

**B.E. CHEMICAL ENGINEERING FOURTH YEAR SECOND SEMESTER - 2022**  
**OPERATIONS RESEARCH**

Time : Four hours

Full Marks : 70

**Answer Three Questions**

**(Total Marks NOT TO Exceed 70)**

1)i) Find the extreme points of the function  $f(x_1, x_2) = x_1^3 + x_2^3 + 2x_1^2 + 4x_2^2 + 6$  (10 Marks)

1)ii) Find the height and radius of base of a cylindrical tin (with top and bottom) made up of sheet metal to maximize its volume such that its total surface area  $A_0 = 24\pi$ . Confirm maxima. (15 marks)

2)i) Acme Metal Jobshop is in the process of purchasing a multipurpose drill press. Two models, A and B, are available with hourly operating costs of \$18 and \$25, respectively. Model A is slower than Model B. Queuing analysis of similar machines shows that when A is used, the average number of jobs in the queue is 4, which is 30% higher than the queue size in B. A delayed job represents lost income, which is estimated by Acme at \$10 per waiting job per hour. Which model should Acme purchase? (10 marks)

2)ii) Suppose that the time between breakdowns for a machine is exponential with mean 6 hours. If the machine has worked without failure during the last 3 hours, what is the probability that it will continue without failure during the next hour? And also, that it will break down during the next 0.5 hour? (15 marks)

3)i) A company stocks an item that is consumed at the rate of 50 units per day. It costs the company \$20 each time an order is placed. An inventory held in stock for a week will cost \$0.35.

- a. Determine the optimum inventory policy, assuming a lead time of 1 week.
- b. Determine the optimum number of orders per year (based on 365 days per year). (10 marks)

3)ii) Two inventory policies have been suggested by the purchasing department of a company:  
Policy 1 – Order 150 units. The reorder point is 50 units and the time between placing and receiving an order is 10 days.

Policy 2 - Order 200 units. The reorder point is 75 units and the time between placing and receiving an order is 15 days.

The setup cost per order is \$20, and the holding cost per unit inventory per day is \$0.02.

- a. Which of the two policies should the company adopt?
- b. if you were in charge of devising an inventory policy for the company, what would you recommend assuming that the supplier requires a lead time of 22 days? (10 marks)

**PLEASE TURN OVER**

4. We have 5 jobs, each of which must go through the two machines A and B in the order AB. Processing times are given in the table below:

PROCESSING TIME, HR		
Job	Machine A	Machine B
1	5	2
2	1	6
3	9	7
4	3	8
5	10	4

Determine a sequence for the 5 jobs that will minimize the elapsed time T. (20 marks)

5. A fleet owner finds from his past records that the costs per year of running a truck whose purchase price is \$6000 are as given below:

Year	1	2	3	4	5	6	7	8
Running Costs	1000	1200	1400	1800	2300	2800	3400	4000
Resale Price	3000	1500	750	375	200	200	200	200

At what age is a replacement due? Justify your answer. (25 marks)

6. Two objects of values \$100 and \$130 are to be auctioned at a public sale. Only two bidders are interested in these items. Bidder A has \$100 available, and bidder B has \$80 available. What should be their strategies if each bidder is interested in maximizing his own gain? (25 marks)