

**B. E. PRODUCTION ENGG. 3<sup>RD</sup> YEAR 2<sup>ND</sup> SEMESTER EXAMINATION 2022**  
**OPERATIONS RESEARCH**

Time : **Three hours**

Full marks: **100**

**Question No. 1 is compulsory. Answer any four from the rest.**

- 1.(a) Using a developed flowchart, explain the simplex method for solving LP problems. (6)
- (b) Explain how your knowledge in Operations Research would help you in enhancing the performance of a turning process. (4)
- (c) Consider the LP problem:  
 Maximize  $Z = 20x_1 + 6x_2 + Px_3$   
 subject to  
 $8x_1 + 2x_2 + 3x_3 \leq 250$  ( $C_1$ )  
 $4x_1 + 3x_2 \leq 150$  ( $C_2$ )  
 $2x_1 + x_3 \leq 50$  ( $C_3$ )  
 $x_1, x_2, x_3 \geq 0$   
 The optimal solution is given as  $x_1^* = 0, x_2^* = 50$  and  $x_3^* = 50$ . The dual variables of the constraints  $C_1, C_2$  and  $C_3$  are  $y_1, y_2$  and  $y_3$  respectively. The optimal values of dual variables are  $y_1^* = 0, y_2^* = 2$  and  $y_3^* = 8$ . Now, determine the parameter  $P$  in the primal objective function. (5)
- (d) With the help of a neat table, differentiate between game theory and decision theory. (5)
2. A transport company is considering the purchase of new vehicles for providing transportation between the city airport and hotels in the city. There are three vehicles under consideration: Station wagons, minibuses and large buses. The purchase price would be Rs. 1,45,000 for each station wagon, Rs. 2,50,000 for each minibus and Rs. 4,00,000 for each large bus. The board of directors has authorized a maximum amount of Rs. 50,00,000 for these purchases. Because of the heavy air travel, the new vehicles would be utilized at maximum capacity, regardless of the type of the vehicles purchased. The expected net annual profit would be Rs. 15,000 for the station wagon, Rs. 35,000 for the minibus and Rs. 45,000 for the large bus. The company has hired 30 new drivers for the new vehicles. The maintenance department has the capacity to handle an additional 80 station wagons. A minibus is equivalent to 1.67 station wagons and each large bus is equivalent to 2 station wagons in terms of the use of the maintenance department. Determine the number of each vehicle that should be purchased in order to maximize profit. (20)
- 3.(a) Distinguish between transportation and transshipment problems. (5)
- (b) ABC Tool Company has a sales force of 25 men, who operate from three regional offices. The company purchases four basic product lines of hand tools. Mr. X, the sales manager, feels that 6 salesmen are needed to distribute product line I, 10 to distribute product line II, 4 for product line III and 5 salesmen for product line IV. The cost (in Rs.) per day of assigning salesmen from each of the offices for selling each of the product lines are as follows:

Regional office	Product line			
	I	II	III	IV
A	20	21	16	18
B	17	28	14	16
C	29	23	19	20

At the present time, 10 salesmen are allocated to office A, 9 to office B and 6 salesmen to office C. How many salesmen should be assigned from each office to sell each product in order to minimize costs? (15)

[ Turn over

- 4.(a) In a town, there are only two discount stores ABC and XYZ. Both stores run annual pre-Dewali sales. Sales are advertised through local newspapers with the aid of an advertising firm. ABC stores constructed the following pay-off in units of Rs. 1,00,000. Find the optimal strategies for both the firms and value of the game. (10)

Store ABC	Store XYZ		
	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
A <sub>1</sub>	1	-2	1
A <sub>2</sub>	-1	3	2
A <sub>3</sub>	-1	-2	3

- (b) On January 01 (this year), Bakery A had 40% of its local market share while the other two bakeries B and C had 40% and 20% respectively of the market share. Based on a study by a marketing research team, the following facts were compiled. Bakery A retains 90% of its own customers, while gaining 10% of C's customers. Bakery B retains 85% of its customers, while gaining 5% of A's customers and 7% of C's customers. Bakery C retains 83% of its customers and gains 5% of A's customers and 10% of B's customers. What will each firm's share be on January 01 next year and what will each firm's market share be at equilibrium? (10)

- 5.(a) State the limitations of an LPP model. (5)

- (b) Solve the following all-integer programming problem using branch and bound technique: (15)

$$\text{Minimize } Z = 3x_1 + 2.5x_2$$

Subject to the constraints:

- (i)  $x_1 + 2x_2 \geq 20$ , (ii)  $3x_1 + 2x_2 \geq 50$  and  $x_1, x_2 \geq 0$  and integers.

- 6.(a) With illustrative examples, classify queuing problems based on queue discipline. (5)

- (b) What is network analysis? State three basic differences between CRM and PERT. (2+3)

- (c) The manager of a flower shop promises its customers delivery within four hours on all flowering orders. All flowers are purchased on the previous day and delivered to parker by 8.0am the next morning. The daily demand for roses is as follows: (10)

Dozens of roses	70	80	90	100
Probability	0.1	0.2	0.4	0.3

The manager purchases roses for Rs.10 per dozen and sells them for Rs. 30. All unsold roses are donated to a local hospital. How many dozens of roses should the manager order each evening to maximize the profit? What is the optimal expected profit?

7. A dentist schedules all his patients for 30-minute appointments. Some of the patients take more than 30 minutes some less, depending on the type of dental work to be done. The following summary shows the various categories of works, their probabilities and time actually needed to complete the work: (20)

Category of service	Time required (in min)	Probability
Filling	45	0.40
Crown	60	0.15
Cleaning	15	0.15
Extraction	45	0.10
Checkup	15	0.20

Simulate the dentist's clinic for four hours and determine the average waiting time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic at exactly their scheduled arrival time at 8.00 AM. Use the following random numbers for handling the above problem: 40, 82, 11, 34, 25, 66, 17 and 79.