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203BS006

Ph.D./M.S. (Engg.) by Research Degree Examination, April/May 2024

Operations Research

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Solve the following linear programming problem graphically:

Maximize $Z = 3x_1 + 4x_2$

Subject to the constraints

$$4x_1 + 2x_2 \le 80$$
$$2x_1 + 5x_2 \le 180$$
$$x_1 \ge 0,\ x_2 \ge 0.$$

(10 Marks)

b. Using simplex method

Maximize $Z = 5x_1 + 3x_2$

Subject to the constraints

$$x_1 + x_2 \le 2$$
$$5x_1 + 2x_2 \le 10$$
$$3x_1 + 8x_2 \le 12$$
$$x_1 \ge 0,\ x_2 \ge 0$$

(10 Marks)

OR

2 a. Using Two-phase simplex method

Maximize $Z = 2x_1 + x_2 + x_3$

Subject to the constraints

$$4x_1 + 6x_2 + 3x_3 \le 8$$
$$3x_1 - 6x_2 - 4x_3 \ge 1$$
$$2x_1 + 3x_2 - 5x_3 \ge 4$$

with $x_1 \ge 0,\ x_2 \ge 0,\ x_3 \ge 0$.

(10 Marks)

b. Find the dual of the primal LPP given that

Maximize $Z = 50x_1 + 100x_2$

Subject to constraints

$$2x_1 + x_2 \le 1250$$
$$2x_1 + 5x_2 \le 1000$$
$$2x_1 + 3x_2 \le 900$$
$$x_2 \le 150$$

with $x_1 \ge 0,\ x_2 \ge 0$.

(10 Marks)

Module-2

3 a. Solve the travelling salesman problem for the data given below by expressing into assignment problem.

$C_{12} = 16$, $C_{13} = 4$, $C_{14} = 12$, $C_{23} = 6$, $C_{34} = 5$, $C_{25} = 8$, $C_{35} = 6$, $C_{45} = 20$, $C_{ij} = C_{ji}$, $C_{ii} = \infty$.

(10 Marks)

b. State any five steps involved in finding basic feasible solution of North-West corner method.

(10 Marks)

OR

4 a. A department head has four subordinates and four tasks have to be performed. Subordinates differ in efficiency and tasks differ in their intrinsic difficulty. Time each man would take to perform each task is given in the effectiveness matrix. How the tasks should be allocated to each person so as to minimize the total man – hours? (Use Hungarian method).

Subordinates

Tasks	I	II	III	IV
A	8	26	17	11
B	13	28	4	26
C	38	19	18	15
D	19	26	24	10

(10 Marks)

b. Define the following with reference to the transportation problem:
   i) Feasible solution
   ii) Basic-feasible solution
   iii) Optimum solution
   iv) State the equation objective function of the transportation problem. **(10 Marks)**

Module-3

5 a. The payoff matrix of a game is given below. Find the solution of the game to the player A to B.

$$A \quad \begin{array}{c} \\ \text{I} \\ \text{II} \\ \text{III} \\ \text{IV} \end{array} \begin{array}{c} \qquad\qquad B \\ \begin{array}{ccccc} \text{I} & \text{II} & \text{III} & \text{IV} & \text{V} \end{array} \\ \begin{pmatrix} -2 & 0 & 0 & 5 & 3 \\ 3 & 2 & 1 & 2 & 2 \\ -4 & -3 & 0 & -2 & 6 \\ 5 & 3 & -4 & 2 & -6 \end{pmatrix} \end{array}$$

(10 Marks)

b. State any five rules of dominance property in game theory. **(10 Marks)**

OR

6 a. State 'minimax criterion of optimality' with a reference to optimal strategy. Find the optimal strategy for the following (two-person, zero-sum) game matrix which represents payoff to the player A given that

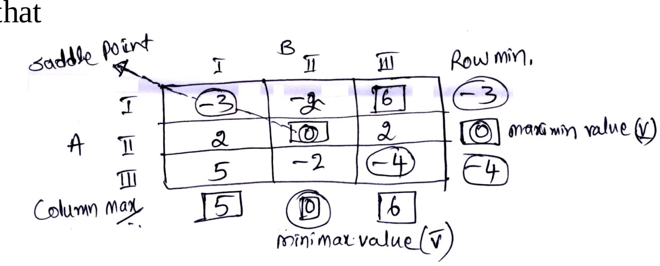

Fig.Q.6(a)

(10 Marks)

b. Solve the game whose pay off matrix is given by

$$\begin{array}{c} \\ \text{I} \\ \text{II} \\ \text{III} \end{array} \begin{array}{c} \begin{array}{ccc} \text{I} & \text{II} & \text{III} \end{array} \\ \begin{pmatrix} -2 & 15 & -2 \\ -5 & -6 & -4 \\ -5 & 20 & -8 \end{pmatrix} \end{array}$$

(10 Marks)

Module-4

7 a. Define the Kendall's notations for representing queueing models. Also give classification of queueing models. **(10 Marks)**

b. Arrivals at a telephone booth are considered to be poisson with an average time of 10 min between one arrival and the next. The length of a phone call assumed to be distributed exponentially with mean 3 min then,

i) What is the probability that a person arriving at the both will have to wait?

ii) What is the average length of the queues that form from time to time? **(10 Marks)**

OR

8 a. State any five limitations queueing models. **(10 Marks)**

b. In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the interarrival time follows an exponential distribution and the service time distribution is also exponential with an average of 36 min. Calculate :

i) The expected waiting time in the queue.

ii) The probability that number of trains in the system exceeds 10. **(10 Marks)**

Module-5

9 a. Explain in brief with reference to PERT/CPM.

i) Planning ii) Scheduling iii) Controlling. **(10 Marks)**

b. From the following network, determine:

i) two paths

ii) two directed cycles

iii) a cycle

iv) a tree

v) a spanning tree

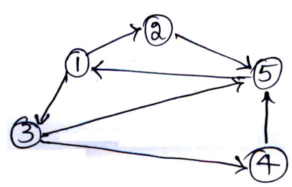

Fig.Q.9(b)

(10 Marks)

OR

10 a. Give any three differences between PERT and CPM. **(10 Marks)**

b. Given the following directed network, determine

i) A directed path from node 1 to 6. Identify three unidentified paths connecting node 1 to 6.

ii) Three directed cycles.

iii) Grow a tree, one tank at a time until a spanning tree has been obtained.

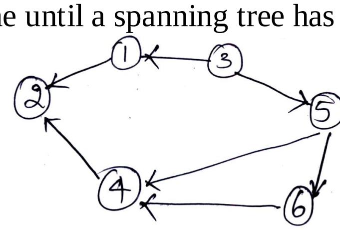

Fig.Q.10(b)

(10 Marks)

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