ENGINEERING TRIPOS PART IIA

Monday 23 April 2012 9.00 to 10.30

Module 3E10

OPERATIONS MANAGEMENT FOR ENGINEERS

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

All questions carry the same number of marks.

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

There are no attachments.

STATIONERY REQUIREMENTS
Single-sided script paper

SPECIAL REQUIREMENTS
CUED approved calculator allowed

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

FINAL Version

1 You have been asked to set up the assembly lines for a manufacturer of electric wall fans. There are 8 tasks required to assemble and test the fan. The tasks, their work content (in minutes) and the sequence that they need to be performed in are given in Table 1.

Task	**Time (mins)**	**Description**	**Predecessors**
A	2	Assemble frame	None
B	1	Mount switch	A
C	3.4	Assemble motor housing	None
D	1.2	Mount motor housing in frame	A, C
E	0.5	Attach blade	D
F	1	Assemble and attach safety grill	E
G	1	Attach cord	B
H	1.4	Test	F, G

Table 1

(a) Draw the precedence diagram for this assembly operation. [10%]

(b) Assuming that each task is performed by a single person:

(i) What is the maximum number of fans that could be produced per hour on this assembly line?

(ii) What is the minimum number of workstations that could be used to achieve this production rate? Which tasks are allocated to which workstation? What is the order of these workstations?

(iii) Calculate the labour efficiency for this configuration;

(iv) Which workstation has the most idle time? Justify your answer;

(v) In steady state, what is the average WIP inventory on this assembly line?

[30%]

(c) Management would like to increase the throughput of the assembly line.

(i) According to the Theory of Constraints, what steps should you follow to increase throughput?

(ii) Management have decided to add one extra worker to the assembly line. It is possible to have up to two workers assigned to each task. Two workers working together in a workstation will halve the duration of the tasks they perform. How would you reorganise the workstations? Justify your answer;

(iii) In this new configuration, where in the assembly line would you place a buffer for WIP inventory? Explain why;

(iv) In steady state, what is the average WIP inventory on the assembly line in its new configuration?

(v) What is the labour efficiency for the new configuration?

[40%]

(d) Assuming there are multiple assembly lines within the factory, how could the labour efficiency of each assembly line be increased to 100%? In practice, why would this not be done? [20%]

2 Your college bar has asked you to help them decide what orders to place with their beer merchant for bottled beer in the Michaelmas Term next year. There are eight weeks in the term. The expected sales for each week are shown in Table 2.

Week	1	2	3	4	5	6	7	8
Quantity	400	600	400	200	400	200	200	600

Table 2

Beer costs 50p a bottle and the beer merchant charges a £30 delivery charge per order. The cost of storing beer in the cold room is 2p per bottle per week.

(a) Using the Least Unit Cost (LUC) heuristic:

(i) Determine what orders to place with the beer merchant in order to minimise the total cost of bottled beer for the bar. For each delivery, give the number of the bottles and in which week it is delivered;

(ii) How much will the total storage cost be by the end of term?

[40%]

(b) An alternative to LUC that could be used in this case is the Period Order Quantity (POQ) heuristic. Using POQ:

(i) What is the period between orders?

(ii) How many bottles are there in each order?

(iii) Which ordering approach (LUC or POQ) is less costly for the bar? Justify your answer.

[20%]

(c) Organisations may need to order many thousands of different items in any given period. Outline the role that Pareto analysis can play in this context. [40%]

3 There are two basic approaches to production planning and control: "push" scheduling and "pull" scheduling.

(a) For "push" scheduling:

(i) Outline the functionality of an MRP system within a factory;

(ii) Why is MRP called "push" scheduling?

(iii) What is the purpose of inventory within a "push" system?

[40%]

(b) For "pull" scheduling:

(i) Why is JIT called "pull" scheduling?

(ii) Describe how Kanban cards are used to schedule production in a JIT system. Use drawings where appropriate;

(iii) What is the purpose of inventory within a "pull" system?

[40%]

(c) Explain why, under certain circumstances, a "push" system might be preferred to a "pull" system. [20%]

4 Assessing the performance of operations is a major concern for operations managers.

(a) What are the five performance objectives of operations management? Explain each one with an example. [15%]

(b) According to Ferdow and de Meyer's Sandcone Model, why is quality the most important of the five performance objectives? [15%]

(c) Operations can be improved using radical improvement or continuous improvement approaches. Explain the difference between radical improvement and continuous improvement. [20%]

(d) A furniture manufacturing company in which you work has experienced high, and increasing, levels of warranty returns on its premium office seat. Your manager has asked you to investigate the issue further.

(i) Outline how the DMAIC framework can be used to address this problem;

(ii) Explain how production problems at Toyota become opportunities for improvement.

[50%]

END OF PAPER