**Q. P. Code: 27287**

May-June 2018

(3 Hours) (Marks: 80

N.B. : (1) Answer any four questions out of the six questions.
(2) Figures to the right indicate full marks.
(3) Illustrate answers with neat sketches where ever required.
(4) Answers to the questions should be grouped and written together.
(5) Assume suitable data if required.

1. (a) Consider the problem for Graphical Method 10

Max. $Z = 3X_1 + 5X_2$
Subject to,
$X_1 + 2X_2 \leq 2000$
$X_1 + X_2 \leq 1500$
$X_2 \leq 600$
$X_1, X_2 \geq 0$

(b) Explain the simulation with suitable example. 10

2. (a) Solve by Big M method 10

Minimize z $20\ X_1 + 10\ X_2$
Subject to
$X_1 + X_2 \leq 40$
$4\ X_1 + 3\ X_2 \geq 60$
$3\ X_1 + X_2 \geq 30$
$X_1, X_2 \geq 0$

(b) The annual demand for a product is 64000 units. The buying cost per order is Rs.10 and the estimated cost of carrying one unit in stock for a year is 20%. The normal price of the product is Rs.10 per unit. However, the supplier offers a quantity discount of 2% on an order of at least 1000 units at a time and the discount of 5% if the order is for at least 5000 units. Suggest the most economic purchase quantity per order. 10

3. (a) Solve the following problem by Dual simplex method 10

Min.$Z = 2\ X_1 + 2\ X_2 + 4\ X_3$
$2X_1 + 3\ X_2 + 5\ X_3 \geq 2$
$3X_1 + X_2 + 7\ X_3 \leq 3$
$X_1 + 4\ X_2 + 6\ X_3 \leq 5$
$X_1, X_2, X_3 \geq 0$

(b) Explain in detail the structure of queuing system describing each element of queue with suitable example. 10

4. (a) A company has three factories X, Y, Z. It supplies goods to four warehouses W1, W2, W3 and W4. The production capacities of the factories and demand of the warehouses are as shown in the table. Determine the optimal solution of the problem. 10

| | | Warehouse | | | | |
|---|---|---|---|---|---|---|
| | | W1 | W2 | W3 | W4 | Production Capacity |
| Factory | X | 19 | 30 | 50 | 12 | 7 |
| | Y | 70 | 30 | 40 | 60 | 10 |
| | Z | 40 | 10 | 60 | 20 | 18 |
| Demand | | 5 | 8 | 7 | 15 | |

(b) A salesman estimates that the following would be the cost on his route, visiting the six cities as shown in the following table: 10

| | | To city | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| From city | 1 | ∞ | 20 | 23 | 27 | 29 | 34 |
| | 2 | 21 | ∞ | 19 | 26 | 31 | 24 |
| | 3 | 26 | 28 | ∞ | 15 | 36 | 26 |
| | 4 | 25 | 16 | 25 | ∞ | 23 | 18 |
| | 5 | 23 | 40 | 23 | 31 | ∞ | 10 |
| | 6 | 27 | 18 | 12 | 35 | 16 | ∞ |

The salesman can visit each of the cities only once. Determine the optimal sequence he should follow to minimize the total distance travelled. What is the total distance travelled?

5. (a) Use two phase simplex method to solve following problem 10

Maximize $Z = 5\ X_1 + 3\ X_2$

Subject to the constraints $2X1 + X_2 \leq 1$

$X_1 + 4\ X_2 \geq 6$

$X_1, X_2 \geq 0$

(b) Find the sequence that minimizes the total time in hours required to complete the following tasks in the order $M_1M_3M_2$: 10

| | Tasks | | | | | | |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G |
| M 1 | 3 | 8 | 7 | 4 | 9 | 8 | 7 |
| M 2 | 6 | 7 | 5 | 11 | 5 | 6 | 12 |
| M 3 | 4 | 3 | 2 | 5 | 1 | 4 | 3 |

6. (a) A boat company makes three different kinds of boats. All boats can be made profitably but the company's monthly production is constrained by limited amount of labour, wood and screws available each month. The director will choose the combination of the boats that maximizes his revenue in view of the information given in the following table: 10

| Input | Row Boat | Canoe | Keyak | Monthly Availability |
|---|---|---|---|---|
| Labour (Hrs) | 12 | 7 | 9 | 1,260 Hrs. |
| Wood (Board Feet) | 22 | 18 | 16 | 19,008 Board Feet |
| Screws (KG) | 2 | 4 | 3 | 396 KG |
| Selling Price | 4, 000 | 2, 000 | 5,000 | |

Formulate the problem as LPP and solve by Simplex method.

From the optimal table of the solved LPP , answer the following

questions:

i) How many boats of each type are produced and what will be the resulting revenue?

ii) Which, if any, of the resources are not fully utilized? If so, how much of spare capacity is left?

iii) How much wood will be used to make all the boats given in the optimal solution?

(b) An electronic device consists of four components, each of which must function for the system to function. The system reliability can be improved by installing parallel units in one or more of the components. The reliability (R) of a component with one, two or three parallel units and the corresponding cost (C) are given in the table below. The maximum amount available for this device is 100. The problem is to determine the number of parallel units in each component. 10

| No. of Units | Components | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | |
| | R | C | R | C | R | C | R | C |
| 1 | 0.7 | 10 | 0.5 | 20 | 0.7 | 10 | 0.6 | 20 |
| 2 | 0.8 | 20 | 0.7 | 40 | 0.9 | 30 | 0.7 | 30 |
| 3 | 0.9 | 30 | 0.8 | 50 | 0.95 | 40 | 0.9 | 40 |

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