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M.A./M.Sc. (IV Sem.) Examination, 2020

MATHEMATICS

Paper MATH-4 O(*i*)

(Operations Research-II)

Time Allowed : Three Hours

Maximum Marks : 70

Minimum Pass Marks : 28

Note :— Non-Programmable Scientific Calculator is allowed in this paper.

This question paper will be divided into ***three*** *sections as under :*

Section-A ***Max. Marks-10***

This Section contains 1 compulsory question comprising ***10*** *short answer type questions (maximum* ***20*** *words answer) taking* ***two*** *questions from each unit. Each question shall be of* ***one*** *mark.*

Section-B ***Max. Marks-25***

This Section contains ***10*** *questions,* ***2*** *questions from each unit (answer about in* ***250*** *words). Students are instructed to attempt* ***five*** *questions by selecting* ***one*** *question from each unit. Each question shall be of* ***five*** *marks.*

Section-C ***Max. Marks-35***

This Section contains ***five*** *long answer type questions comprising* ***one*** *compulsory question (Question No.* ***7****) of* ***15*** *marks and* ***four*** *questions of* ***10*** *marks each. Students are instructed to attempt total* ***three*** *questions with* ***one*** *compulsory question (answer about in* ***500*** *words) and any* ***two*** *more questions (answer about in* ***400*** *words) out of remaining* ***four*** *questions.*

Section A

1. (*a*) Write models of dynamic programming.

   (*b*) State the principle of optimality in dynamic programming.

   (*c*) Write *three* advantages of inventory.

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(d) Define probabilistic model.

(e) Write the necessary and sufficient conditions for non-negative saddle point.

(f) Write the K.T. conditions for constrained optimization.

(g) Define Kuhn-Tucker necessary conditions for an optimal solution to a quadratic programming problem.

(h) Define separable convex programming problem.

(i) Define *three* types of customers behaviour in queueing theory.

(j) What is transient and steady states.

Section B

Unit I

2. Use dynamic programming to show that :

$$\sum_{i=1}^{n} p_i \log p_i \text{ subject to } \sum_{i=1}^{n} p_i = 1,\ p_i \geq 0$$

is minimum. When $p_1 = p_2 = \ldots\ldots = p_n = \frac{1}{n}$.

3. Use dynamic programming to solve the following L.P.P. :

Max.. $Z = 2x_1 + 5x_2$

Subject to :

$$2x_1 + x_2 \leq 43$$

$$2x_2 \leq 46$$

and $x_1 \geq 0,\ x_2 \geq 0.$

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Unit II

4. ABC manufacturing company purchases 9000 parts of a machine for its annual requirements, ordering one month usage at a time. Each part costs Rs. 20. The ordering cost per order is Rs. 15, and carrying charges are 15% of the average inventory per year.

You have been asked to suggest a more economical policy for the company. What advice would you offer, and how much would it save per year.

5. The demand of an item in a company is 18000 units per year and the company can produce the item at a rate of 3000 per month. The cost of one set up is Rs. 500 and the holding cost of one unit per month is 15 paisa. The shortage cost of one unit is Rs. 20 per year, find :

   (*a*) The optimum manufacturing quantity and the number of shortage.

   (*b*) The manufacturing time and the time between set-ups.

Unit III

6. Use Lagrange multiplier technique to maximize a function $z = x_1 \cdot x_2 \ldots\ldots\ldots x_n$ subject to the constraints :

$$x_1 + x_2 + x_3 + \ldots\ldots\ldots + x_n = b$$

$$x_i \geq 0, \; i = 1, 2 \ldots\ldots\ldots n$$

given $b > 0$.

7. Write the Kuhn-Tucker conditions for the problem :

$$\text{Max. } Z = -x_1^2 - x_2^2 - x_3^2 + 4x_1 + 6x_2$$

Subject to :

$$x_1 + x_2 \leq 2$$

$$2x_1 + 3x_2 \leq 12$$

and $x_1, x_2 \geq 0$.

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Unit IV

8. Solve the following quadratic programming problem by Beale's method :

$$\text{Max. } f(x) = 2x_1 + 3x_2 - 2x_2^2$$

Subject to :

$$x_1 + 4x_2 \leq 4$$

$$x_1 + 2x_2 \leq 2$$

and $x_1 \geq 0,\ x_2 \geq 0.$

9. Find an approximate optimal solution of the following separable programming problem :

$$\text{Max. } Z = x_1 + x_2^4$$

Subject to :

$$3x_1 + 2x_2^2 \leq 9$$

and $x_1 \geq 0,\ x_2 \geq 0.$

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Unit V

10. In a railway Marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the inter-arrival time follows an exponential distribution and the service time distribution is also exponential with an average 36 minutes. Calculate the following :

(a) The mean queue size.

(b) The probability that the queue size exceeds 10

11. If for a period of 2 hours in a day (7 a.m. to 9 a.m.) customers arrive in a barber's shop that has space to accommodate only 4 customers. Arrival rate of customers is 3 per hour and service time in 36 minutes per customer. For the above period find :

(a) The probability that there is no customers in the shop.

(b) Average number of customer in the shop.

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Section C

12. Solve the following quadratic programming problem by Wolfe's method :

Max. $Z = x_1 + x_2 - x_1^2 + x_1x_2 - 2x_2^2$

Subject to :

$$2x_1 + x_2 \leq 1$$

and $x_1 \geq 0,\ x_2 \geq 0.$

13. Derive the Kuhn-Tucker necessary conditions for the general non-linear programming problem :

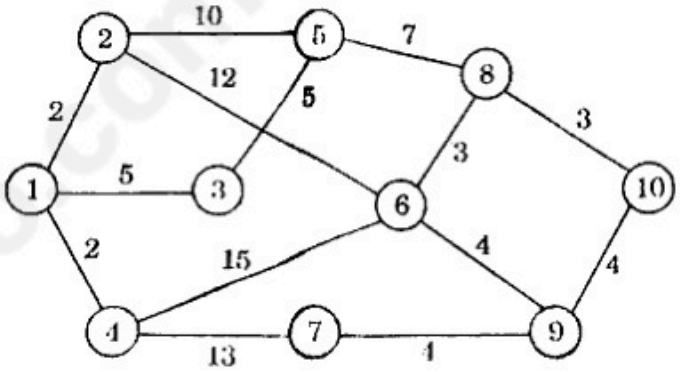
$g_i(X) \geq 0,\ i = 1, 2, 3 \ldots\ldots n,\ X \geq 0$

Maximize :

$Z = f(x).$

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14. From the following route-distance chart find the route by dynamic programming which minimize the distance for travelling from station 1 to station 10 :



15. (*a*) Five jobs must go through three machines M_1, M_2 and M_3 in the order $M_1M_2M_3$. Find the sequence that will minimize the total elapsed time :

Jobs → / Machine ↓	1	2	3	4	5
M_1	5	7	6	9	5
M_2	2	1	4	5	3
M_3	3	7	5	6	7

(b) An item is produced at the rate of 50 items per day. The demand occurs at the rate of 25 items per day. If the setup cost is Rs. 100 per setup and holding cost is Rs. 0.01 per unit of item per day. Find the economic order quantity for one run assuming that the shortage are not permitted.

16. Explain the model II (M/M/1) : (∞/FIFO) of queueing theory.

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