BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION MO/2022)

CLASS: B.TECH. **SEMESTER: 3rd**
BRANCH: PIE **SESSION: MO/2022**

SUBJECT: PE203 OPERATIONS RESEARCH

TIME: 03 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*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates.**

Q.1 (a) A pharmaceutical company produces two pharmaceutical products: A and B. Production of both these products requires the same process – I and II. The production of B also results in a by-product C at no extra cost. Product A can be sold at a profit of ₹ 3 per unit and B at a profit of ₹ 8 per unit. Some quantity of this by-product can be sold at a unit profit of ₹ 2, the remainder has to be destroyed and the destruction cost is ₹ 1 per unit. Forecasts show that only up to 5 units of C can be sold. The company gets 3 units of C for each unit of B produced. The manufacturing times are 3 hours per unit for A on process I and II, respectively, and 4 hours and 5 hours per unit for B on process I and II, respectively. Because product C is a by-product of B, no time is used in producing C. The available times are 18 and 21 hours of process I and II, respectively. Formulate this problem as an LP model to determine the quantity of A and B which should be produced, keeping C in mind, to make the highest total profit to the company. [5] CO1 BL4

Q.1 (b) Use the graphical method to solve the following LP problem. [5] CO2 BL4

$$\text{Maximize } Z = 2x_1 + 3x_2$$
subjected to:
$$x_1 + x_2 \le 30 \qquad 0 \le x_1 \le 20$$
$$x_2 \ge 3 \qquad x_1 - x_2 \ge 0$$
$$0 \le x_2 \le 12 \qquad x_1, x_2 \ge 0$$

Q.2 (a) Use the Big-M method to solve the following LP problem. [5] CO2 BL4

$$\text{Minimize } Z = 600x_1 + 500x_2$$
subjected to:
$$2x_1 + x_2 \ge 80$$
$$x_1 + 2x_2 \ge 60$$
$$x_1, x_2 \ge 0$$

Q.2 (b) Use the Big-M method to solve the following LP problem. [5] CO2 BL4

$$\text{Minimize } Z = 600x_1 + 500x_2$$
subjected to:
$$2x_1 + x_2 \ge 80$$
$$x_1 + 2x_2 \ge 60$$
$$x_1, x_2 \ge 0$$

Q.3 (a) A product is produced by four factories A, B, C, and D. The unit production costs in them are ₹ 2, ₹ 3, ₹ 1 and ₹ 5, respectively. Their production capacities are: factory A – 50 units, B – 70 units, C – 30 units, and D – 50 units. These factories supply the product to four stores, demands of which are 25, 35, 105, and 20 units, respectively. Unit transportation cost in rupees from each factory to each store is given in the table below. [5] CO3 BL4

		Stores			
		1	2	3	4
Factories	A	2	4	6	11
	B	10	8	7	5
	C	13	3	9	12
	D	4	6	8	3

Determine the extent of deliveries from each of the factories to each of the stores so that the total production and transportation cost is minimum.

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Q.3 (b) A salesman wants to visit cities 1, 2, 3, and 4. He does not want to visit any city twice before completing the tour of all the cities and wishes to return to his home city, the starting station. The cost of going from one city to another in rupees is given in the table. Find the least-cost route. [5] CO3 BL4

		To city			
		1	2	3	4
From city	1	0	30	80	50
	2	40	0	140	30
	3	40	50	0	20
	4	70	80	130	0

Q.4 (a) Six jobs, A, B, C, D, E, and F, have arrived at one time to be processed on a single machine. Assume that no new jobs arrive thereafter. Determine the optimal sequence as per the STP rule. Also, determine the completion times of the jobs. [4] CO4 BL4

Job	:	A	B	C	D	E	F
Processing time (minutes)	:	7	6	8	4	3	5

Q.4 (b) There are five jobs, each of which will be processed through three machines, A, B, and C, in the order ABC. Processing times in hours are shown in the table below. [6] CO4 BL4

Jobs	**A**	**B**	**C**
1	3	4	7
2	8	5	9
3	7	1	5
4	5	2	6
5	4	3	10

Determine the optimum sequence for the five jobs and the minimum elapsed time. Also, find the idle time for the three machines and the waiting time for the jobs.

Q.5 (a) Briefly discuss the various characteristics of games. [4] CO5 BL4

Q.5 (b) Reduce the following game by dominance and find the game value: [6] CO5 BL4

		Player B			
		I	II	III	IV
Player A	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

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