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# 0804E053

Candidate's Seat No :_____

**IM.Sc. DS Sem.-6 Examination**

**CC-311**

**Operation Research**

**April-2025**

**Time : 2-30 Hours]** **[Max. Marks : 70**

**Instructions:** All questions are compulsory. Use of a non-programmable scientific calculator is allowed.

**Q.1** **(a)** A firm manufactures two products, A and B, from which the profits earned per unit are Rs. 3 and Rs. 4 respectively. Each product is processed on two machines, $M_1$ and $M_2$. Product A requires one minute of processing time on $M_1$ and two minutes on $M_2$. While B requires one minute on $M_1$ and one minutes on $M_2$. Machine $M_1$ is available for not more than 7 hours while machine $M_2$ is available for 10 hours during any working days. Find the number of units of products A and B to be manufactured to get maximum profit. Formulate the above as a linear programming problem to maximize the total profit. **(07)**

**(b)** Give dual of the given LPP: **(07)**

Maximize $z = -5x - 7y$;

Subject to the constrains $x + y \geq 3$;

$2x + y \leq 4$;

$3x + 2y \geq 15$;

$y \leq 7$, with $x, y \geq 0$

**OR**

**(a)** Give solution up to first simplex iterative table (only) using simplex method for following LPP **(07)**

Maximize $z = 3x_1 + 4x_2 + 7x_3$

Subject to the constrains: $100x_1 + 120x_2 + 70x_3 \leq 1{,}00{,}000$;

$7x_1 + 10x_2 + 8x_3 \leq 8{,}000$;

$x_1 + x_2 + x_3 \leq 1{,}000$, where $x_1, x_2, x_3 \geq 0$

**(b)** Use Big-M method to Maximize $z = 3x + 5y$; **(07)**

Subject to the constrains $2x + 3y \leq 24$;

$4x + 8y \leq 18$;

$x + y \geq 5$, with $x, y \geq 0$

Give which variable enters onto the basis and which leaves the basis at the end of second Simplex iterative table.

**Q.2** **(a)** What is the Transportation Problem? State its types? **(07)**

A company has three plants (A, B, and C) with supplies of 40, 30, and 20 units respectively. It needs to supply four warehouses (W, X, Y, and Z) with demands of 25, 35, 20, and 10 units, respectively.



(P.T.O)

| Factories | Warehouses | | | |
|---|---|---|---|---|
| | W | X | Y | Z |
| A | 9 | 7 | 10 | 8 |
| B | 8 | 11 | 9 | 11 |
| C | 13 | 10 | 12 | 10 |

Solve for the initial basic feasible solution by using the Northwest Corner Method.

**(b)** Solve the following Travelling Salesman Problem. Find the Path and minimum cost. **(07)**

| | A | B | C | D | E |
|---|---|---|---|---|---|
| A | ∞ | 2 | 5 | 7 | 1 |
| B | 6 | ∞ | 3 | 8 | 2 |
| C | 8 | 7 | ∞ | 4 | 7 |
| D | 12 | 4 | 6 | ∞ | 5 |
| E | 1 | 3 | 2 | 8 | ∞ |

**OR**

**(a)** Solve the Assignment problem by using Hungarian Method. Assign the jobs for different machines to minimize the total cost. **(07)**

| Jobs | Machines | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 1 | 13 | 8 | 16 | 18 | 19 |
| 2 | 9 | 15 | 24 | 9 | 12 |
| 3 | 12 | 9 | 4 | 4 | 4 |
| 4 | 6 | 12 | 10 | 8 | 19 |
| 5 | 15 | 17 | 18 | 12 | 20 |

**(b)** A production company needs to ship goods from three warehouses to four destinations. The cost per unit between each warehouse and destination is given. **(07)**

| Warehouses | Destinations | | | | Supply |
|---|---|---|---|---|---|
| | D1 | D2 | D3 | D4 | |
| W1 | 3 | 1 | 7 | 4 | 250 |
| W2 | 2 | 6 | 5 | 9 | 350 |
| W3 | 8 | 3 | 3 | 2 | 400 |
| Demand | 200 | 300 | 350 | 150 | |

Use MODI Method to determine the optimal solution.

