# CBCS SCHEME

USN | 1 | C | R | 2 | 1 | B | A | 0 | 5 | 5 |

## Second Semester MBA Degree Examination, July/August 2022
## Operations Research

Time: 3 hrs.　　　　　　　　　　　　　　　　　　　　　　Max. Marks:100

**Note: 1. *Answer any FOUR full questions from Q1 to Q7.***
**2. *Question No. 8 is compulsory.***
**3. *Use of Normal Distribution Table is permitted.***

1　a.　Define operation research.　　　　　　　　　　　　　　　**(03 Marks)**
　　b.　Discuss the applications of operations research.　　　　　　**(07 Marks)**
　　c.　Use the graphical method to solve the following LP problem
　　　　Maximize $Z = 15x_1 + 10x_2$
　　　　Subject to the constraints　$4x_1 + 6x_2 \leq 360$
　　　　　　　　　　　　　　　　$3x_1 + 0x_2 \leq 180$
　　　　　　　　　　　　　　　　$0x_1 + 5x_2 \leq 200$
　　　　　　　　　　　　　　and　$x_1, x_2 \geq 0$　　　　　　　　**(10 Marks)**

2　a.　What is a basic feasible solution? Mention the type of basic feasible solution.　**(03 Marks)**
　　b.　A computer centre has three expert programmes. The centre want three application programmes to be developed. The head of the computer centre, after studying carefully the programmes to be developed, estimates the computer time in minutes required by the experts for the applications programmes as follows:

| | | Programmers | |
|---|---|---|---|
| | A | B | C |
| Programmes　1 | 120 | 100 | 80 |
| 2 | 80 | 90 | 110 |
| 3 | 110 | 140 | 120 |

Assign the programmers to the programmes in a such a way that the total computer time is minimum.　　　　　　　　　　　　　　　　　　　　　　　　　　**(07 Marks)**
　　c.　Briefly discuss the operations research models.　　　　　　**(10 Marks)**

3　a.　What is an assignment problem?　　　　　　　　　　　　**(03 Marks)**
　　b.　Use Vogel's Approximation Method (VAM) to find initial basic feasible solution, for the following transportation problem.

| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | Supply |
|---|---|---|---|---|---|
| $S_1$ | 19 | 30 | 50 | 10 | 7 |
| $S_2$ | 70 | 30 | 40 | 60 | 9 |
| $S_3$ | 40 | 8 | 70 | 20 | 18 |
| Demand | 5 | 8 | 7 | 14 | 34 |

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**(07 Marks)**
　　c.　Explain the various assumption, Advantages and limitation of linear programming models.　　　　　　　　　　　　　　　　　　　　　　　　　　**(10 Marks)**

4  a. What is pure strategy and mixed strategy? (03 Marks)

b. A company management and the labour union are negotiating a new three year settlement. Each of these has 4 strategies. The costs to the company are given for every pair of strategy choice.

| Union strategies | Company strategies | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| I | 20 | 15 | 12 | 25 |
| II | 25 | 14 | 8 | 10 |
| III | 40 | 2 | 10 | 5 |
| IV | -5 | 4 | 11 | 0 |

What strategy will the two sides adopt? Also determine the value of the game. (07 Marks)

c. Determine an initial basic feasible solutions to the following transportation problem by using
i) NWCM     ii) LCM.

| Destination / Source | $D_1$ | $D_2$ | $D_3$ | Supply |
|---|---|---|---|---|
| $S_1$ | 6 | 4 | 1 | 50 |
| $S_2$ | 3 | 8 | 7 | 40 |
| $S_3$ | 4 | 4 | 2 | 60 |
| Demand | 20 | 95 | 35 | |

(10 Marks)

5  a. What is network analysis? (03 Marks)

b. Find the best strategy for each player and value of the game.

Player B

| Player A | $B_1$ | $B_2$ |
|---|---|---|
| $A_1$ | 1 | $-\frac{1}{2}$ |
| $A_2$ | $-\frac{1}{2}$ | 0 |

(07 Marks)

c. The following matrix gives the payoff (Rs.) of different strategies $S_1$, $S_2$ and $S_3$ against conditions $N_1$, $N_2$ and $N_3$. What is the best strategy based on i) maximini criterion ii) Laplace criterion.

| Strategies | States of nature | | |
|---|---|---|---|
| | $N_1$ | $N_2$ | $N_3$ |
| $S_1$ | 7,00,000 | 3,00,000 | 1,50,000 |
| $S_2$ | 5,00,000 | 4,50,000 | 0 |
| $S_3$ | 3,00,000 | 3,00,000 | 3,00,000 |

(10 Marks)

6  a. What are the objectives of scheduling? (10 Marks)

b. What are the steps of decision – making process? (03 Marks)

c. Find the sequence that minimizes the total time required in performing the following jobs on three machines in the order ABC. Processing times (in hours) are given in the following table (07 Marks)

| Job | : | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Machine A | : | 8 | 10 | 6 | 7 | 11 |
| Machine B | : | 5 | 6 | 2 | 3 | 4 |
| Machine C | : | 4 | 9 | 8 | 6 | 5 |

(10 Marks)

7    a.  What do you mean by simulation?    (03 Marks)

   b.  A bakery keeps stock of a popular brand of cake previous experience shows the daily demand pattern for the item with associated probabilities as given below :

| Daily demand (No) | : | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|
| Probability | : | 0.01 | 0.20 | 0.15 | 0.50 | 0.12 | 0.02 |

