Ex/PROD/PC/H/T/326/2024

B. E. PRODUCTION ENGG. 3RD YEAR 2ND SEMESTER EXAMINATION 2024

OPERATIONS RESEARCH

Time : **Three hours** Full marks: **100**

Answer any five questions. All questions carry equal marks.

1.(a) Develop the flowchart for the simplex method used in solving linear programming problems. (6)

(b) A metal works company produces waste cans, filing cabinets, file boxes for correspondence and lunch boxes. Its inputs are sheet metal of two different thickness, called A and B, and manual labor. The input-output relationships for the company are shown in the following table: (14)

Input	Waste cans	Filing cabinets	Correspondence boxes	Lunch boxes
Sheet metal A	6	0	2	3
Sheet metal B	0	10	0	0
Manual labor	4	8	2	3

The sales revenue per unit of waste cans, filing cabinets, correspondence boxes and lunch boxes are Rs. 20, Rs. 400, Rs. 90 and Rs. 20, respectively. There are 225 units of sheet metal A available in the company's inventory, 300 units of sheet metal B and a total of 190 units of manual labor. What is the company's optimal sales revenue?

2.(a) State why an assignment problem can be regarded as a special type of transportation problem. (5)

(b) ABC Limited has three production shops that supply a product to five warehouses. The cost of production varies from shop to shop and cost of transportation from one shop to a warehouse also varies. Each shop has a specific production capacity and each warehouse has certain amount of requirement. The costs of transportation are given below: (15)

Shop	Warehouse					Supply
	I	II	III	IV	V	
A	6	4	4	7	5	100
B	5	6	7	4	8	125
C	3	4	6	3	4	175
Demand	60	80	85	105	70	400

The cost of manufacturing the product at different production shops is:

Shop	Variable cost	Fixed cost
A	14	7000
B	16	4000
C	15	5000

Find the optimal quantity to be supplied from each shop to different warehouses at the minimum total cost.

3.(a) Differentiate between game theory and decision theory. (4)

(b) The Ore Mining Company is attempting to decide whether or not a certain piece of land should be purchased. The land costs Rs. 3,00,000. If there are commercial ore deposits on the land, the estimated value of the property is Rs. 5,00,000. If no ore deposits exist, however, the property value is estimated at Rs. 2,00,000. Before purchasing the land, the property can be cored at a cost of Rs. 20,000. The coring will indicate if conditions are favorable or unfavorable for ore mining. If the coring report is favorable, the probability of

recoverable ore deposits on the land is 0.8. However, if the coring report is unfavorable, then probability is only 0.2. Prior to obtaining any coring information, the management estimates that the odds of ore being present on the land is 50-50. Management has also received coring reports on pieces of land similar to the ore in question and found that 60 percent of the coring reports were favorable.

Construct a decision tree and determine whether the company should purchase the land, decline to purchase it or take a coring test before making its decision. Specify the optimal course of action and the corresponding EMV.

4.(a) Define saddle point in a two-person zero-sum game problem. (2)

(b) Briefly describe the dominance rule in a two-person zero-sum game. (6)

(c) Solve the following game problem. (12)

Player A	Player B			
	B_1	B_2	B_3	B_4
A_1	3	2	4	0
A_2	3	4	2	4
A_3	4	2	4	0
A_4	0	4	0	8

5.(a) State various customer's behaviours in a typical queuing system. (6)

(b) A small bank has two tellers, one for deposits and one for withdrawals. The service time for each teller is exponentially distributed, with a mean of 1 min. Customers arrive at the bank according to a Poisson process, with mean rate 40 per hour; it is assumed that depositors and withdrawers constitute separate Poisson processes, each with mean rate 20 per hour, and that no customer is both a depositor and a withdrawer. The bank is thinking of changing the current arrangement to allow each teller to handle both deposits and withdrawals. The bank would expect that each teller's mean service time would increase to 1.2 minutes, but it hopes that the new arrangement would prevent long lines in front of one teller while the other teller is idle, a situation that occurs from time to time under the current set-up. Analyze the two arrangements with respect to the average idle time of a teller and the expected number of customers in the bank at any given time. (14)

6.(a) State the assumptions in Markov chain analysis. (6)

(b) A firm uses three machines in the manufacture of two products. Each unit of product A requires 1 hour on machine I, 2 hours on machine II and one hour on machine III. Each unit of product B requires 2 hours on machine I, one hour on machine II and 3 hours on machine III. The contribution of the two products is Rs. 10 and Rs. 18 respectively. At present, the numbers of these machines (machines I, II and II) in the firm are three each which can individually operate 20 hours per day. With the availability of additional fund and meet the increasing demands, the firm has decided to install new machines, one for each category. Decide what would the change in the profit margin per day. (14)

7. A company trading in motor vehicle spares wishes to determine the level of stock it should carry for the items in its range. Demand is not certain and there is a lead time for stock replenishment of a specific time. The following information is obtained: (20)

Demand (units/day)	3	4	5	6	7
Probability	0.10	0.20	0.30	0.30	0.10

Carrying cost (per unit per day) = 20 paise

Ordering cost (per order) = Rs. 5

Lead time for replenishment = 3 days

Stock in hand at the beginning of the simulation exercise was 20 units.

You are required to carry out a simulation run over a period of ten days with the objective of evaluating the following inventory rule: Order 15 units when the present inventory plus any outstanding order falls below 15 units.
The sequence of random numbers to be used is : 0, 9, 1, 1, 5, 1, 8, 6, 3, 5, 7, 1, 2, 9, using the first number for day one. Your calculation should include the total cost of operating the inventory rule for ten days.