**Q.3** **(a)** What is the primary objective of the Critical Path Method (CPM)? Explain the difference between total float and free float in CPM. **(07)**

**(b)** The following indicates the details of a project. The durations are in days; '$a$' refers to optimistic time, '$m$' refers to most likely time and '$b$' refers to pessimistic time duration. **(07)**

| Activity | 1-2 | 1-3 | 1-4 | 2-4 | 2-5 | 3-4 | 4-5 |
|---|---|---|---|---|---|---|---|
| a | 2 | 3 | 4 | 8 | 6 | 2 | 2 |
| m | 4 | 4 | 5 | 9 | 8 | 3 | 5 |
| b | 5 | 6 | 6 | 11 | 12 | 4 | 7 |

I. Draw the network.
II. Find the critical path.

**OR**

**(a)** Listed in the table are the activities and sequencing requirements necessary for the completion of a research project. **(07)**

| Activity | Description | Procedure | Duration (Week) |
|---|---|---|---|
| A | Literature search | - | 6 |
| B | Formulation of Hypothesis | - | 5 |
| C | Preliminary Feasibility study | B | 2 |
| D | Formal Disposal | C | 2 |
| E | Field analysis | A, D | 2 |
| F | Progress Report | D | 1 |
| G | Formal Research | A, D | 6 |
| H | Data collection | E | 5 |
| I | Data analysis | G, H | 6 |
| J | Conclusions | I | 2 |
| K | Rough draft | G | 4 |
| L | Final copy | J, K | 3 |
| M | Preparation of oral presentation | L | 1 |

I. Draw a network diagram for this project.
II. Find the critical path and duration of the project.



(P.T.O)

**(b)** Discuss in brief: The origin, use and applications of PERT and CPM. **(07)**

**Q.4** **(a)** State assumptions for economic order model and derive it when shortages are not allowed. **(07)**

**(b)** A company has a demand for a product of 1000 items per month. The purchase cost is Rs. 12 per item and the cost of ordering the material is Rs. 100 per order. The holding charge fraction is 20 % per annum. Find EOQ and total cost. **(07)**

**OR**

**(a)** The cost of parameters and other factors for a production inventory system of paint color are given below. Find (a) optimal lot size, (b) number of shortages, and (c) manufacturing time and time between set-ups. **(07)**

Demand per year = 3000 units
Units cost = Rs 20
Set-up cost Rs 100
Production rate per year = 36000 units
Holding cost per year = Rs 5
Shortage cost per unit per year Rs 20

**(b)** Derive inventory formula (only) for economic production inventory model when shortages are not allowed. **(07)**

**Q.5** Attempt any **SEVEN** out of **TWELVE:** **(14)**

**(1)** If a primal LP problem has a finite solution, then the dual LP problem should have
A) Finite solution.
B) Infeasible solution
C) Unbounded solution.
D) None of the above.

**(2)** Consider the L.P. Problem
Minimize z = 5x2
Subject to $x_1 = 4,\ x_2 = 7,\ x_1 \geq 0,\ x_2 \geq 0$ then, the solution to the given L.P.P. is
A) Unbounded
B) Infeasible
C) Unique
D) Multiple optimum solution.

**(3)** If dual has unbounded solution, primal has
A) No feasible solution.
B) Unbounded solution.
C) Feasible solution.
D) None of the above.

**(4)** In an assignment problem involving 5 workers and 5 jobs, the total number of assignments possible are _____.
A) 5!
B) 10
C) 25
D) 5

**(5)** The three probabilistic estimates about one activity analyzed under PERT have three-time estimates of 4,5 and 6 days for the optimistic, normal, and pessimistic situation respectively. The expected time in days under PERT will be:

A) 5.167 days
B) 5 days
C) 9 days
D) 6 days

**(6)** In the optimum solution, more than one empty cell has their opportunity cost as zero, it indicates

A) The solution is not optimal.
B) The problem has alternate solutions.
C) The problem will be a cycle.
D) Something wrong with the solution

**(7)** The activity that can be delayed without affecting the execution of the immediate succeeding activity is determined by

A) Total Float
B) Free Float
C) Independent Float
D) Dummy Float

**(8)** In PERT/CPM, the merge event represents _____ of two or more events.

A) Splitting
B) Completion
C) Beginning
D) Joining

**(9)** When the total allocations in a transportation model of $m \times n$ size do not equal to $m + n - 1$ then the situation is known as

A) Unbalanced situation
B) Degeneracy
C) Tie situation
D) Optimum situation

**(10)** Which assumption is true for the EOQ model with a finite replenishment rate

A) Replenishment rate is finite at P uints/time units with P < R
B) Replenishment rate is finite at P uints/time units with P > R
C) Replenishment rate is finite at P uints/time units with R/P
D) Replenishment rate is finite at P uints/time units with P/R

**(11)** The total cost of an inventory system when shortages are not allowed is a sum of

A) Inventory holding cost
B) Shortage cost
C) Set up cost
D) both (A) and (C)

**(12)** The ordering cost per order and average carrying cost is constant, and demand suddenly falls by 50%, then by what rate EOQ will change?

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