Version GY/3

EGT2
ENGINEERING TRIPOS PART IIA

Thursday 7 May 2026 14:00 to 15:40

Module 3E10

OPERATIONS MANAGEMENT

*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.

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) Determine the economic order quantity (EOQ) for this component. How frequently should the company place orders to meet demand? [20%]

(ii) Write the total cost function. How much does the company spend per year for this product? [20%]

(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. [20%]

(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) 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 Delta Electronics manufactures smart home sensors. The company sources components from multiple suppliers and assembles the products in-house. Weekend demand has increased, leading to longer waiting times, inconsistent service, and occasional quality issues. Management wants to improve supply chain efficiency, ensure timely deliveries, and maintain consistent product quality.

Table 1 – Summary of the Microcontroller Production at Delta Electronics

Component	Lead Time (weeks)	Current Stock	Weekly Demand	Lot Size
Microcontroller	2	100	50	50
PCB	1	200	100	100
Sensor Module	1	300	150	150

Each sensor requires 1 Microcontroller, 1 PCB, and 2 Sensor Modules.

(a) Propose digital solution(s) that could improve weekend order fulfilment and support consistent service delivery. Explain how it addresses operational bottlenecks in assembly and supply chain. [20%]

(b) Explain how Delta Electronics could use the DMAIC methodology to implement your proposed digital solution. For each DMAIC stage, describe its purpose and give a brief example relevant to supply chain or assembly operations: Define (problem and objective), Measure (how the system collects data), Analyse (how bottlenecks are identified), Improve (changes supported by the system), and Control (how improvements are sustained). [30%]

(c) Delta Electronics wants the PCB thickness to be 1.00 mm ±0.05 mm. A sample of 40 PCBs shows: mean = 1.02 mm and standard deviation = 0.02 mm. Based on a Three Sigma standard, is the process capable of meeting the quality requirements? Please show your calculations and explain your results. [20%]

Note: $C_p = \frac{USL-LSL}{6\sigma}$; $C_{pk} = \min\left\{\frac{USL-\mu}{3\sigma}, \frac{LSL-\mu}{3\sigma}\right\}$

(d) Using the component requirements above, please calculate the net requirements and planned order releases for all components for the next two weeks, assuming constant weekly demand. Clearly state all assumptions. [30%]

3 Big Oven Pizzeria is a new establishment in Cambridge that delivers an authentic pizza napolitana experience. The pizzeria is currently managed by a single employee who performs all process steps sequentially. Operational data shows high defect rates, and a site visit has confirmed that any defect results in the complete loss of the pizza with no possibility for rework.

Table 2 – Pizza Making Process at Big Oven Pizzeria

Process Step	Preparing Toppings (per pizza)	Dough Kneading and Shaping (per pizza)	Adding Toppings (per pizza)	Baking (per pizza)	Finishing Touches and Serving (per pizza)
Capacity per Employee	1 Pizza	1 Pizza	1 Pizza	1 Pizza	1 Pizza
Process Time	1.5 minutes	1.5 minutes	1 minute	2 minutes	1 minute
Quality Failures (avg. occurrence per pizza)	25%	15%	10%	60%	10%
Capacity					
Remaining Yield					
Effective Capacity					

(a) Calculate the Capacity per Hour for each of the five process steps. Table 2 can be used to fill in the results; please show your calculations on the answer sheet. Alternatively, you can draw your own table. [20%]

Note: This should be calculated as the number of units a step can theoretically produce in 60 minutes, assuming 100% quality.

(b) For each step, calculate the Remaining Yield that is the number of successful pizzas per hour that pass that step's individual quality check. Table 2 can be used to fill in the results; please show your calculations on the answer sheet. Alternatively, you can draw your own table. [20%]

(c) Calculate the Effective Capacity for each step. Table 2 can be used to fill in the results; please show your calculations on the answer sheet. Alternatively, you can draw your own table. [20%]

Note: $Effective\ Capacity = y_{cumulative} \times \text{Capacity}$

$y_{cumulative} = y_{step} \times y_{step+1} \times \ldots\ldots \times y_{final}$

(d) Identify which step is the bottleneck in the current pizza-making process based on the effective capacity results and clearly state your assumptions. [10%]

cont.

(e) Apply Lean Philosophy to propose an improvement plan that addresses waste, flow issues, quality defects, and employee workload. [30%]

END OF PAPER

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