

MANUFACTURING ENGINEERING TRIPOS PART IIA

Friday, 26 April 2013 9 to 12

PAPER 3

Module 3P4: OPERATIONS MANAGEMENT

Module 3P5: INDUSTRIAL ENGINEERING

*Answer **all questions** from Sections **A** and **B**.*

*Answers to sections **A** and **B** must appear in two separate booklets.*

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.*

There are no attachments.

STATIONERY REQUIREMENTS

20 page answer booklet x 2

Rough work paper

SPECIAL REQUIREMENTS

Engineering Data Book

3P5 Data Sheet

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

SECTION A

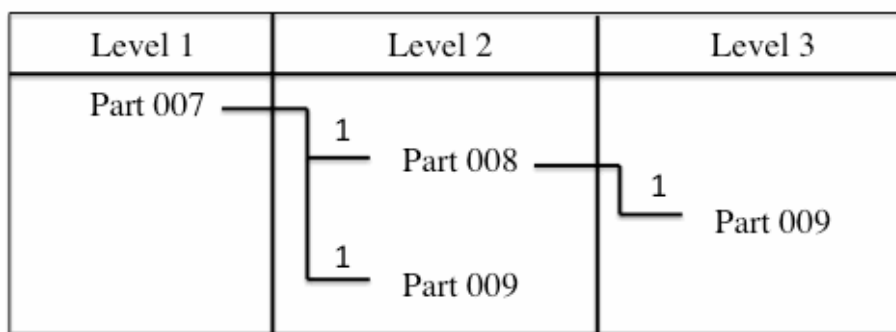
1 The primary role of the 'Operations' function in a firm is to manage the process that convert inputs into outputs that are supplied to the customer.

- (a) Outline the key *managerial* activities in this conversion process. [30%]
- (b) Discuss the key performance criteria of this process. Of these, which ones are most important? Justify your answer. [20%]
- (c) A common perception in service firms is that service processes should be as responsive as possible to meet specific customer requirements. To what extent do you agree or disagree with this statement? Discuss. [25%]
- (d) It has been argued that internal company, or 'overhead' processes such as accounting or human resources are also service processes, and should be treated as such. Do you agree? Discuss. [25%]

2 Materials Requirements Planning (MRP) provides a means for scheduling the ordering of raw materials and parts.

- (a) (i) What are the main inputs to an MRP system?
- (ii) How is a Bill of Materials used in MRP calculations? [20%]

(b) Part of the Bill of Materials for a vacuum coating machine includes the following structure:



The following ordering details are known about each part:

- Part 007 has a lead time of 2 weeks and a Minimum Order Quantity of 50.
- Part 008 has a lead time of 1 week and Economic Order Quantity of 65.
- Part 009 has a lead time of 2 weeks and a fixed order period of 3 weeks i.e. there is always 3 weeks between orders.

The gross requirements for part 007 over the following 10 weeks are:

Week	1	2	3	4	5	6	7	8	9	10
Number of parts	40		30	60		20	80		70	30

There are scheduled receipts in week 1 of 50 of Part 007, 65 of Part 008 and 165 of Part 009.

Construct the MRP records for all three parts over the ten week planning horizon. [50%]

- (c) (i) Discuss the limitations of MRP.
- (ii) Describe what is meant by closed-loop MRP, and discuss to what extent it addresses the limitations you have identified? [30%]

SECTION B

3 (a) Outline the systematic questioning technique used in method study to critically assess manufacturing operations. Explain the rationale behind the questions. [15%]

(b) Describe the principles of motion economy that relate to the 'Arrangement of the Workplace'. [15%]

(c) In the context of manual work, discuss the differences between static and dynamic muscular activity, give examples, and briefly describe the differing physiological effects of each. [10%]

(d) A worker is exposed to two coexisting sources of noise, one at 81 dBA and the other at 84 dBA. What is the maximum length of exposure to this to avoid exceeding an eight hour average of 85 dBA? [10%]

(e) An engineer times an assembly operation, and observes the following:

Operation	Observed Time (s)	Observed Rating (BSI scale)
Load components to assembly fixture	40	110
Insert 10 bolts, hand tighten	50	100
Tighten to specified torque	30	110
Unload assembly	10	120

Total allowances are 15%.

(i) Calculate the standard time for the assembly operation.

(ii) How many components would be assembled in an eight hour shift, by an operator working at 90 BSI? [10%]

(f) An activity sampling study is required to determine the utilisation of a crane to an accuracy of +/- 5%, with 80% confidence. A pilot study shows the utilisation to be around 80%. How many observations should be planned for the study? [10%]

(g) Discuss the two requirements for a process to consistently produce outputs that meet specifications. Define *accuracy* and *precision*, and explain the difference between C_p and C_{pk} . [15%]

(h) A manufacturing process has a defect rate of 5 percent, based upon 10 samples of 20 data points each. Calculate the control limits for a p-chart, and explain how it would be used to detect changes in the process performance. [15%]

4 (a) In the context of a manufacturing facility, describe the differences between a functional layout and a cellular layout based on the principles of Group Technology. What are the advantages and disadvantages of each? [30%]

(b) You have just taken over as the cell leader for a poorly performing production cell. Scrap levels are high, mainly due to careless mistakes by operatives; and efficiencies are low, due to short runs. The cell's performance shows no sign of improving. The factory manager has instructed you to carry out a 5S implementation and to come up with a six month improvement plan based on the principles of the *Toyota Production System*.

(i) Outline how you would carry out the 5S implementation.

(ii) Describe and prioritise *three* initiatives that would form the basis of your improvement plan. [70%]

END OF PAPER