A

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
II Semester 2022 – 2023

Course No: ME F320/MF F320 **Course Title:** Engineering Optimization
Date: 8th May 2023 FN **Max Time:** 180 min
Max Marks: 135 **Comprehensive Exam (Open Book)**

Q. 1. Consider the transportation problem having the following parameter table. Use Vogel's approximation method to obtain an initial BF solution and obtain an optimal solution. [15]

		Destination				
Source		**1**	**2**	**3**	**4**	**Supply**
	1	7	11	10	8	20
	2	6	8	7	6	8
	3	8	7	12	9	20
	Demand	12	12	8	8	

Q. 2. Manually apply the Hungarian algorithm to solve the assignment problem having the following cost table: [15]

		Task			
		1	2	3	4
Assignee	A	7	10	8	9
	B	11	7	9	10
	C	7	11	10	6
	D	8	5	7	11

Q. 3. Find the optimal solution by cutting plane method: Maximize $z = x_1 + 2x_2$ subject to $2x_2 \leq 7$, $x_1 + x_2 \leq 7$, $2x_1 \leq 11$ $x_1, x_2 \geq 0$ and are Integers [15]

Q. 4. Birla Sarvjanik Hospital plans the short-stay assignment of surplus beds (those that are not already occupied) 4 days in advance. During the 4-day planning period, about 60, 50, and 40 patients will require 1-, 2-, or 3-day stays, respectively. Surplus beds during the same period are estimated at 40, 60, 60, and 60, respectively. Use GP to resolve the problem of over-admission and under-admission in the hospital. Only formulation [15]

Q. 5. Using the artificial constraint procedure, solve the following problems by the dual simplex method. Maximize $z = x1 - 3x2$ subject to $x1 - x2 \leq 20$ $x1 + x2 \geq 40$ $2x1 - 2x2 \geq 30$ $x1, x2 \geq 0$ [15]

B

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Q. 1. Solve the quadratic programming problem: Maximize f (x1, x2) = $15x_1 + 30x_2 + 4x_1x_2 - 2x_1^2 - 4x_2^2$, subject to $2x_1 + 4x_2 \leq 60$, and $x1 \geq 0$, $x2 \geq 0$. [15]

Q. 2. Determine the extreme points of the $f(x, y, z) = 2x^4 + 2x^2 y + 2y^2 + 2z^2 + 2xz + 2$ [15]

Q. 3. Write down the Kuhn-Tucker conditions for the following problem:
Maximize: $12x_1^2 - 4x_2$ Subjected to: $2x_1 + x_2 = 2, x_1^2 + x_2^2 \leq 4.85, x_1 \geq 0.$
Find out whether points $(0, 2)^T$ and $(1.7, -1.4)^T$ are Kuhn-Tucker points. How would the maximum function value change if the equality constraint is changed to the following: $2x_1 + x_2 = 3$? [15]

Q. 4. Consider the simple optimization problem using Genetic Algorithm: [15]
Maximize,

$$f(x) = 64 - x^2$$
$$1 \leq x \leq 64$$
$$x \ \ is\ an\ integer$$

(i) How many binary digits are present in each of the string for the above problem?
(ii) What is the fitness function you would assume in the above problem?
(iii) Assume that 5 random strings are created corresponding to x values, 63, 4, 1, 10, 36. Write the binary strings corresponding to the values of x and write down the fitness values.
(iv) Find out the expected number of copies of the best string in the above population in the mating pool under roulette-wheel selection, based on the following random numbers 0.5469, 0.9575,0.9649,0.1576,0.9706
(v) Write the schema corresponding to $x \geq 33$
(vi) If single point crossover with probability 0.9 and a bit-wise mutation with a probability of 0.01 are used, how many copies of the above schema are expected in generation five?
