Version RD/5

MET2
MANUFACTURING ENGINEERING TRIPOS PART IIA

Friday 29 April 2016 9 to 10.30

Paper 6

Module 3P10: CONTEMPORARY ISSUES IN MANUFACTURING

*Answer **all** questions.*

*Answers to sections **A**, **B**, and **C** must appear in three 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.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS
8 page answer booklet x 3
Graph paper x 1

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM
CUED approved calculator allowed
Engineering Data Book

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.

SECTION A

1 A company is setting up a new factory to manufacture photocopier machines in the UK, aiming for the highest environmental performance in all aspects of the factory and the product.

(a) The company starts by conducting an eco-audit. Explain what is meant by an eco-audit. What use might the company expect to make of this information? [20%]

(b) Product design can influence the environmental impact of all the different stages of the product lifecycle.

(i) Which lifecycle stages would you expect to be most important in determining the energy consumption over the product lifetime? Explain your reasoning. [10%]

(ii) Discuss product design features that can reduce the environmental impact of the product, indicating their relative importance and their influence on different parts of the lifecycle. [35%]

(iii) Suggest steps in addition to product design that could be taken to reduce the eco-impact of the use phase and the end-of-life phase, discussing each phase separately. [15%]

(c) What factors should the company consider in drawing up specifications for eco-efficient design and eco-efficient operation of the factory buildings? The buildings include ‘office’ operations as well as a manufacturing production line. Which factors are expected to have the biggest influence on the annual energy consumption of the factory? [20%]

SECTION B

2

(a) (i) Describe what is meant by the term *biomaterial*, giving examples where appropriate. [20%]

(ii) Describe two different applications where polymer degradation is deliberately used in a medical device. Include in your description the benefits of using degradable polymers in each case. [15%]

(ii) Assume one of your polymer systems noted in part (ii) above degrades by bulk erosion. If a new version of the device requires degradation by surface erosion, what factors must you consider to deliver this change? [20%]

(b) (i) Describe what is meant by a *Quality Management System*, with specific reference to medical device manufacturing. [15%]

(ii) A steam sterilisation technique is used to sterilise a batch of medical devices for 42 minutes in total. The targeted Sterility Assurance Level (SAL) is 10^{-6}. A safety factor of 20% additional time has been included in the 42 minutes. Microorganism quantities have recently been recorded at two time points of this process and are shown in Table 1. Determine the bioburden you would expect to find on this batch of medical devices. [30%]

	Time (min)	**No. of microorganisms**
Time point 1	5	3.55×10^5
Time point 2	10	4.47×10^3

Table 1

SECTION C

3. You have visited six different industry sectors as part of the METIIA Industrial Visits module, namely: Primary Processes; Automotive; Aerospace; Electronics; Electro-mechanical; and Fast Moving Consumer Goods.

(a) As part of the visits, you examined Materials and Production Processes in 11 companies.

(i) Using specific examples from four different companies, describe new material developments and/or new production processes that were noted during the visits. For each example, discuss why this innovation took place. [40%]

(ii) From your observations, which *sectors* appear most and least proactive in developing materials innovations? Give reasons why you think this is the case. [10%]

(b) The companies you visited used both in-house fabrication and out-sourcing of parts. Give three examples of the different approaches observed in the companies. In these examples, discuss the reasons for choosing the particular approach. [50%]

END OF PAPER