USN | | | | | | | | | | |

06ME74

# Seventh Semester B.E. Degree Examination, December 2011
# Operations Research

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

## PART – A

1 a. Define operations research and discuss its scope. **(05 Marks)**

b. Old machines can be bought at Rs. 2 lakhs each and new machines at Rs.5 lakhs each. The old machines produce 3 components / week, while new machines produce 5 components / week, each component being worth Rs.30000. A machine (new or old) costs Rs.1 lakh /week to maintain. The company has only Rs.80 lakhs to spend on the machines. How many of each kind should the company buy to get a profit of more than Rs.6 lakhs/week? Assume that the company cannot house more than 20 machines. Formulate the problem and solve it graphically. **(15 Marks)**

2 a. Explain the concept the degeneracy in the simplex method. **(05 Marks)**

b. Solve the following LPP by BIG-M-Method:

Minimize $z = -8x_2$,

Subjected to the constraints $x_1 - x_2 \geq 0$

$2x_1 + 3x_2 \leq -6$

and $x_1, x_2$ are unrestricted. **(15 Marks)**

3 a. Explain clearly unbalanced transportation and degenerate transportation problems. **(05 Marks)**

b. A company has four factories $F_1$, $F_2$, $F_3$ and $F_4$ manufacturing the same product. Production and raw material costs differ from factory to factory and are given in the following table in the first two rows. The transportation costs from the factories to sales depots $S_1$, $S_2$, $S_3$ are also given. The last two columns in the table give the sales price and the toal requirement at the each depot. The production capacity of each factory is given in the last row.

| | | $F_1$ | $F_2$ | $F_3$ | $F_4$ | Sales price/unit | Requirement |
|---|---|---|---|---|---|---|---|
| Production cost/unit | | 15 | 18 | 14 | 13 | | |
| Raw material cost/unit | | 10 | 9 | 12 | 9 | | |
| Transportation cost/unit | $S_1$ | 3 | 9 | 5 | 4 | 34 | 80 |
| | $S_2$ | 1 | 7 | 4 | 5 | 32 | 120 |
| | $S_3$ | 5 | 8 | 3 | 6 | 31 | 150 |
| Availability | | 10 | 150 | 50 | 100 | | |

Determine the most profitable production and distribution schedule and the corresponding profit. The surplus production should be taken to yield zero profit. **(15 Marks)**

4 a. Solve the traveling salesman problem given by the following data:
$C_{12} = 20$, $C_{13} = 4$, $C_{14} = 10$, $C_{23} = 5$, $C_{34} = 6$, $C_{25} = 10$, $C_{35} = 6$, $C_{45} = 20$ where $C_{ij} = C_{ji}$. There is no route between cities i and j, if the value for $C_{ij}$ is not shown. **(10 Marks)**

b. A ready made garment manufacturer has to process seven items through two stages of production, viz, cutting and sewing. The time taken for each of these items at the different stages is given below in appropriate units.

| Item No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Processing time Cutting | 5 | 7 | 3 | 4 | 6 | 7 | 12 |
| Processing time Sewing | 2 | 6 | 7 | 5 | 9 | 5 | 8 |

i) Find an order in which these items are to be processed through these stages so as to minimize the total processing time.

ii) Suppose the third stage of production is added viz, pressing and packing with processing time for these items as follows:

**Q.No.4 (b) Contd...**

| Item: | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Processing time (Pressing and Packing): | 10 | 12 | 11 | 13 | 12 | 10 | 11 |

Minimize the time taken to process all the items through all the three stages. **(10 Marks)**

## PART – B

5 a. Describe the characteristics of queuing systems. **(05 Marks)**

b. In a railway yard, goods trains arrive at a rate of 30 trains per day. Assume that the inter arrival time follows an exponential distribution and the service time distribution is also exponential with an average 36 minutes. Calculate the following:

i) The average number of trains in the system.
ii) The probability that the queue size exceed 10.
iii) Expected waiting time in the queue.
iv) Average number of trains in the queue.
v) The changes in (I) and (II) if the input of trains increases to an average 33 per day.

**(15 Marks)**

6 a. Explain the basic steps in PERT / CPM techniques. **(05 Marks)**

b. A project consists of a series of tasks labeled A, B, .....H, I with the following relationships (W<XY means X and Y can not float until W is completed). With this notation, construct the network diagram having the following constraints:

A < D, E; B, D < F; C < G; G < H; F, G < I

Find also the minimum time of completion of the project when the time (in days) of completion of each task is as follows:

| Task: | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| Time: | 23 | 8 | 20 | 16 | 24 | 18 | 19 | 4 | 10 |

Further determine ES,EF, LS, LF and TF, FF, Interference and Independent float. **(15 Marks)**

7 a. Explain the characteristics of game theory. **(05 Marks)**

b. Use the dominance rule to reduce the following game to either $z \times n$ or $m \times z$ game and then solve it graphically. **(15 Marks)**

| | | Player B | | | |
|---|---|---|---|---|---|
| | | $B_1$ | $B_2$ | $B_3$ | $B_4$ |
| Player A | $A_1$ | 19 | 6 | 7 | 5 |
| | $A_2$ | 7 | 3 | 14 | 6 |
| | $A_3$ | 12 | 8 | 18 | 4 |
| | $A_4$ | 8 | 7 | 13 | -1 |

8 a. What is an integer linear programming problem? How does the optimal solution of integer programming problem compares with that of linear programming problem? **(05 Marks)**

b. Use branch-and-bound technique to solve the following integer programming problem:

Maximize $z = x_1 + 2x_2$

Subject to constraints: $2x_2 \leq 7$

$x_1 + x_2 \leq 7$

$2x_1 \leq 11$

$x_1 \geq 0, x_2 \geq 0$ and $x_1, x_2$ are integers. **(15 Marks)**

* * * * *