Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Operations Research

Time: 3 hrs.

Max. Marks:100

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

PART – A

1 a. What is operations Research? Explain linear programming problems. **(04 Marks)**

b. The owner of metro sports wishes to determine how many advertisements to place in the selected three monthly magazines A, B and C. His objective is to advertise in such a way that total exposure to principal buyers of expensive sports goods in maximized. Percentages of readers for each magazine are known. Exposure in any particular magazine is the number of advertisements placed multiplied by the number of principal buyers. The following data is available.

	Magazine		
	A	B	C
Readers	1 lakh	0.6 Lakh	0.4 Lakh
Principal buyers	20%	15%	8%
cost per advertisement (RS)	8000/-	6000/-	5000/-

The budgeted amount is at most Rs 1 lakh for advertisements. The owner has already decided that magazine A should have no more than 15 advertisements and that B and C each have at least 50 advertisements. Formulate an LP model for this problem. **(06 Marks)**

c. Solve the LPP :

Max $Z = 3x_1 + 2x_2$

Subject to : $4x_1 + 3x_2 \le 12$

$\qquad\qquad 4x_1 + x_2 \le 8$

$\qquad\qquad x_2 - 4x_1 \ge -8$ and $x_1, x_2 \ge 0$. **(10 Marks)**

2 a. Solve the following LPP graphically and comment on the result.

Maximize $Z = x_1 + x_2$

Subject to : $x_1 + x_2 \le 1$

$\qquad\qquad -3x_1 + x_2 \ge 3$

$\qquad\qquad x_1 \ge 0,$ and $x_2 \ge 0,$ **(06 Marks)**

b. Use Big M method to solve the following LPP.

Minimize $\qquad\qquad Z = 5x_1 + 3x_2$

Subject to constraints $\quad 2x_1 + 4x_2 \le 12$

$\qquad\qquad\qquad\qquad 2x_1 + 2x_2 = 10$

$\qquad\qquad\qquad\qquad 5x_1 + 2x_2 \ge 10$ and $x_1, x_2 \ge 0.$ **(14 Marks)**

3 a. Write the Dual of the following primal problem.

Maximize $Z = 2x_1 + 3x_2$

Subject to $5x_1 + 2x_2 \leq 40$

$6x_1 + 12x_2 \leq 80$ where x_1 and x_2 are unrestricted in sign. (06 Marks)

b. Use Revised simplex method to solve the following LPP.

Maximize $Z = x_1 + x_2$

Subject to $2x_1 + 5x_2 \leq 6$

$x_1 + x_2 \geq 2$ and

$x_1 \geq 0,$ and $x_2 \geq 0,$ (07 Marks)

c. Solve the given LPP using dual simplex method.

Minimize $Z = 2x_1 + 4x_2$

Subject to constraints $2x_1 + x_2 \geq 4$

$x_1 + 2x_2 \geq 3$

$2x_1 + 2x_2 \leq 12$

$x_1, x_2 \geq 0.$ (07 Marks)

4 a. Alpha construction company has five crews. The skills of the crews differ from one another. The company has five different projects on hand. The times (in days) taken by different crews to complete different projects are summarized in Table Q4(a). Find the best assignment of the crews to different project such that the total time taken to complete all the projects is minimized

Table Q4 (a)   Crew

	Project				
	A	B	C	D	E
1	20	30	25	15	35
2	25	10	40	12	28
3	15	18	22	32	24
4	29	8	34	10	40
5	35	23	17	26	45

Project execution time in days

(10 Marks)

b. A machine operator processes five types of items on his machine each week and must choose a sequence for them. The set up cost per change depends on the items presently on the machine and set up to be made, according to the following table

To items

$$\begin{array}{c}
 & \begin{array}{ccccc} A & B & C & D & E \end{array} \\
\begin{array}{c} A \\ B \\ \text{From items} \quad C \\ D \\ E \end{array} &
\left[\begin{array}{ccccc}
\infty & 4 & 7 & 3 & 4 \\
4 & \infty & 6 & 3 & 4 \\
7 & 6 & \infty & 7 & 5 \\
3 & 3 & 7 & \infty & 7 \\
4 & 4 & 5 & 7 & \infty
\end{array}\right]
\end{array}$$

