Version RD/04

MET 2
MANUFACTURING ENGINEERING TRIPOS PART IIA

Thursday 2 May 2024 9:00 to 10:40

Paper 6

MODULE 3P10: CONTEMPORARY ISSUES IN MANUFACTURING

*Answer **all** 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 and at the top of each answer booklet.
Use a separate answer booklet for each question.

STATIONERY REQUIREMENTS
8 page answer booklet x 3
Rough work pad

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM
CUED approved calculator allowed
Engineering data books

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.

Question 1

A small manufacturing company wishes to improve its environmental performance without increasing costs. The company makes small pieces of laboratory equipment, buying in electronic components and assembling within metal or plastic casings which are manufactured in-house. Business aspects of the firm are run from offices within the factory building. The main operations within the factory are polymer injection moulding, sheet metal work (drilling, cutting and bending sheet steel), spray painting of metal parts, manual assembly of products, packing, and dispatching. The only energy source in the building is electricity. There are 20 employees on site.

Considering only what happens within the factory building and excluding upstream and downstream supply chain aspects, the company has identified that its initial improvement aims are to:

- reduce waste generated in-house;
- reduce energy usage and the environmental impact of any energy used.

They want to present their results as simply as possible on their website and are thinking about using carbon footprint as the metric.

(a) For each of the improvement aims, list the main contributory factors, discussing what you might expect to be their relative contributions to the carbon footprint. You should look at the in-house production operations, the 'office' operations and the operation of the factory building.

[30%]

(b) Outline how carbon footprint of the various contributory factors could be estimated. What data would be needed?

[15%]

(c) Suggest ways in which the company might implement improvements to tackle the contributory factors. Propose three measures which might be introduced within the next month and three further measures which would require longer timescales. Comment on the financial implications of putting in place any improvements you propose.

[35%]

(cont.

(d) Discuss whether carbon footprint is the most appropriate metric for the company to use.

[10%]

(e) A more wide-ranging follow-on study on improving environmental performance of the company looks beyond the factory building. What additional factors should they consider? Explain the relative significance of the factors you suggest.

[10%]

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Question 2

(a) (i) Define what is meant by the term *biomaterial*, giving examples within your answer.

[10%]

(ii) A degradable polymer implant can be used to deliver drugs to a patient over many months. Describe the factors you would consider when selecting the appropriate polymer for this implant.

[30%]

(b) Taking a large enough sample of someone's liver to diagnose disease can have a negative effect on a patient. A firm has developed a new approach, where only a very small sample of cells is taken from the liver, which are then grown using tissue engineering techniques into a large sample that is put into a microfluidic chip to give a diagnosis.

Without knowing the details of how such a diagnostic device would operate, describe any 5 challenges you anticipate to receiving regulatory approval for this new method of diagnosis.

[40%]

(c) (i) Explain why the global harmonisation of medical device regulations would be beneficial.

[10%]

(ii) Describe any one challenge faced by medical device manufacturers with the introduction of new EU Medical Device Regulations in 2017.

[10%]

Question 3

(a) Two firms operate in the same sector. Firm A is a large, established firm that manufactures and sells sensors that detect a range of toxic gases. They use a standard sensing technology and modify it slightly for each new gas to detect. They usually bring a new product from idea to commercialisation every 2 years.

Firm B is a start-up by researchers in a university. They have developed a new nanoparticle 'platform technology' and one application is to make a precise and more sensitive gas sensing technology. The researchers want to scale up their technology to rival the products of the large firm.

(i) Define what is meant by the term *platform technology*.

[10%]

(ii) Describe and discuss the different methods you anticipate would be used by the two firms when managing risks to scale-up a new product.

[40%]

(iii) What recommendations would you give to Firm B to avoid the 'Valley of Death'?

[30%]

(iv) In addition to the Valley of Death, describe any three challenges you anticipate will be faced by Firm B and note if they link to any specific dimensions of scale-up.

[20%]

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