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ME 181 OE 11

05/01/2023

Roll No. of candidate

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2022

BINA CHOWDHURY CENTRAL LIBRARY
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Azara, Harkhowapara,
Guwahati - 781017

B.Tech. 7th Semester End-Term Examination

Mechanical Engineering

OPERATION RESEARCH

(New Regulation (w.e.f. 2017-18) &

(New Syllabus w.e.f. 2018-19))

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Fill in the blanks : (10 × 1 = 10)
- (i) _____ means the set of variables for which the solution has been found.
 - (ii) Any given LPP may be called the Primal problem which can be stated meaningfully in another form called _____.
 - (iii) Dual Simplex method begins with _____ and optimal Solution, after which it iterates for feasible optimal solution.
 - (iv) _____ in Linear programming is said to occur when one or more basic variables have zero value.
 - (v) Integer programming is a special class of LPP where an _____ is used to state that the variables are integers.
 - (vi) In Transportation method the total quantity of the item available at different _____ is equal to the total requirement at different _____.
 - (vii) In Assignment model the zeroes inside the Squares are called _____ and those not inside any Squares are called _____.
 - (viii) A single variable function, which when plotted results in a curve, always curving downwards or not curving at all, is called a _____.
 - (ix) _____ tried to imitate the reality to see what might happen under operating conditions.
 - (x) Inventories are generally classified into _____ and _____.

[Turn over

2. (a) What are the main characteristics of operations research? State any four applications of operations research. (4)

(b) A firm manufacturer's headache pills in two sizes A and B. Size A contains 2 grains of aspirin, 5 grains of bicarbonate and 1 grain of codeine. Size B contains 1 grain of aspirin, 8 grains of bicarbonate and 6 grains of codeine. It is found by users that it requires at least 12 grains of aspirin, 74 grains of bicarbonate and 24 grains of codeine for providing immediate relief. Formulate the mathematical model for the problem. (3)

(c) Use graphical method to solve the following problems: (8)

$$\text{Maximize } Z = 5x_1 + 3x_2,$$

$$\text{Subject to } 3x_1 + 5x_2 \leq 15,$$

$$5x_1 + 2x_2 \leq 10,$$

$$x_1 + x_2 \geq 0$$

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3. (a) Explain the concept of degeneracy in Simplex method. (4)

(b) What is the role of surplus variables in the Simplex method? (3)

(c) Solve the following. (8)

$$\text{Minimize } Z = x_1 + 4x_2 + 3x_4,$$

$$\text{Subject to } x_1 + 2x_2 - x_3 + x_4 \geq 3,$$

$$-2x_1 - x_2 + 4x_3 + x_4 \geq 2,$$

$$x_1, x_2, x_3, x_4 \geq 0$$

4. (a) What is the concept involved in the Gomory's cutting plane method? (5)

(b) Solve the following. (10)

$$\text{Maximize } Z = 2x_1 + 2x_2,$$

$$\text{Subject to } 5x_1 + 3x_2 \leq 8,$$

$$x_1 + 2x_2 \leq 4,$$

$$x_1, x_2 \geq 0 \text{ and integer}$$

5. (a) Describe a general transportation problem. Explain how to determine an initial basic feasible solution to the problem using Vogel's method. (5)

(b) Solve any one of the following. (10)

(i) Find the optimum solution to the following transportation problem in which the cells contain the transportation cost in rupees.

	W1	W2	W3	W4	W5	Available
F1	7	6	4	5	9	40
F2	8	5	6	7	8	30
F3	6	8	9	6	5	20
F4	5	7	7	8	6	10
Required	30	30	15	20	5	

Or

(ii) Consider the problem of assigning five operators to five machines. The assignment cost are given below:

		Operator				
		I	II	III	IV	V
Machines	A	10	5	13	15	16
	B	3	9	18	3	6
	C	10	7	2	2	2
	D	5	11	9	7	12
	E	7	9	10	4	12

Assign the operators to different machines so that total cost is minimized. Also formulate the mathematical model. -

6. (a) Consider the following Non-linear programming problem:

$$\text{Minimize } Z = 2x_1^2 - 24x_2^2 - 8x_2 + 2x_3^2 - 12x_3 + 200$$

By separating this function into three one variable functions, show that the function is convex. Solve the problem by solving each one-variable function by calculus. (7)

(b) For each of the following functions determine whether it is convex, concave or neither. (8)

(i) $f(x) = x_1x_2 - x_1^2 - x_2^2$

(ii) $f(x) = 3x_1 + 2x_1^2 + 4x_2 + x_2^2 - 2x_1x_2$

(iii) $f(x) = x_1^2 + 3x_1x_2 + 2x_2^2$

(iv) $f(x) = 20x_1 + 10x_2$

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7. (a) Explain the following terms in inventory management: (4)
- (i) carrying cost
 - (ii) shortage cost
- (b) List the advantages and the limitations of Simulation. (3)
- (c) Solve any *one* of the following.

(i) A stockiest has to supply 400 units of a product every Monday to his customers. He gets the product at Rs.50 per unit from the manufacturer. The cost of ordering and transportation from the manufacturer is Rs.75 per order. The cost of carrying inventory is 7.5% per year of the cost of the product. Find

- (1) the economic lot size
- (2) the total optimal cost (including the capital cost)
- (3) the total weekly profit if the item is sold for Rs.55 per unit.

(3+3+2)

Or

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(ii) A dentist schedules all her patients for 30 minutes appointment. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following summary shows the various categories, work, their probabilities, and the time needed to complete the work. (8)

Category	Time required (minutes)	Probability of category
Filling	45	0.40
Crown	60	0.15
Cleaning	15	0.15
Extraction	45	0.10
Checkup	15	0.20

Simulate the dentist's clinic for four hours and determine the average waiting time for the patients as well as the Idleness of the doctor. Assume that all the patients show up at the clinic at exactly their scheduled arrival times, starting at 8 a.m. Use the following random number for handling the above problem: 40, 82, 11, 34, 25, 66, 17 and 79.