If he processes each type of them only once in each week, how should he sequence the items on his machine in order to minimize the total set up cost? (10 Marks)

PART – B

5 a. What is degeneracy in transportation problems? How to resolve it? **(04 Marks)**

b. Obtain the initial basic feasible solution to the given transportation problem using Vogel's Approximation method. **(06 Marks)**

Table Q 5 (b)

D\S	D_1	D_2	D_3	D_4	Supply
S_1	2	2	2	1	3
S_2	10	8	5	4	7
S_3	7	6	6	3	5
Demand	4	3	4	4	15

c. A company has three plants A, B and C, 3 ware houses X, Y and Z. The number of units available at the plants is 60, 70, 80 and the demand at X, Y, Z is 50, 80, 80 respectively. The unit cost of transportation is given in the following table.

	X	Y	Z
A	8	7	3
B	3	8	9
C	11	3	5

Find the optimum allocation, so that the total transportation cost is minimum. **(10 Marks)**

6 a. Define pure strategy, mixed strategy and Two – person zero sum game. **(06 Marks)**

b. Solve the game whose pay off matrix is given by

Player B

Player A $\begin{bmatrix} 3 & 2 & 4 \\ 0 & -4 & 2 \\ 2 & -1 & 5 \end{bmatrix}$ Comment on the result. **(06 Marks)**

c. In a game of matching coins with two players A and B, suppose A wins one unit of value when there are two heads, wins nothing when there are two tails and losses $\frac{1}{2}$ unit of value when there are one head and one tail. Determine the pay off matrix, the best strategies for each player and the value of the game to player A. **(08 Marks)**

7 a. A project consists of a series of tasks A, B …… H, I with the following relationships, W < X, Y means X and Y can not start until W is completed. X, Y < W means, W can not start until both X and Y are completed. With this notation, construct the network diagram having the following constraints: A < D, E; B, D < F ; C < G ; B < H ; F, G < I. Find the critical path and minimum time of completion of project, when the time of completion of each task is given as below. Also find the float for each activity.

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

(08 Marks)

b. A project is composed of different activities whose time estimates are listed in the following table.

	Estimated Duration		
Activity	Optimistic to	Most likely tm	Pessimistic Tp
1 – 2	1	2	9
2 – 3	1	4	7
2 – 4	2	4	12
3 – 4	0	0	0
3 – 5	2	3	4
4 – 5	4	6	8
4 – 6	3	5	7
5 – 6	1	3	5
5 – 7	5	7	15
3 – 7	6	8	16
6 – 7	3	4	5

i) Draw the project network
ii) Find the expected duration and variance of each activity
iii) Determine the expected project completion time
iv) What is the probability of completing the project in 25 days?
(Given that for standard normal $Z = 1.08$, area under the standard normal curve from extreme left $Z = -\infty$ to Z is 0.8599)   (12 Marks)

8 a. A truck owner finds from his past records that the maintenance costs per year of a truck, whose purchase price is Rs. 8000, are as given in table Q8(a). Determine the time at which it is profitable to replace the truck.

Year	1	2	3	4	5	6	7	8
Maintenance Cost	1000	1300	1700	2200	2900	3800	4800	6000
Resale price	4000	2000	1200	600	500	400	400	400

(08 Marks)

b. The following mortality rates have been observed for a certain type of light bulbs.

Week	1	2	3	4	5
Percent failure of the end of week	10	25	45	75	100

There are 1000 bulbs in use and it costs Rs. 2 to replace an individual bulb, which has burnt out. If all the bulbs were replaced simultaneously, it would cost 50 paise per bulb. It is proposed to replace all bulbs at fixed intervals, whether or not they have burnt out and to continue replacing burnt out bulbs as they fail. Determine the optimum interval at which all the bulbs should be replaced.   (12 Marks)

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