Code No: 721CN

**R15**

**Note:** This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

### PART - A                                    5 × 5Marks = 25

1.a) Choose proper option and right your choice in complete word/s.                [5]
   I) Operations Research (OR), which is a very powerful tool for ------------ Research.
      i) Decision Making
      ii) Operations
      iii) None of the above
      iv) Both
   II) Who coined the term Operations Research?
      i) J.F. McCloskey
      ii) F.N. Trefethen
      iii)P.F. Adams
      iv) Both A and B
   III) The term Operations Research was coined in the year --------------
      i) 1950
      ii) 1940
      iii)1978
      iv) 1960
   IV) This innovative science of Operations Research was discovered during -------------
      i) Civil War
      ii) World War I
      iii) World War II
      iv) Industrial Revolution
      v) Cold war
   V) Operations Research was known as an ability to win a war without really going in to a --------------
      i) Battle field
      ii) Fighting
      iii) War
      iv) Both A and B

b) Solve the following transportation problem (use Vogel's Method only and check for optimality).                [5]

|        | 1  | 2  | 3  | Capacity |
|--------|----|----|----|----------|
| 1      | 2  | 2  | 3  | 10       |
| 2      | 4  | 1  | 2  | 15       |
| 3      | 1  | 3  | 1  | 40       |
| Demand | 20 | 15 | 30 |          |

c) What is an assignment problem? Give two examples. What is the difference between a transportation problem and an assignment problem? [5]

d) What are the different criterions of decision making? What is the difference between decision making under uncertainty and risk? [5]

e) Explain the following terms in the context of queuing models: [5]
   (i) Traffic intensity
   (ii) Service Channels
   (iii) Steady and transient state
   (iv) Utilization factor
   (v) Queue disipline

## PART - B                           5 ×10Marks = 50

2. Solve the following example:
   Maximize $z = 4x_1 + 6x_2 + 2x_3$;
   Subject to,
   $x_1 + x_2 + x_3 \leq 3$;
   $x_1 + 4x_2 + 7x_3 \leq 9$;
   $x_1, x_2, x_3 \geq 0$

   Solve the LPP. Find the range on the value of non-basic variable coefficient $c_3$ such that the current solution will still remain optimal. [10]

### OR

3. Consider the following LPP problem:
   Maximize $Z = x_1 + 2x_2$;
   subject to $x_1 + 3x_2 \leq 8$;
   $x_1 + x_2 \leq 4$;
   And
   $x_1 \geq 0, x_2 \geq 0$
   (a) Use graphical analysis to identify all the *corner-point solutions* for this model. Label each as either feasible or infeasible.
   (b) Calculate the value of the objective function for each of the CPF solutions. Use this information to identify an optimal solution. [10]

4.  The ABC Corporation has decided to produce three newproducts. Five branch plants now have excess product capacity. The unit manufacturing cost of the first product would be 31K, 29K,32K, 28K, and 29K (in rupees) in Plants 1, 2, 3, 4, and 5, respectively. The unitmanufacturing cost of the second product would be 45K, 41K, 46K, 42K, and 43K(in rupees) in Plants 1, 2, 3, 4, and 5, respectively. The unit manufacturing cost of the third product would be 38K, 35K, and 40K (all in rupees) in Plants 1, 2, and 3, respectively, whereas Plants 4 and 5 do not havethe capability for producing this product. Sales forecasts indicatethat 600, 1,000, and 800 units of products 1, 2, and 3, respectively,should be produced per day. Plants 1, 2, 3, 4, and 5 have the capacityto produce 400, 600, 400, 600, and 1,000 units daily, respectively,regardless of the product or combination of products involved.

    Assume that any plant having the capability and capacity to produce them can produce any combination of the products in any quantity.

    Management wishes to know how to allocate the new products to the plants to minimize total manufacturing cost.

    (a) Formulate this problem as a *transportation problem* by constructing the appropriate parameter table.

