B.E. COMPUTER SCIENCE AND ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2018

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

Answer all questions

1. a. When do you select reverse simplex method over normal simplex method and why? 3

   b. What are the differences between geometric and quadratic programming? 3

   c. How is the multi-objective programming problem solved? 2

   d. What do you mean by stochastic programming problem? 2

2. a. What is degeneracy in LPP? When does it occur? Explain with appropriate example. 5

   b. i. Solve the following LPP using simplex method 10

$$Maximize\ Z = 270x_1 + 144x_2 + 225x_3$$
$$s.t.\ 8x_1 + 4x_2 + 5x_3 \leq 1000$$
$$5x_1 + 3x_2 + 3x_3 \leq 650$$
$$9x_1 + 6x_2 + 9x_3 \leq 1260$$
$$x_1, x_2, x_3 \geq 0$$

OR

ii. A firm manufactures two types of products X and Y and sells them at a profit of Rs. 2 on type X and Rs. 3 on type Y. Each product is processed on two machines G and H. Type X requires one minute of processing time on G and two minutes processing time on H. Type Y requires one minute on G and one minutes on H. The machine G is available for not more than 6 hours 40 minutes while machine H is available for 10 hours during any working day. Solve the problem using graphical method.

3. a. What do you mean by Strong and weak Duality? How is sensitivity related to duality? 2+3

   b. Find the optimal solution using either two-phase simplex method **or** Big M method (any one method). 10

$$\text{Minimize } Z = 3x_1 + 2x_2$$
$$s.t.\ x_1 + x_2 \geq 2$$
$$x_1 + 3x_2 \leq 3$$
$$x_1 - x_2 = 1$$
$$x_1, x_2 \geq 0$$

4. a. What is the philosophy of Conjugate gradient method? When will you use Conjugate gradient method over traditional gradient method? 5

b. i. Solve the following equation using revise simplex method 10

$$Maximize\ Z = 3x_1 + 5x_2$$
$$s.t.\ x_1 + x_2 \leq 4$$
$$5x_1 + 3x_2 \geq 8$$
$$x_1, x_2 \geq 0$$

OR

ii. Solve the following equation using Dual simplex method

$$Maximize\ Z = -2x_1 - 3x_2$$
$$s.t.\ x_1 + x_2 \geq 2$$
$$2x_1 + x_2 \leq 10$$
$$x_1 + x_2 \leq 8$$
$$x_1, x_2 \geq 0$$

5 a. What are the characteristics of dynamic programming? Why is it not usable to solve all kind of problems? What is the significance of integer programming? 3 +2 +2

b. i. The world health council has 5 medical teams available to allocate them among three undeveloped countries to improve their medical care as shown in following figure. How many teams should be allocated to each country to maximize the total efficiency? 8

Medical teams	Extra person-years of life, 1000		
	Country		
	1	2	3
0	0	0	0
1	45	20	50
2	70	45	70
3	90	75	80
4	105	110	100
5	120	150	130

OR

ii. At a railway station only one train is handled at a time. The railway yard is sufficient only for two trains to wait while the other is given signal to leave the station. Trains arrive at the station at an average rate of 6/hour and the railway station can handle them at an average 12/hour. Assume Poisson arrivals and exponential service distribution, find the steady state probabilities for the various number of trains in the system. Find also the average waiting time of a train coming into the yard.

a What is the Kuhn-Tucker condition(s) for maximization and minimization problem? What is the significance of it? 3+2

b. i. The Hardrock Concrete Company has plants in three locations and is currently working on three major construction projects, each located at different sites. The shipping cost per truckload of concrete, daily plant capacities, and daily project requirements are provided in the accompanying table. 10

From \ To	Project A	Project B	Project C	Plant Capacities
Plant 1	$10	$ 4	$11	70
Plant 2	12	5	8	50
Plant 3	9	7	6	30
Project Requirements	40	50	60	150

a) Formulate an initial feasible solution.
b) Then solve it using the MODI method.
c) Is the initial solution optimal?

OR

ii. Solve the following assignment problem using Hungarian method.
The matrix below shows the time required (in minutes) for each combination of a worker and a job. The jobs are denoted by J1, J2, J3, and J4, the workers by W1, W2, W3, and W4.

	J1	*J2*	*J3*	*J4*
W1	82	83	69	92
W2	77	37	49	92
W3	11	69	5	86
W4	8	9	98	23

Each worker should perform exactly one job and the objective is to minimize the total time required to perform all jobs.

a. $Maximize\ z = -sinX_1 X_2 + \cos(X_1 - X_2)$ using steepest ascent search within tolerance of 0.05. 7

OR

Use Newton method to $maximize: z = -(x_1 - \sqrt{5})^2 - (x_2 - \pi)^2 - 10$ within tolerance of 0.05.

b. Solve the following non-linear programming problem using the langrage multiplier method. 8

$$Minimize\ Z = 3.6\,x_1 - 0.4{x_1}^2 + 1.6\,x_2 - 0.2{x_2}^2$$
$$s.t.\ 2x_1 + x_2 = 10$$
$$x_1, x_2 \geq 0$$