

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

**CLASS: B.Tech
BRANCH: Production and Industrial Engineering**

**SEMESTER : III
SESSION : MO/2025**

SUBJECT: PE24203 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.
6. Read the questions carefully, answer only what is asked, no extra marks for extra steps.

- Q.1(a) Farmer Jane owns 45 acres of land. She is going to plant each with wheat or corn. Each [5] CO BL
acre planted with wheat yields \$200 profit; each with corn yields \$300 profit. The labor and fertilizer used for each acre are given in following table. One hundred workers and 120 tons of fertilizer are available. Formulate the problem in form of a Linear Programming problem to decide which type of crop he must plant that maximizes the profit.

| | Wheat | Corn |
|------------|-----------|-----------|
| Labor | 5 workers | 2 workers |
| Fertilizer | 2 tons | 4 tons |

- Q.1(b) Use graphical method to solve the problem formulated in the question 1 (a). [5] 1 3

- Q.2 Find the optimum value of Z and other decision variables of the following linear [10] 2 3
programming problem by using simplex method.

$$\text{Maximize : } Z = 60x_1 + 30x_2 + 20x_3$$

S.T.

$$8x_1 + 6x_2 + x_3 \leq 48$$

$$4x_1 + 2x_2 + 1.5x_3 \leq 20$$

$$2x_1 + 1.5x_2 + 0.5x_3 \leq 8$$

$$x_1, x_2, x_3 \geq 0$$

- Q.3(a) Cars are shipped from three distribution center to four dealers. The cost of transport [4+2] 3 4
is based on the distance between two cities and is independent of the fact that whether the truck is made the trip with full load or partial load. A full load truck carries 50 cars. Following table shows the distance between the various cities, availability of cars at distribution center, and requirement at dealers. Use Vogel's Approximation Method (VAM) to identify a feasible supply and demand possibility. What is the cost at this solution if the cost of transport is INR 30/km/truck?

| | Dealer 1 | Dealer 2 | Dealer 3 | Dealer 4 | Availability |
|-------------|----------|----------|----------|----------|--------------|
| Center 1 | 100 | 150 | 200 | 140 | 200 |
| Center 2 | 50 | 70 | 60 | 65 | 250 |
| Center 3 | 40 | 90 | 100 | 150 | 200 |
| Requirement | 100 | 200 | 150 | 160 | |

- Q.3(b) Four jobs are to be assigned to the four workers. The following table shows the time [4] 3 3
taken by each worker to complete each job. Assign the jobs to the workers in such a way that minimizes total time. Also calculate the total minimum time that will be required to complete all jobs.

| | J1 | J2 | J3 | J4 |
|----|----|----|----|----|
| W1 | 14 | 5 | 8 | 7 |
| W2 | 2 | 12 | 6 | 5 |
| W3 | 7 | 8 | 3 | 9 |
| W4 | 2 | 4 | 6 | 10 |

- Q.4(a) Four jobs are to be sequenced in four machines. The processing time and the due date is also provided. Use shortest Processing Time (SPT), and Earliest Due Date (EDD) rule to sequence the jobs and calculate the total lateness in both the cases. Which rule is better if penalty is imposed for late jobs? [5] 4 4

| Job | Processing time (days) | Due Date (Day) |
|-----|------------------------|----------------|
| J1 | 2 | 4 |
| J2 | 5 | 6 |
| J3 | 3 | 2 |
| J4 | 5 | 9 |

- Q.4(b) In a self-service cafeteria, customers arrive, on an average, in every 50 seconds. The cashier can serve 8 people in 5 minutes. If the arrival follows Poisson distribution and the service follows the exponential distribution, [5] 4 3
- Calculate the probability that the cashier will remain ideal
 - What will be the probability that there will be exactly 5 customers in the system?
 - What is the expected length of people standing in the queue at any time?
 - What is the expected waiting time in the system?

- Q.5(a) Calculate expected return from the game played between two players, as described below. [5] 5 3

| | B1 | B2 | B3 | B4 | B5 |
|----|----|----|----|----|----|
| A1 | 2 | 0 | 0 | 5 | 3 |
| A2 | 3 | 2 | 1 | 2 | 2 |
| A3 | 4 | 3 | 0 | -2 | 6 |
| A4 | 5 | 3 | -4 | 2 | -6 |

- Q.5(b) Due to change in demand of the commodity traded by A, and B, there is some change in the payoff matrix between A and B. The payoff corresponding to the cell A2B3 is changes to -1; and the payoff corresponding to the cell A3B3 is changed to 1. What would be now the expected return from the game? [5] 5 4