BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER : V**
BRANCH: AIML **SESSION : MO/2025**

SUBJECT: AI313 CLASSICAL OPTIMIZATION TECHNIQUES

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL

Q.1(a)	Fine tune/optimize the following code.
	#include <stdio.h>
	int main() {
	int arr[] = {10, 25, 30, 45, 50};
	int n = sizeof(arr) / sizeof(arr[0]);
	int divisor = 7;
	long long sum = 0;
	
	for (int i = 0; i < n; i++) {
	sum += arr[i];
	printf("Element %d mod %d: %d\n", arr[i], divisor, arr[i] % divisor);
	}
	printf("Total sum: %lld\n", sum);
	return 0; }
	Give the Explain of Optimization.
		[5]	1	3

Q.1(b)	Krrish loves poha and potato chips. Therefore, he has decided to go on a steady diet of only these two foods (plus some liquids and vitamin supplements) for all his meals. Krrish realizes that this isn't the healthiest diet, so he wants to make sure that he eats the right quantities of the two foods to satisfy some key nutritional requirements. He obtained nutritional and cost information in the following table. Krrish wishes to determine the number of daily servings (may be fractional) of Poha and potatoes that will meet these requirements at a minimum cost. Formulate a linear programming model for this problem.	[5]	1	2

	Poha	Potato Chips	Daily Requirements
Carbohydrates	5	15	50
Protein	20	5	40
Fats	15	2	60
Cost	40	20	

Q.2(a)	BIT a Deemed to be University maintains a powerful HPC for research use by its faculty, Ph.D. students, and research associates. During all working hours, an operator must be available to operate and maintain the computer, as well as to perform some programming services. Professor in charge of HPC facility, oversees the operation. It is now the beginning of the Spring semester, and Professor is confronted with the problem of assigning different working hours to his operators. Because all the operators are currently enrolled in the university, they are available to work only a limited number of hours each day, as shown in the following table.	[5]	2	2

		MAXIMUM HOURS OF AVALABILITY				
Operator	Rate/ Hour	MON	TUE	WED	THU	FRI
SURESH	25	6	0	6	0	6
GANESH	30	0	6	0	6	0
JIGNESH	26	4	8	4	0	4
PRATHAMESH	28	5	5	5	0	5
CHANDRESH	24	3	0	3	8	0
DINESH	27	0	0	0	6	2

There are six operators (four undergraduate students and two graduate students). They all have different wage rates because of differences in their experience with computers and in their programming ability. The above table shows their wage rates, along with the maximum number of hours that each can work each day.

Each operator is guaranteed a certain minimum number of hours per week that will maintain an adequate knowledge of the operation. This level is set arbitrarily at 8 hours per week for the undergraduate students (Suresh, Dinesh, Prathamesh and Chandresh) and 7 hours per week for the graduate students (Ganesh and Jignesh.)

The HPC facility is to be open for operation from 8 A.M. to 10 P.M. Monday through Friday with exactly one operator on duty during these hours. On Saturdays and Sundays, the computer is to be operated by other staff. Because of a tight budget, Professor must minimize cost. He wishes to determine the number of hours she should assign to each operator on each day. Formulate a linear programming model for this problem.

Q.2(b) Solve using Graphical method to find all optimal solutions [5] 2 2

Maximize $Z = 500X_1 + 300X_2$

Subject to $15X_1 + 5X_2 <= 300$, $10X_1 + 6X_2 <= 240$, $8X_1 + 12X_2 <= 450$, and X_1 , $X_2 >= 0$.

Q.3(a) Use the dual simplex method to solve maximize Z= -2x1 -3x2 [5] 3 2

subject to x1+x2>=2

2x1+x2<=10

X1+x2<=8 with x1, x2 nonnegative.

Q.3(b) Use Simplex method to solve Z=X1 + 9X2 + X3 subject to X1+ 2X2+ 3X3<=9 and 3X1+2x2+2X3 <=15 with all nonnegative variables. [5] 3 2

Q.4(a) Discuss the methods for Non-Linear Programming single variable optimization and explain with examples. [5] 4 1

Q.4(b) Write the Transportation algorithm and discuss the Northwest Corner rule table in detail with examples. [5] 4 1

Q.5(a) List the methods for Nonlinear programming with multivariable optimization without constraint with examples. [5] 5 1

Q.5(b) $Z = \sin(x_1x_2 + x_3)$ subject to $-x_1x_2^3 + x_1^2x_3^2 = 5$. Find the Gradient Vector, Hessian Matrix and Jacobian Matrix with respect to the functions given. [5] 5 3

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