Version FE/2

EGT2: IIA
ENGINEERING TRIPOS PART IIA

Friday 29 April 2016 9:30 to 11:00

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
Single-sided script paper

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM
CUED approved calculator allowed

10 minutes reading time is allowed for this paper.

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

1 (a) Discuss the key wastes lean production seeks to address. [20%]

(b) There are two fundamental approaches to scheduling production operations: pull and push scheduling.

(i) Discuss the key differences between pull and push scheduling. [10%]

(ii) What is the role of inventory in a pull-scheduled production system? [5%]

(iii) What is the role of inventory in a push-scheduled production system? [5%]

(c) Which forecasting method would be appropriate in each of the following scenarios?

(i) Holiday Inn is attempting to predict next year's demand for motel rooms based on a history of demand observations. [10%]

(ii) Standard Brands has developed a new type of outdoor paint. The company wishes to forecast sales based on new housing starts. [10%]

(d) An end item has the product structure diagram given in Fig. 1.

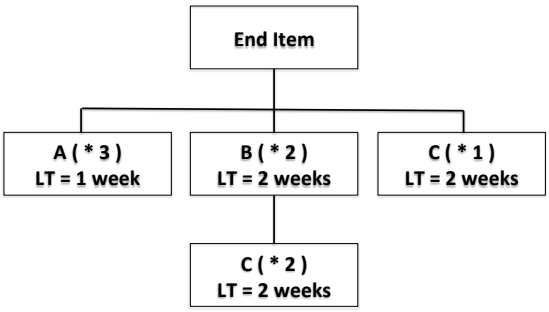

Fig. 1: The product structure diagram for the end item [LT: Leadtime]

Suppose that the master production schedule (MPS) for the end item is as follows:

Week	6	7	8	9	10	11	12	13	14	15
MPS	0	0	0	0	80	90	100	110	100	120

Currently, there are no on-hand inventories of any components or end items. Scheduled receipts for B in period 11 and in period 14 are 40 and 60, respectively. Find the planned order releases for component C assuming a lot-for-lot scheduling rule. [40%]

2 Three refineries with maximum daily capacities of 6, 5, and 8 million gallons of oil supply three distribution centres (DCs) with daily demands of 4, 8, and 7 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. The mileage table below shows that refinery I is not connected to DC3.

Table 1: Mileage table

	DC1	**DC2**	**DC3**	**Capacity (in million gallons)**
Refinery I	120	180	-	6
Refinery II	300	100	80	5
Refinery III	200	250	120	8
Demand (million gallons)	4	8	7	19

(a) State the basic principles of the North West corner approach for allocating supply to demand. What are the limitations of the approach? [10%]

(b) Find an initial North West corner allocation for the configuration in Table 1 and calculate the total distribution cost associated with that allocation. [20%]

(c) Due to a planning change, the capacity of refinery III is reduced to 6 million gallons. Also, DC1 must receive all its demand, and any shortage in DC2 and DC3 will result in a penalty of 5 pence per gallon. Discuss the implication of this change for your allocation, and indicate how you would revise your calculations in (b) to accommodate this change. [25%]

(d) Consider the scenario in Table 1. Now suppose the daily demand at DC3 drops to 4 million gallons. Any surplus production at refineries II and III must be diverted to other DCs by tanker. The resulting average transportation costs per 100 gallons are £1.50 from refinery II and £2.20 from refinery III. Refinery I can divert its surplus oil to other chemical processes within the plant. Discuss the implication of this change for your allocation, and indicate how you would revise your calculations in (b) to accommodate this change. [25%]

(e) Show that the solution in part (d) is not optimal by providing an alternative solution with a lower cost. [20%]

3 (a) Discuss, with examples, when the fixed time period inventory model should be preferred to the fixed-quantity inventory model and vice versa. [20%]

(b) Annual demand for a product is deterministic and constant, but the value is not specified. A firm uses an order quantity of $Q = 1,000$ units. The firm's annual inventory holding cost is £500 and their annual setup cost is £700. Discuss whether the order quantity that the firm uses is appropriate. [10%]

(c) A mobile phone company sells two kinds of smartphones, A and B. The company has the option of setting up the order for A and B separately (separate setups) or at the same time (common setup). If the company chooses separate setups, for each kind of smartphones, the setup cost is K_i, $i \in \{A, B\}$. If the company chooses common setup, owing to the economy of scale, the setup cost will be $\alpha(K_A + K_B)$, where $0 < \alpha < 1$. Regardless of the setup choice, the annual holding cost per item is h_i and the annual demand is λ_i.

(i) For separate setups, derive the expressions for EOQ_i and the corresponding optimal total cost in terms of the given parameters λ_i, K_i, and h_i. [10%]

(ii) For common setup, express the total cost in terms of the time elapsed between subsequent orders, T. [20%]

(iii) Determine the optimal T^* based on the total cost function from part (c)(ii), and derive the expression for the corresponding optimal total cost in terms of the given parameters λ_i, K_i, and h_i. [20%]

(iv) Derive the condition for α in terms of the given parameters λ_i, K_i, and h_i such that the company would prefer common setup to separate setups. [20%]

END OF PAPER