Exam.Code:0016
Sub. Code: 0839

2071
Bachelor of Commerce
Sixth Semester
BCM-605: Operational Research

Time allowed: 3 Hours Max. Marks: 80

***NOTE**: Attempt <u>four</u> short answer type questions from Section–A. Attempt <u>two</u> questions each from Section B and C respectively.*

*x-x-x*

## Section – A

I. Attempt <u>any four</u> of the following:-

a) Differentiate between stock variable and surplus variable.

b) Differentiate between gradual failure and sudden failure.

c) Write the dual to the following primal LP problem :

Minimize $Z = 20x_1 + 15x_2 + 18x_3 + 10x_4$
Subject to $4x_1 - 3x_2 + 10x_3 + 4x_4 \leq 60$
$x_1 + x_2 + x_3 = 27$
$-x_2 + 4x_3 + 7x_4 \geq 35$
$x_1, x_2, x_3 \geq 0$ and $x_4$ unrestricted in sign

d) Solve graphically Max. $Z = 5x_1 + 4x_2$
Subject to $4x_1 + x_2 \leq 40$
$2x_1 + 3x_2 \leq 90$
where $x_1, x_2 \geq 0$

e) A food product company is contemplating the introduction of a revolutionary new product with new packaging to replace the existing product at much higher price ($S_1$) or a moderate change in the composition on the existing product with a new packaging at a small increase in price ($S_2$) or a small change in the composition of the existing except the word 'new' with a negligible increase in price ($S_2$). The three possible states of nature events are *(i)* high increase in sales (N), (ii) no change in sales ($N_2$) and *(iii)* decrease in sales ($N_3$). The marketing department of the company

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worked out the pay offs in terms of yearly net profits for each of the strategies for these events (expected sales). This is represented in the following table:

| State of Nature strategies | Pay-offs (in Rs.) | | |
|---|---|---|---|
| | $N_1$ | $N_2$ | $N_3$ |
| $S_1$ | 700,000 | 300,000 | 150,000 |
| $S_2$ | 500,000 | 450,000 | 0 |
| $S_3$ | 300,000 | 300,000 | 300,000 |

Which strategy should the executive concerned choose on; the basis of

(i) Maximin

(ii) Maximax

*(iii)* Minimax Regret criterions.

f) Solve the following 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 $C_{ij} = C_{ji}$, and there is no route between cities i & j if a value of $C_{ij}$ is not known. (4x5)

## Section - B

II. Write an essay on the scope and methodology of O.R. Explain briefly the main phases of an O.R. study and techniques used in solving O.R. problems.

III. Solve the L.P.P. problem:-

Max $Z = 5x_1 + 6x_2 + x_3$

Sub to $9x_1 + 3x_2 - 2x_2 \leq 5$

$4x_1 + 2x_2 - x_3 \leq 2$

$x_1 - 4x_2 + x_3 \leq 3$

$x_1, x_2, x_3 \geq 0$ (15)

IV. The captain of a cricket team has to allot five middle batting positions to five batsmen. The average runs scored by each batsman at these positions are as follows :

| | | Batting Positions | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| Batsmen | P | 40 | 40 | 35 | 25 | 50 |
| | Q | 42 | 30 | 16 | 25 | 27 |
| | R | 50 | 48 | 40 | 60 | 50 |
| | S | 20 | 19 | 20 | 18 | 25 |
| | T | 58 | 60 | 59 | 55 | 53 |

a) Find the assignment of batsman to positions which would give the maximum number of runs.

b) If another batsman U with the following average runs in batting positions as given below.

| Batting Positions | I | II | III | IV | V |
|---|---|---|---|---|---|
| Average Runs | 45 | 52 | 38 | 50 | 49 |

is added to the team, should he be included to play in the team? If so, who will be replaced by whom? (15)

V. A company has three factories and four customers. The company furnishes that following schedule of profit per unit on transportation of its goods to the customers in rupees:

| | Customers | | | | |
|---|---|---|---|---|---|
| Factory | A | B | C | D | Supply |
| P | 40 | 25 | 22 | 33 | 100 |
| Q | 44 | 35 | 30 | 30 | 30 |
| R | 38 | 38 | 28 | 30 | 70 |
| Demand | 40 | 20 | 60 | 30 | |

You are required to solve the transportation problem to maximize the profit and determine the resultant optimal profit. (15)

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## Section - C

VI. What do you understand by Decision Tree Analysis? How is a decision three drawn and how is such an analysis useful in decision making? Explain taking an examples. (15)

VII. Solve the game by using principle of dominance.

| | | Player B | | | | | |
|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI |
| Player A | 1 | 4 | 2 | 0 | 2 | 1 | 1 |
| | 2 | 4 | 3 | 1 | 3 | 2 | 2 |
| | 3 | 4 | 3 | 7 | –5 | 1 | 2 |
| | 4 | 4 | 3 | 4 | –1 | 2 | 2 |
| | 5 | 4 | 3 | 2 | –2 | 2 | 2 |

VIII. The following mortality rates have been observed for a certain type of tubes.

| Week | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| % failing by the end of the week | 5 | 15 | 35 | 75 | 100 |

There are 1000 tubes in use and it costs Rs. 5 to replace an individual tube. If all tubes are replaced simultaneously, it would cost Rs. 1.25 per tube. What should be the replacement policy ? (15)

IX. A company manufactures around 200 mopeds. Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 mopped to 204 mopped, whose probability distribution is as given below :

| Production per day | Probability |
|---|---|
| 196 | 0.05 |
| 197 | 0.09 |
| 198 | 0.12 |
| 199 | 0.14 |
| 200 | 0.20 |
| 201 | 0.15 |
| 202 | 0.11 |
| 203 | 0.08 |
| 204 | 0.06 |

The finished mopeds are transported in a specially designed three storeyed lorry that can accommodate only 200 mopped. Using the following 15 random numbers 82, 89, 78, 24, 53, 61, 18, 45, 04, 23, 50, 77, 27, 54, 10, stimulate the process to find out :

a) What will be the average number of mopeds waiting in the factory?

b) What will be the average number of empty spaces on the lorry? (15)

*x-x-x*