Use the following sequence of random numbers to simulate the demand for next 10 days.
Random numbers 6, 40, 19, 87, 83, 73, 84, 29, 09, 02, 20    (07 Marks)

   c.  The following network diagram represents activities associated with a project (weeks)

| Activities | : | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|---|
| Optimistic time | : | 5 | 18 | 26 | 16 | 15 | 6 | 7 | 7 | 3 |
| Pessimistic time | : | 10 | 22 | 40 | 20 | 25 | 12 | 12 | 9 | 5 |
| Most likely time | : | 8 | 20 | 33 | 18 | 20 | 9 | 10 | 8 | 4 |

Determine the following :
   i)  The critical path
   ii)  The length of the critical path
   iii)  The probability of expected completion time of the project if the original scheduled time of completing the project is 41.5 weeks.    (10 Marks)

8    CASE STUDY [Compulsory]

   a.  Draw network diagram for the following data :
Determine:  i) Critical path and its length   ii) Total and free float.

| Activities | : | 1 – 3 | 1 – 4 | 2 – 6 | 2 – 7 | 3 – 4 | 4 – 9 | 7 – 8 | 8 – 10 |
|---|---|---|---|---|---|---|---|---|---|
| Duration | : | 2 | 12 | 9 | 2 | 10 | 6 | 4 | |

(10 Marks)

   b.  An agriculturist has a 125 acre farm. The produces radish, muttar and potato. Whatever he raises is sold fully in the market. He gets Rs. 5 per kg for radish Rs. 4 per kg for muttar and Rs. 5 per kg for potato. The average per acre yield is 1500Kg of radish, 1800Kg of muttar and 1200kg of potato. To produce each 100Kg of radish and muttar and 80kg of potato, a sum of Rs. 12.50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for radish and potato each and 5 man-days for muttar. A total of 500 man-days of labour at a rate of Rs. 40 per man-day is available.
Formulate this as a linear programming model to maximize the agriculturist's total profit.    (10 Marks)

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1. a) operations Research
"A scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control." ③

b) Applications of OR
→ Game theory.
→ decision theory.
→ Queuing theory
→ Inventory models
→ Simulation
→ Dynamic programming
→ Simulation process
→ network scheduling

writing the points
3 marks and 4 marks for explanation. ⑦

c) max. Z = 2,400
$X_1 = 100$, $X_2 = 90$

5 marks for graph &
5 marks for justified ⑩

2. a) Basic feasible Solution
It is a solution with a minimal set of non-zero variables. ③

b)

| Programmes | Programmes | Time |
|---|---|---|
| 1 | C | 80 |
| 2 | A | 80 |
| 3 | B | 140 |
| | Total Min. Time | 300 |

⑦

①

c) Operations Research models
  → Transportation
  → Simulation
  → Queuing model
  → Network techniques
  → Game theory
  → Linear programming

  } 3 marks for writing points and 7 marks for explanation (10)

B.9) Assignment problem
  It is a fundamental combinatorial optimization problem. (3)

b) VAM = 2300 ₨. (7)

c) Linear programming models
  Assumptions:
  → Constraints and the objective function.
  → parameters are vary as per magnitude
  → Optimal value based on certain available problem

  Limitation: (10)
  → All relations are linear then it may not hold good for all the situations.
  → All the constraints and coefficients are mentioned in linear programming with certainty
  → we cannot compute the solution manually if number of variables or constraints are very large.

  ②

a) Pure strategy and mixed strategy
A mixed strategy is an assignment of a (3)
probability to each pure strategy.

b) min. cost = ß 19. (7)

$12 + 10 + 2 - 5 = 19.$

c) NWCM = ß 210 (w)

LCM = ß. 280

5. a) Network Analysis [Structure representing a group of objectives and relationship between them.] (3)
meaning need to be written.

b) V (value of Game) = 12. (7)

c) Maximin = 3,00,000  } 5 marks for (w)
replace = 3,00,000  } each.

6. a) objectives of scheduling (3)
→ Making efficient use of lbr.
→ increasing the profit
→ increasing the %.
→ improving the service level

b) Steps in decision-making process (6)
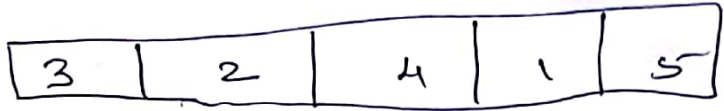→ Identify the decision
→ Gather relevant info%.
→ Identify the alternative
→ Evidence                   } continues
→ choose among alternatives  } 5 marks &
→ Take action                } explanation
→ Review your decision & its } 5 marks
  consequences. (3)

c)

Job sequencing

| 3 | 2 | 4 | 1 | 5 |

Total time = 45 hours

idle time : $MB = 7$ hours

$MC = 8$ hours

(10)

7. a) Simulation

It is a method of solving decision making problem by designing, constructing and manipulating a model of the real system

(5)

b) Question is Incomplete.

(10)

c) Question is Incomplete.

(10)

8. a) Question is incomplete.

(10)

b)

Max. $Z = 5X_1 + 4X_2 + 5X_3$

$1500 X_1 + 1800 X_2 + 1200 X_3 \leq 6$

$100 X_1 + 80 X_2 + 12.50 X_3 \leq 5$

$X_1, X_2, X_3 \geq 0.$

(10)

———— end of scheme & solution ————

(4)