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EE76.

# Seventh Semester B.E. Degree Examination, Dec. 07 / Jan. 08
## Operations Research

Time: 3 hrs. Max. Marks:100

**Note :** *1. Answer any FIVE full questions.*
*2. Tables of area under normal curve are permitted.*

1 a. Define the term 'Operations Research' and list main phases of operations research study. Also explain any one phase briefly. **(06 Marks)**

b. A person requires 10, 12 and 12 units of three chemicals A, B and C, respectively for his garden. A liquid product contains 5, 2 and one units of chemicals 'A', 'B' and 'C' respectively per jar. A dry product contains 1, 2 and 4 units of chemicals 'A', 'B' and 'C' respectively per carton. If the liquid product sells at Rs.30 per jar and dry product sells at Rs.20 per carton, how many of each should be purchased to minimize the cost and meet the requirements. Formulate the problem as L.P.P. and solve it by graphical method. **(14 Marks)**

2 a. The manager of an oil refinery must decide on the optimal mix of two possible blending processes for which the inputs and outputs per production run are as follows:

| Processes | Input (units) | | Output (units) | |
|---|---|---|---|---|
| | Crude 'A' | Crude 'B' | Gasoline 'X' | Gasoline 'Y' |
| 1 | 5 | 3 | 5 | 8 |
| 2 | 4 | 5 | 4 | 4 |

The maximum amounts available of crude 'A' and 'B' are 200 units and 150 units respectively. Market requirements show that at least 100 units of gasoline 'X' and 80 units of gasoline 'Y' must be produced. The profits per production run from process 1 and 2 are Rs.300 and Rs.400 respectively. Formulate and represent the problem in the standard format of LPP. **(06 Marks)**

b. Solve the following LPP by two-phase method:

Minimize, $Z = 12x_1 + 20x_2$

Subjected to, $6x_1 + 8x_2 \geq 100$

$7x_1 + 12x_2 \geq 120$

$x_1, x_2 \geq 0$ **(14 Marks)**

3 a. Determine initial basic solution for the following transportation problem by 'VAM' (Vogels method). **(06 Marks)**

| | | Destinations | | | | Availability |
|---|---|---|---|---|---|---|
| | | $D_1$ | $D_2$ | $D_3$ | $D_4$ | |
| Origin | 01 | 19 | 30 | 50 | 10 | 7 |
| | 02 | 70 | 30 | 40 | 60 | 9 |
| | 03 | 40 | 8 | 70 | 20 | 18 |
| Requirements | | 5 | 8 | 7 | 14 | |

b. Consider following transportation problem:

| | | Show rooms | | | | |
|---|---|---|---|---|---|---|
| | | $S_1$ | $S_2$ | $S_3$ | $S_4$ | Availability |
| Factories | $F_1$ | 40 | 20 | 15 | 12 | 100 |
| | $F_2$ | 10 | 15 | 50 | 45 | 90 |
| | $F_3$ | 38 | 35 | 10 | 57 | 60 |
| Requirements | | 60 | 50 | 80 | 60 | |

i) Find two initial basic solution one by NWC rule and another by 'Lowest Cost Entry' method

ii) Show that of the above two solutions, the solution obtained by Lowest Cost Entry method represents optimal solution. **(14 Marks)**

4 a. A manufacturing company purchases 9000 parts for a machine for its annual requirements. Each part costs Rs.20. The ordering cost per order is Rs.15 and the carrying charges are 15% of the average inventory per year. Find the lot size that minimize the cost of the system and also determine the optimal cost. **(06 Marks)**

b. A company has four territories open, and four salesmen available for assignment. The territories are not equally rich in their sales potential. It is estimated that a typical salesman operating in each territory would bring in the following annual sales:

| Territory | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Annual sales (Rs.) | 60000 | 50000 | 40000 | 30000 |

Four salesmen also differ in their ability. It is estimated that, working under the same conditions, their yearly sales would be proportionately as follows:

| Salesman | A | B | C | D |
|---|---|---|---|---|
| Proportion | 70% | 50% | 50% | 40% |

