

EGT2
ENGINEERING TRIPOS PART IIA

Thursday 2 May 2024 14.00 to 15.40

Module 3E10

OPERATIONS MANAGEMENT FOR ENGINEERS

*Answer not more than **two** questions.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS

Write on single-sided paper.

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM

CUED approved calculator allowed.

10 minutes reading time is allowed for this paper at the start of the exam.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

You may not remove any stationery from the Examination Room.

1 (a) Consider a product with a one-month shelf life. The average monthly sales for the product is 1,000 units. The fixed cost of ordering is £1,000. The cost per unit is £50. The cost of keeping the product in stock is 40% of its value per year.

(i) Find the optimal order quantity for this product. How frequently must the company place an order? [20%]

(ii) Write the total cost function. How much does the company spend per year for this product? [15%]

(iii) The company is considering alternative sourcing options for this product. Discuss key advantages and disadvantages of moving the production in-house rather than outsourcing. [15%]

(b) Using key competitive priorities, explain and discuss how a company's operations can provide a competitive advantage. Provide examples of companies as appropriate. [20%]

(c) Discuss and explain the following statement: Problems are natural and opportunities to learn, not blame! [10%]

(d) Explain the following order fulfilment strategies: Make-to-Stock, Assemble-to-Order, Make-to-Order, Engineer-to-Order. Provide examples and discuss the P:D ratio for each. [20%]

2 (a) Three refineries with maximum daily capacities of 10, 7, and 10 million gallons of oil supply three Distribution Centres (DCs) with daily demands of 8, 12, and 5 million gallons.

Oil is transported to the three DCs through a network of pipes. The transportation cost is 1 pence per 100 gallons per mile. Refinery I is not connected to DC3. Table 1 shows the mileage among refineries and DCs.

Table 1

	DC1	DC2	DC3	Capacity (in million gallons)
Refinery I	60	95	-	10
Refinery II	150	50	40	7
Refinery III	100	125	60	10
Demand (in million gallons)	8	12	5	

- (i) State the basic principles of the North West Corner approach for allocating supply to demand. What are the limitations of the approach? [20%]
- (ii) Find an initial North West Corner allocation for the configuration in Table 1 and calculate the total distribution cost associated with that allocation. [10%]
- (iii) Is the solution in part (a)(ii) optimal? If yes, explain why. If no, find an improved solution. [10%]
- (b) Explain the following terms: cycle stock, safety stock, pipeline stock, and anticipation stock. Discuss the function of each of these inventory types. How can a company decrease them? [20%]
- (c) All operations management decisions are trade-offs. Discuss the need of trade-offs in short- and long-term. [20%]
- (d) According to Goldratt, “An hour lost at a bottleneck is an hour lost to the system.” Based on this statement, discuss how a company following the principles of theory of constraints can manage its operations. [20%]

3 (a) Consider a company that estimates the following demand for its products over the next three months:

Month	July	August	September
Demand Forecast	2,000	1,600	2,000

There are currently 10 workers working at the company and it is estimated that one worker can produce 5 products per day. It can be assumed that each month has 20 working days. Hiring cost is £1,000 and lay-off cost is £2,000 per worker. Inventory cost is £10 per product per month.

The company will have 450 products in inventory at the end of June, and would like to have at least 600 products in inventory at the end of September. Assuming that stock-outs or backorders are not allowed:

- (i) Determine the minimum constant workforce plan and the cost of that plan. [20%]
- (ii) Determine the zero-inventory plan (chase strategy) and the cost of that plan. [20%]
- (iii) Assume that estimates for the following 2 months became available and the company also wants to capture those months in the plan.

Month	October	November
Demand Forecast	400	1,200

Now assume that you do not need to have any inventory on hand at the end of September but you still have 450 products in inventory at the beginning of July and no ending inventory is needed at the end of November. Now the company is allowed to hire/layoff workers once at the beginning of July and second at the end of September (beginning of October). Suggest the mixed plan possible in this situation where no backorders or stock-outs are allowed. Determine the total holding and hiring/layoff cost in this mixed case. [20%]

(b) Many manufacturing companies include 'set-up time reduction' activities in their production improvement programmes. Explain how reducing set-up times in manufacturing can benefit an organisation, and what can be done for implementing shorter set-ups. [20%]

(c) Discuss the impact of recent capacity problems/closures of Suez and Panama canals on supply chains and customers. [20%]

END OF PAPER