**SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)**
**(Affiliated to the University of Madras and Re-accredited with 'A+' Grade by NAAC)**
**Chromepet, Chennai — 600 044.**
**M.Sc. - END SEMESTER EXAMINATIONS APRIL - 2022**
**SEMESTER - IV**
**20PAMET4005 - Operations Research**

**Total Duration : 3 Hrs.** **Total Marks : 60**

## Section A

Answer any **SIX** questions $(6 \times 5 = 30$ Marks)

1. Solve the LP problem by dual-simplex method
   Minimize Z = $3x_1 + x_2$
   subject to the constraints
   (i)$x_1 + x_2 \geq 1$, (ii)$2x_1 + 3x_2 \geq 2$ and $x1$, $x2 \geq 0$

2. Use dynamic programming to solve the following problem
   Maximize Z = $x_1^2 + 2x_2^2 + 4x_3$
   subject to the constraint
   $x_1 + 2x_2 + x_3 \leq 8$ and $x_1$, $x_2$, $x_3 \geq 0$.

3. The production department of a company requires 3,600 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is Rs 36 and the cost of carrying inventory is 25 per cent of the investment in the inventories. The price is Rs 10 per kg. Help the purchase manager to determine an ordering policy for raw material.

4. In a factory cafeteria the customers (employees) have to pass through three counters. The customers buy coupons at the first counter, select and collect the snacks at the second counter and collect tea at the third. The server at each counter takes, on an average, 1.5 minutes, although the distribution of service time is approximately Poisson at an average rate of 6 per hour. Calculate
   (a) The average time a customer spends waiting in the cafeteria.
   (b) The average time of getting the service.
   (c) The most probable time in getting the service.

5. Use the method of Lagrangian multipliers to solve the following NLP problem. Does the solution maximize or minimize the objective function ?
   Optimize Z = $2x_1^2 + x_2^2 + 3x_3^2 + 10x_1 + 8x_2 + 6x_3$ - 100
   subject to the constraint
   g (x) = $x_1 + x_2 + x_3 = 20$ and $x_1$, $x_2$, $x_3 \geq 0$

6. What are the advantages of dual simplex method? What is the essential difference between regular simplex method and dual simplex method?

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7. At present a company purchases an item X from outside suppliers. The consumption of this item is 10,000 units/year. The cost of the item is Rs 5 per unit and the ordering cost is estimated to be Rs 100 per order. The cost of carrying inventory is 25 per cent. If the consumption rate is uniform, determine the economic purchasing quantity. Assume that company is going to manufacture the item with the equipment that is estimated to produce 100 units per day. The cost of the unit thus produced is Rs 3.50 per unit. The set-up cost is Rs 150 per set-up and the inventory carrying charge is 25 per cent. How has your answer changed?

8. Determine $x_1$ and $x_2$ so as to
   Maximize Z = $12x_1 + 21x_2 + 2x_1\ x_2 - 2x_1^2 - 2x_2^2$
   subject to the constraints
   (i) $x_2 \leq 8$, (ii) $x_1 + x_2 \leq 10$, and $x1, x2 \geq 0$

## Section B

### Part A

Answer any **TWO** questions $(2 \times 10 = 20$ Marks)

9. Use the revised simplex method to solve the following LP problem
   Maximize Z = $3x_1 + 5x_2$
   subject to the constraints
   (i) $x_1 \leq 4$, (ii) $x_2 \leq 6$, (iii) $3x_1 + 2x_2 \leq 18$ and $x_1, x_2 \geq 0$

10. Suppose there are n machines that can perform two jobs. If x number of them do the first job, then they produce goods worth g(x) = $3x$, and if y number of them perform the second job, then they produce goods worth $h$(y)=2.5y. Machines are subject to depreciation so that after performing the first job only $a(x) = x/3$ machines remain available and after performing the second job $b$(y) = 2y/3 machines remain available in the beginning of the second year. The process is repeated with the remaining machines. Obtain the maximum total return after three years and also find the optimal policy in each year.

11. A dealer supplies you the following information with regard to a product that he deals in: Annual demand = 10,000 units; Ordering cost = Rs 10 per order; Price = Rs 20 per unit Inventory carrying cost = 20 per cent of the value of inventory per year. The dealer is considering the possibility of allowing some backorder (stockout) to occur. He has estimated that the annual cost of backordering will be 25 per cent of the value of inventory.
    (a) What should be the optimum number of units of the product he should buy in one lot?

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(b) What quantity of the product should be allowed to be backordered, if any?
(c) What would be the maximum quantity of inventory at any time of the year?
(d) Would you recommend to allow backordering? If so, what would be the annual cost saving by adopting the policy of backordering.

12. The demand for an item in a company is 18,000 units per year, and the company can produce the item at a rate of 3,000 per month. The cost of one set-up is Rs 500 and the holding cost of one unit per month is 15 paise. The shortage cost of one unit is Rs 240 per year. Determine the optimum manufacturing quantity and the number of shortages. Also determine the manufacturing time and the time between set-ups.

## Part B

Compulsory question $(1 \times 10 = 10$ Marks)

13. Use Wolfe's method to solve the quadratic programming problem:
    Maximize Z = $4x_1 + 6x_2 - 2x_1^2 - 2x_1x_2 - 2x_2^2$
    subject to the constraint
    $x_1 + 2x_2 \leq 2$ and $x_1, x_2 \geq 0$

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