Find the assignment of salesman to territories that will result in maximum sales. **(14 Marks)**

5 a. A project consists of 11 jobs (activities). The time required for each job and the interrelationship between the jobs has been given in the following table. Draw the network and identify the critical path. What will be the expected time of completing the project?

| Job | Time (Days) | Immediate predecessors |
|---|---|---|
| A | 13 | - |
| B | 8 | A |
| C | 10 | B |
| D | 9 | C |
| E | 11 | B |
| F | 10 | E |
| G | 8 | D, F |
| H | 6 | E |
| I | 7 | H |
| J | 14 | G, I |
| K | 18 | J |

**(08 Marks)**

b. The following table lists the activities of a project: 8

| Activity | Optimistic time (days) | Perssimistic time (days) | Most likely time (days) |
|---|---|---|---|
| 1 – 2 | 3 | 15 | 6 |
| 1 – 6 | 2 | 14 | 5 |
| 2 – 3 | 6 | 30 | 12 |
| 2 – 4 | 2 | 8 | 5 |
| 3 – 5 | 5 | 17 | 11 |
| 4 – 5 | 3 | 15 | 6 |
| 6 – 7 | 3 | 27 | 9 |
| 5 – 8 | 1 | 7 | 4 |
| 7 – 8 | 4 | 28 | 19 |

i) Draw the network.
ii) Calculate expected time and variance for each activity.
iii) Determine critical path and expected time for completing the project.
iv) What is the probability of completing the project 4 days before the expected time?
**(12 Marks)**

6 a. A TV repairman finds that the time spent on his jobs has an exponential distribution with an average of 30 minutes. If he repairs the sets in the order of their arrival and if the arrival of the sets follow Poisson distribution with a rate of 10 per 8 hour day, what is the repairmen expected idle time each day? How many sets are ahead of a new set just brought in for repair? What is the probability of having more than 4 TV sets waiting in the queue for repair? **(08 Marks)**

b. Arrivals at a telephone booth are considered to be Poisson, with an average of 10 minutes between one arrival and the next. The length of the phone call is assumed to be exponentially distributed with an average of 3 minutes.

i) What is the probability that an arrival will have to wait more than 10 minutes before the phone is free?

ii) What is the probability that it will take for an arrival more than 10 minutes altogether to wait for phone and complete his call?

iii) Estimate the fraction of a day for which the phone will be in use.

iv) The telephone department will install a second booth when convinced that an arrival would expect to have to wait at least 3 minutes in the queue. By how much the flow of arrivals should be increased in order to justify a second booth? **(12 Marks)**

7 a. The management of a big hotel is considering the periodic replacement of light bulbs fitted in its rooms. There are 500 rooms and each room has 6 bulbs. The management is now following the policy of replacing the bulbs as they fail at a cost of Rs.3 per bulb. The management feels that it can adopt a periodic replacement of all the bulbs for which the cost per bulb will be Re.1. On the basis of the information given below suggest a suitable replacement policy:

| Month | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| % bulbs failed in that month | 10 | 15 | 25 | 30 | 20 |

**(08 Marks)**

b. Certain equipment has an initial cost of Rs.30,000. The time value of money is represented by a discount factor of 0.90. Past records indicate the following maintenance costs:

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Maintenance cost | 5000 | 6000 | 8000 | 10000 | 13000 |

From sixth year onwards the maintenance cost increases by Rs.4000 per year. When should the machine be replaced? **(12 Marks)**

8 a. Using the dominance properties reduce the following game to (2 ×2) game and then solve it:

| | | B | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| A | 1 | 4 | 4 | 2 | -4 | -6 |
| | 2 | 8 | 6 | 8 | -4 | 0 |
| | 3 | 10 | 2 | 4 | 10 | 12 |
| | 4 | 3 | 5 | 8 | -6 | -8 |

**(08 Marks)**

b. Solve the following game by graphical procedure:

| | | B | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| A | 1 | 1 | 3 | 11 |
| | 2 | 8 | 5 | 2 |

**(12 Marks)**

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