    (b) Obtain an optimal solution.                                               [10]

**OR**

5.  A canning company operates two canning plants, A and B. Three grower are willing to supply the following amounts of fresh fruits:

    Kumar      200 tons at Rs. 100 per ton
    Raja        300 tons at Rs. 90 per ton
    Vimal       400 tons at Rs. 80 per ton

    Shipping costs in rupees per ton is given in the following table.

    | From | To | |
    |---|---|---|
    |  | **Plant A** | **Plant B** |
    | Kumar | 20 | 20.50 |
    | Raja | 10 | 10.50 |
    | Vimal | 50 | 30.00 |

    Plant capacities and labour costs are as follows:

    |  | Plant A | Plant B |
    |---|---|---|
    | Capacity | 450 tons | 550 tons |
    | Labour Cost | Rs. 25/ton | Rs. 20/ton |

    The canned fruits are sold at Rs. 250 per ton to the distributors. The company can sell at this price, the entire quantity it produces. How should the company plan its operations at two plants so as to maximize profits?                    [10]

6.  JoShop wants to assign for different categories of machines of five types of tasks. The number of machines available in the four categories are 25, 30 20, and 30. The number of jobs in the five tasks are 20, 20, 30, 10, and 25. Machine category 4 cannot be assigned to task type 4. The following table provides the unit cost (in dollars) of assigning a machine category to a task type. Solve the problem and interpret the solution.                                                        [10]

| Machine Category | Task Type | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | 10 | 2 | 3 | 15 | 9 |
| 2 | 5 | 10 | 15 | 2 | 4 |
| 3 | 15 | 5 | 14 | 7 | 15 |
| 4 | 20 | 15 | 13 | - | 8 |

**OR**

7. The Cost matrix is given below. Solve it as an assignment problem and write your findings. [10]

| | | Task | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Assignee | A | 4 | 1 | 0 | 1 |
| | B | 1 | 3 | 4 | 0 |
| | C | 3 | 2 | 1 | 3 |
| | D | 2 | 2 | 3 | 0 |

8. For a game played between two players the payoff of the first player is given in the following table:

| Strategy | | Player 2 | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Player 1 | 1 | 3 | -3 | -2 | -4 |
| | 2 | -4 | -2 | -1 | 1 |
| | 3 | 1 | -1 | 2 | 0 |

Solve the game using at least two criterions. [10]

**OR**

9. Consider the game having the following payoff table.

| Strategy | | Player 2 | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Player 1 | 1 | 5 | -7 | -2 | 2 |
| | 2 | -2 | 2 | -5 | 5 |
| | 3 | -2 | 5 | -2 | 7 |

Determine the optimal strategy for each player by successively eliminating dominated strategy. What is the value of the game? Can we call the game as a fair game? [10]

10.a) Explain a typical queuing system with required assumptions. What is an M/M/s system? Explain.

b) A repairman is to be hired to repair machines which break down at an average rate of three per hour. Breakdowns are distributed in a manner that may be regarded as Poisson. Non-productive time on any one machine is considered to cost the company $5 per hour. The company has narrowed down to two repairman one slow but cheap and the other fast but expensive. The slow cheap repairman asks $3 per hour; in return he will service breakdown machines at an average rate of four per hour. The fast expensive repairman demands $5 an hour, and will repair machines exponentially at an average rate of six per hour. Which repairman should be hired? [10]

**OR**

11. The Garrett-Tompkins Company provides three copymachines in its copying room for the use of its employees. However, due to recent complaints about considerable time being wasted waiting for a copier to become free, management is consideringadding one or more additional copy machines. During the 2,000 working hours per year, employees arrive atthe copying room according to a Poisson process at a mean rate of 30 per hour. The time each employee needs with a copy machineis believed to have an exponential distribution with a mean of 5minutes. The lost productivity due to an employee spending time in the copying room is estimated to cost the company an average of $25 per hour. Each copy machine is leased for $3,000 per year. Determine how many copy machines the company should have to minimize its expected total cost per hour. [10]

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