EGT2: IIA
ENGINEERING TRIPOS PART IIA

Tuesday 2 May 2017 14 to 15.30

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) Consider the following four-step process, which consists of four machines in a series (A -> B -> C -> D):

Step	Setup time	Run Time
A	10 mins	0.05 min/part
B	20 mins	0.1 min/part
C	14 mins	0.2 min/part
D	10 mins	0.1 min/part

Machines need a set up for each batch and cannot process parts while set ups are occurring. The set up for a given batch may not begin until the prior batch (i.e. both set up and run) is complete.

If the batch size is fixed at 75 parts per batch, what is the daily capacity of the process for a 7.5 hour day? [20%]

(b) Explain the external process performance objectives. Discuss, with examples, how companies can use these objectives to compete effectively. [15%]

(c) Define the bullwhip effect. Discuss drivers of the bullwhip effect and how the bullwhip effect can be reduced in supply chains. [15%]

(d) A manufacturer produces an end item with the following product structure diagram (Fig. 1):

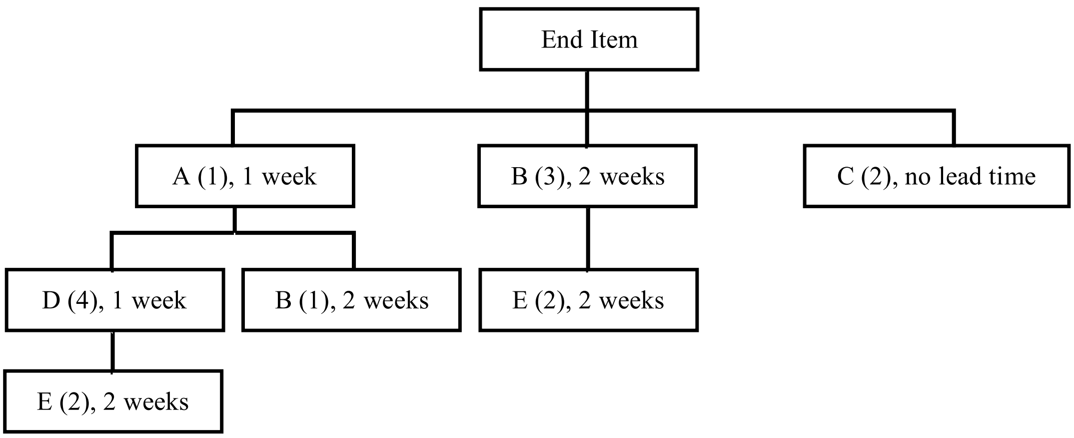

Fig. 1: The product structure diagram for the end item

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

Week	1	2	3	4	5	6	7	8	9
Demand for End Item					20	10	30	60	10

Assume that the manufacturer produces the end item on demand instantaneously. Assume that the lot sizing rule is lot-for-lot for components A and B, least unit cost (LUC) for component C, POQ for component D, and EOQ for component E.

(i) If production is scheduled on a lot-for-lot basis for component B, complete the following MRP table for component B. Suppose that an external supplier will supply 100 units of B in week 2 and 30 units of B in week 8. There are no inventory or standing orders for any other components. [25%]

Week	1	2	3	4	5	6	7	8	9
Gross Requirements									
Scheduled Receipts									
Net Requirements									
Planned Order Release									

(ii) Suppose that the order cost of component C is £1,000 per order, and the inventory holding cost is £15 per item per week. Inventory cost is incurred at the end of each week. Determine the production lot sizes for component C using LUC. [20%]

(iii) Discuss the advantages and limitations of LUC. [5%]

2 (a) Discuss the key features of a lean organisation. How much should Toyota be afraid of copycats? [20%]

(b) Explain the simple exponential smoothing model and the triple exponential smoothing model in your own words. Explain when you would prefer to use the triple exponential smoothing model over the simple exponential smoothing model. [15%]

(c) A scientist has been studying the passage of insects through a certain cubic metre of air using automated instruments to continuously monitor insect positions. Her measurements show that, during the calendar year 2010, insects crossed the boundary of the 'invisible cube' at an overall rate of 0.061 per hour, either going in or going out, and that the average number of insects in the cube was 0.0082. What was the average duration of an insect visit to the cube during 2010? [15%]

(d) CESP Co. manufactures car engine spare parts. One particular spare part has a known and constant demand rate of 1,600 units per year. The fixed cost of the setup for each production run is £200 and the inventory holding cost is £4 per unit per year. There is a lead time of 1 week.

Assuming that there is infinite production capacity. Compute:

(i) The optimal order quantity and the resulting annual setup cost [10%]

(ii) The optimal reorder point [10%]

Now assume that there is a finite production rate of 8,000 units per year. Compute:

(iii) The optimal order quantity and the total annual holding cost [10%]

(iv) The maximum inventory level [10%]

(v) The length of time required (years) to produce a production lot [10%]

3 (a) What is a service shop? Provide typical examples of circumstances under which such an operating approach is suitable. [15%]

(b) What is a P:D ratio? Discuss, with examples, how it can be used to determine the order fulfilment strategy of a firm. [15%]

(c) Explain Taguchi's 'Loss to Society' notion and Juran's 'Cost of Quality' model. Compare and contrast these two. [20%]

(d) 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

For each job, the customer will pay your costs plus £P ($P \geq 0$) for each job completed before or on the specified due date. However, if a job is completed late then there will be a £750 penalty for each day which that job is late.

(i) Which jobs should you accept independent of the value of P? How should you schedule these jobs? [40%]

(ii) Comment on the sensitivity of the answer in part (d)(i) to changes in the penalty for lateness (express your answer in terms of P). [10%]

END OF PAPER

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