_3 + x_4 \leq 8$$
$$2x_1 + 3x_2 + 3x_3 + x_4 \leq 9$$
$$2x_1 + x_2 + 2x_3 + 2x_4 \leq 12$$

$x_i \geq 0$, i = 1, 2, 3, 4.

5. (a) Define the Transportation problem. [5 + 7 + 14 + 6 = 32]

(b) A company has three factories A, B, C which supply to warehouse at X, Y and Z: Weekly factory capacities (supply) as well as the warehouse requirements are given in the rightmost column and bottom row of the following table respectively. The Transportation cost involved in transporting each unit of product from factories to warehouses are given in the 3X3 matrix.

Factories	Warehouses	Supply
	XYZ	
A	16 2012	200
B	14 8 18	160
C	262416	90
Demand	180120150	450

(i) Find a ***Initial Basic Feasible Solutions*** using (i) North West Corner Rule.

(ii) Verify whether the feasible solution obtained by using N-W Corner Ruleis optimal or not by using optimality test.

(iii) In case, the above ***IBF*** is found non-optimal, briefly outline, what iterative procedure may be followed to bring Optimatlity. No need not work it out.

6. A business executive must make the four round-trips listed in the following table between the head office in Dallas and a branch office in Atlanta. [14]

The price of a round-trip ticket from Dallas is $400. A 25% discount is granted if the dates of arrival and departure of a ticket span a weekend (Saturday and Sunday). If the stay in Atlanta lasts more than 21 days, the discount is increased to 30%. A one-way ticket between Dallas and Atlanta (either direction) costs $250. How should the executive purchase the tickets?

Departure date from Dallas	Return date to Dallas
Monday, June 3	Friday, June 7
Monday, June 10	Wednesday, June 12
Monday, June 17	Friday, June 21
Tuesday, June 25	Friday, June 28
