

EGT2
ENGINEERING TRIPOS PART IIA

Friday 3 May 2019 9.30-11.10

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 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.

1 (a) Indicate whether the following statements are true or false. Provide a brief reason for each answer.

- (i) The fixed-time period model is preferred over the fixed-order quantity model for more expensive items. [5%]
- (ii) Make-to-stock production outperforms make-to-order production in terms of efficiency and inventory. [5%]
- (iii) Forecasting is essential for dependent demand. [5%]
- (iv) A process that is under control is also capable. [5%]

(b) Ada owns and operates a small factory that manufactures plastic bottles which she sells to bottling companies. The annual demand is 1 million bottles spread evenly over the year. The setup cost is £5,000 per batch, the holding cost is £3 per annum for each bottle. The maximum production capacity is 2 million bottles per annum. Currently, bottles are manufactured in 10 equal batches.

- (i) Calculate the current annual holding cost and setup cost. [15%]
- (ii) Find the optimal production quantity that Ada should produce to minimise her costs. [20%]
- (iii) Calculate Ada's savings relative to the current strategy if she adopts the quantity in part (ii). [15%]

(c) Define the customer value equation. Discuss, with examples, how companies can maximise customer value. [15%]

(d) Discuss common methods of adjusting medium term capacity, and describe various trade-offs of these methods. [15%]

- 2 (a) The table below shows the distribution matrix for a transportation problem.

	L	M	N	Supply
P	3	5	8	22
Q	4	3	7	18
R	6	4	8	11
S	8	2	5	9
Demand	15	17	20	

- (i) Explain the concept of degeneracy in a solution given by the northwest corner method. [15%]
- (ii) Write down the initial solution given by the northwest corner method and calculate the total distribution cost associated with that allocation. [15%]
- (iii) Show that this initial solution is not optimal by providing an alternative solution with a lower cost. [20%]
- (b) Describe the MRP concept, including inputs to MRP, components of an MRP record, and the outputs of MRP. [40%]
- (c) Describe the Collaborative Planning Forecasting and Replenishment (CPFR) framework. Discuss the potential advantages and disadvantages of this framework. [10%]

3 (a) Define service quality. Explain the challenges of delivering service quality and discuss how the gap model can help overcoming these challenges. [25%]

(b) Describe the Exponential Smoothing (ES) forecasting method and explain its advantages and disadvantages. Discuss how ES can be modified to overcome its disadvantages. [20%]

(c) You have received an order from a customer to process six jobs for delivery on the following due dates:

Job	A	B	C	D	E	F
Processing time (days)	2	4	2	1	2	4
Due date (from current day)	6	8	7	4	10	9

Assign the order of jobs to minimise the number of tardy jobs and explain the rationale for your answer. Calculate the mean flow time and the average tardiness. [15%]

(d) Consider a queuing model with a single server, where only one customer is allowed in the system. Customers who arrive and find the system busy never return. Assume that the arrival distribution is Poisson with mean λ and the service time is exponentially distributed with mean service rate μ .

(i) Set up the transition diagram, and determine the balance equations. [10%]

(ii) Determine the steady-state probabilities. [15%]

(iii) Determine the average number of customers in the system, the average queue length, the average waiting time in the system, the average waiting time in the queue, and the arrival rate for the customers who are served in the system. [15%]

END OF PAPER