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10MR763

# Seventh Semester B.E. Degree Examination, June/July 2017
## 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. Discuss the scope of OR. **(06 Marks)**

b. A publisher of text books is in the process of presenting a new book to the market. The book may be bound by either cloth or hard paper. Each cloth bound book sold contributes ₹ 30 and each paper bound book sold contributes ₹ 25. It takes 8 minutes to bind a cloth cover and 6 minutes to bind a paper back. The total available time for binding is 800 hrs. After considerable market survey, it is predicted that the cloth cover sales will be at least 2000 copies but the paperback will be at most 5000 copies. Formulate the problem as LPP and find the optimal solution by graphical method. **(14 Marks)**

2 a. Define slack, surplus and artificial variables. **(06 Marks)**

b. Solve the following LPP using Big-M method.

Minimize $z = x_2$

Subject to $3x_1 + 2x_2 \geq 0$

$x_1 + x_2 \leq 1$

$x_1 - x_2 \leq 4$

$x_1 \geq 0$, $x_2$ unrestricted in sign. **(14 Marks)**

3 a. A steel company has 3 open hearth furnaces and 5 rolling mills. transportation cost (₹/ton) for shipping steel from furnaces to mills are shown in the following table

| | $M_1$ | $M_2$ | $M_3$ | $M_4$ | $M_5$ | Capacity (tons) |
|---|---|---|---|---|---|---|
| $F_1$ | 4 | 2 | 3 | 2 | 6 | 8 |
| $F_2$ | 5 | 4 | 5 | 2 | 1 | 12 |
| $F_3$ | 6 | 5 | 4 | 7 | 3 | 14 |
| Requirement (tons) | 4 | 4 | 6 | 8 | 8 | |

Determine the optimum transportation schedule and the transportation cost. Use VAM for getting initial BFS and MODI method for optimal solution. **(12 Marks)**

b. Solve the following travelling salesman problem: **(08 Marks)**

| | A | B | C | D | E |
|---|---|---|---|---|---|
| A | ∞ | 4 | 7 | 3 | 4 |
| B | 4 | ∞ | 6 | 3 | 4 |
| C | 7 | 6 | ∞ | 7 | 5 |
| D | 3 | 3 | 7 | ∞ | 7 |
| E | 4 | 4 | 5 | 7 | ∞ |

4 a. Briefly explain what is meant by pure IPP and mixed IPP. **(06 Marks)**

b. Use Gomary's fractional cutting plane method to solve the following IPP:

Maximize $z = x_1 + 4x_2$

Subject to $2x_1 + 4x_2 \leq 7$

$5x_1 + 3x_2 \leq 15$

$x_1, x_2 \geq 0$ and are integers. **(14 Marks)**

## PART – B

5 a. Explain Fulkerson's rule for numbering the events. **(04 Marks)**

b. The details of a small project are given in the following table:

| Activity | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Predecessor (S) | - | - | - | B | A | A | B | C,D | C,D | E | F,G,H | F,G,H | I | J,K |
| Duration (weeks) | 2 | 6 | 4 | 3 | 6 | 8 | 3 | 7 | 2 | 5 | 4 | 3 | 13 | 7 |

(i) Draw an activity on arrow diagram to represent the project.

(ii) Compute ES, EF, LS, LF, TS and Free slack for each activity. Present your answer in tabular form.

(iii) What is the critical path and project duration? **(16 Marks)**

6 a. Briefly explain the characteristics of the queuing system. **(06 Marks)**

b. A departmental store has two girls servicing sales at the counters. If the service time for each customer is exponential with mean 4 min and if people arrive in a Poisson fashion at the rate of 10 per hour.

(i) What is the probability of having to wait for service?

(ii) What is the expected percentage of idle time for each girl?

(iii) If a customer has to wait, what is the expected length of his waiting time? **(14 Marks)**

7 a. Find the range p and q that will render the entry (2, 2) a saddle point in the following game: **(06 Marks)**

| | | |
|---|---|---|
| 1 | q | 6 |
| p | 5 | 10 |
| 6 | 2 | 3 |

b. Use the concept of dominance to solve the following game: **(14 Marks)**

| | | B | | |
|---|---|---|---|---|
| | | I | II | III |
| A | I | 1 | 7 | 2 |
| | II | 6 | 2 | 7 |
| | III | 5 | 1 | 6 |

8 a. Find the sequence for the following eight jobs that will minimize the total elapsed time for the completion of all jobs. Each job is processed in the order CAB. **(10 Marks)**

| | | Jobs | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Machines (hrs) | A | 4 | 6 | 7 | 4 | 5 | 3 | 6 | 2 |
| | B | 8 | 10 | 7 | 8 | 11 | 8 | 9 | 13 |
| | C | 5 | 6 | 2 | 3 | 4 | 9 | 15 | 11 |

b. Four jobs 1, 2, 3 and 4 are to be processed on each of the five machines A, B, C, D and E in the order ABCDE. Find the total minimum elapsed time if no passing of jobs is permitted. Also determine the idle time for each machine (hrs). **(10 Marks)**

| | | Machines | | | | |
|---|---|---|---|---|---|---|
| | | A | B | C | D | E |
| Jobs | 1 | 7 | 5 | 2 | 3 | 9 |
| | 2 | 6 | 6 | 4 | 5 | 10 |
| | 3 | 5 | 4 | 5 | 6 | 8 |
| | 4 | 8 | 3 | 3 | 2 | 6 |

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