**B.E. COMPUTER SCIENCE AND ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2019**

**Subject:** OPTIMIZATION TECHNIQUES AND OPERATIONS RESEARCH **Time:** Three hours **Full marks:** 100

*Answer all questions*

1. a. When does unbounded solution occur in LPP? Explain it with appropriate example through graphical representation? 2+4

   b. Briefly note down the main differences between Simplex method and Dual simplex method. 4

2. a. What are the advantages and limitations of the graphical method? 3

   b. V. K. Shipyard company makes three different kinds of boats. All can be made profitability in the company. The company's monthly production is constrained by the limited amount of labour, wood, and screws available each month. The director will choose the combination of boats that maximizes his revenue in view of the information given in the following table. 12

| Input | Row Boat | Canoe | Kayak | Monthly available |
|---|---|---|---|---|
| Labour(Hours) | 12 | 7 | 9 | 1.260hrs |
| Wood(Board feet) | 22 | 18 | 16 | 19008 board feet |
| Screw(Kg.) | 2 | 4 | 3 | 396 kg |
| Selling Price(in Rs.) | 4000 | 2000 | 5000 | |

   (a) Formulate the above as a linear programming problem.
   (b) Solve it by simplex method. From the optimal table of the solved linear programming problem, answer the following questions:
   (c) How many boats of each type will be produced and what will be the resulting revenue?
   (d) Which, if any, of the resources, are not fully utilized? If so, how much of spare capacity is left?
   (e) How much wood will be used to make all of the boats given in the optimal solution?

3. a. What is the significance of sensitivity analysis? Analyze the sensitivity of the following problem after solving by Dual simplex method 3+12

$$\text{minimize } Z = 2x_1 + x_2$$
$$s.t.\ 3x_1 + x_2 \geq 3$$
$$4x_1 + 3x_2 \geq 6$$
$$x_1 + 2x_2 \geq 3$$
$$x_1, x_2 \geq 0$$

**OR**

b. i. What do you mean by Geometric Programming Problem? 2

ii. What are the connections between shadow price with duality? 3

iii. Two-phase and Big-M method which one will you select to solve an optimization problem? –Justify the answer. Briefly describe the selected algorithm properly? 1+3+6

4. a. What do you mean by duality? What are the advantages of Duality? Describe the general rule for converting any primal into its dual problem? Write the dual of the primary problem. 2+3+3+7

$$Maximize\ Z = 5x_1 + 12x_2 + 4x_3$$

$$s.t.\ x_1 + 2x_2 + x_3 \leq 5$$

$$2x_1 - x_2 + 3x_3 = 2$$

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

Also, verify that dual of dual is primal.

OR

b. What are the advantages and disadvantages of revised simplex method? Develop the flow chart of the revised simplex method. 5+10

5 a. i. When will you use dynamic programming and why? How does Dynamic programming differ from branch and bound method? 3 +2

ii. A government space project is conducting research on a certain engineering problem that must be solved before a man can fly to moon safely. These research teams are currently trying three different approaches for solving this problem. This estimate has been made that, under present circumstances, the probability that the respective teams-call them A, B and C-will not succeed are 0.40, 0.60 and 0.80 respectively. Thus the current probability that all three teams will fail is $(0.40 \times 0.60 \times 0.80) = 0.192$. Since the objective is to minimize this probability, the decision has been made to assign two top scientists among the three teams in order to lower it as much as possible. The following table gives the estimated probability that the respective teams will fail when 0, 1 or 2 additional scientists are added to that team. 10

| | | | **Team** | |
|---|---|---|---|---|
| | | A | B | C |
| Number of Scientists | 0 | 0.40 | 0.60 | 0.80 |
| | 1 | 0.20 | 0.40 | 0.50 |
| | 2 | 0.15 | 0.20 | 0.30 |

How should the additional scientists reallocated to the team? (Solve this using Dynamic programming)

OR

b. i. Explain briefly the main characteristics of Queueing system. 5

ii. Five men are available to do five different jobs. From past records, the time (in hours) that each man takes to do each job is known and given in the following table: 10

| | | Job | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| | A | 2 | 9 | 2 | 7 | 1 |
| | B | 6 | 8 | 7 | 6 | 1 |
| Man | C | 4 | 6 | 5 | 3 | 1 |
| | D | 4 | 2 | 7 | 3 | 1 |
| | E | 5 | 3 | 9 | 5 | 1 |

Find the assignment of men to jobs that will minimize the total cost.

6. a. Find the optimum integer solution to solve the following all Integer Programming Problem 15

$$Maximize\ Z = x_1 + 2x_2$$

$$s.t.\ 2x_2 \leq 7$$

$$x_1 + x_2 \leq 7$$

$$2x_1 \leq 11$$

$$x_1, x_2 \geq 0\ and\ x_1, x_2\ are\ integer$$

OR

b. Find the initial basic feasible solution using Vogel approximation method of the following transportation problem: 15

| | Warehouse | | | | |
|---|---|---|---|---|---|
| Factory | W1 | W2 | W3 | W4 | Factory Capacity |
| F1 | 19 | 30 | 50 | 10 | 7 |
| F2 | 70 | 30 | 40 | 60 | 9 |
| F3 | 40 | 8 | 70 | 20 | 18 |
| Warehouse Requirement | 5 | 8 | 7 | 14 | 34 |

Then solve it using the MODI method.

7. a. i. Explain the utility of Lagrange multiplier concerning an optimization problem with sufficient and necessary condition. 5+10

ii. Solve the following non-linear programming problem using the Lagrange multiplier method.

$$Optimize\ Z = 4{x_1}^2 + 2{x_2}^2 + {x_3}^2 - 4\,x_1x_2$$
$$s.t.\ x_1 + x_2 + x_3 = 15$$
$$2x_1 - x_2 + 2x_3 = 20$$

OR

b. i. Why is the iterative method preferred over traditional derivative-based method to solve nonlinear programming? What are the relations of positive definite and negative definite with optimality? Explain with examples. 2+4

ii. Find the maximum or minimum of the function 9

$$f(X) = {x_1}^2 + {x_2}^2 + {x_3}^2 - 4\,x_1 - 8x_2 - 12\,x_3 + 56$$