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

CLASS: B.TECH. **SEMESTER: III**
BRANCH: PIE **SESSION: MO/2024**

SUBJECT: PE203 OPERATIONS RESEARCH

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)	A company has two plants, each of which produces and supplies two products: A and B. The plants can each work up to 16 hours a day. In plant 1, it takes three hours to prepare and pack 1,000 gallons of A and one hour to prepare and pack one quintal of B. In plant 2, it takes two hours to prepare and pack 1,000 gallons of A and 1.5 hours to prepare and pack a quintal of B. In plant 1, it costs Rs 15,000 to prepare and pack 1,000 gallons of A and Rs 28,000 to prepare and pack a quintal of B, whereas in plant 2 these costs are Rs 18,000 and Rs 26,000, respectively. The company is obliged to produce daily at least 10 thousand gallons of A and 8 quintals of B. Formulate this problem as an LP model to find out as to how the company should organize its production so that the required amounts of the two products be obtained at the minimum cost.	[5]	1	4
Q.1(b)	Anita Electric Company produces two products P1 and P2. Products are produced and sold on a weekly basis. The weekly production cannot exceed 25 for product P1 and 35 for product P2 because of limited available facilities. The company employs total of 60 workers. Product P1 requires 2 man-weeks of labour, while P2 requires one man-week of labour. Profit margin on P1 is Rs. 60 and on P2 is Rs. 40. Formulate this problem as an LP problem and solve that using graphical method.	[5]	1	4
Q.2(a)	Maximize $Z = x_1 + 2x_2 + 3x_3 - x_4$ Subjected to: $x_1 + 2x_2 + 3x_3 = 15$ $2x_1 + x_2 + 5x_3 = 20$ $x_1 + 2x_2 + x_3 + x_4 = 10$ $x_1, x_2, x_3, x_4 \geq 0$	[8]	2	4
Q.2(b)	Construct the dual of the problem Minimize $Z = 3x_1 - 2x_2 + 4x_3$ Subjected to: $3x_1 + 5x_2 + 4x_3 \geq 7$ $6x_1 + x_2 + 3x_3 \geq 4$ $7x_1 - 2x_2 - x_3 \leq 10$ $x_1 - 2x_2 + 5x_3 \geq 3$ $4x_1 + 7x_2 - 2x_3 \geq 2$ $x_1, x_2, x_3 \geq 0$	[2]	2	4
Q.3(a)	The following table provides all the necessary information on the availability of supply to each warehouse, the requirement of each market, and the unit transportation cost (in Rs) from each warehouse to each market.	[6]	3	4

		Market				
		P	Q	R	S	Supply
Warehouse	A	6	3	5	4	22
	B	5	9	2	7	15
	C	5	7	8	6	8
	Demand	7	12	17	9	45

The shipping clerk of the shipping agency has worked out the following schedule, based on his own experience: 12 units from A to Q, 1 unit from A to R, 9 units from A to S, 15 units from B to R, 7 units from C to P and 1 unit from C to R.

(a) Check and see if the clerk has the optimal schedule.
(b) Find the optimal schedule and minimum total transport cost.

Q.3(b) A travelling salesman has to visit five cities. He wishes to start from a particular city, visit each city once and then return to his starting point. The travelling cost (in '000 Rs) of each city from a particular city is given below: [4] 3 4

From city \ *To city*	A	B	C	D	E
A	∞	2	5	7	1
B	6	∞	3	8	2
C	8	7	∞	4	7
D	12	4	6	∞	5
E	1	3	2	8	∞

What should be the sequence of visit of the salesman so that the cost is minimum?

Q.4(a) Using the graphical method, calculate the minimum time needed to process jobs 1 and 2 on five machines A, B, C, D and E, i.e. for each machine find the job that should be done first. Also, calculate the total time needed to complete both jobs. [6] 4 4

		Machines				
Job 1	*Sequence*	A	B	C	D	E
	Time (hrs)	6	8	4	12	4
Job 2	*Sequence*	B	C	A	D	E
	Time (hrs)	10	8	6	4	12

Q.4(b) Briefly discuss Kendall's notation for representing queuing models. [4] 4 2

Q.5(a) Briefly discuss the various characteristics of games. [4] 5 2

Q.5(b) Reduce the following game by dominance and find the game value: [6] 5 4

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

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