Version RD/5

MET2
MANUFACTURING ENGINEERING TRIPOS PART IIA

Friday 6 May 2022 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 sheet.*

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 Book

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.

1 Avoiding waste has been identified as one of the main ways in which companies can reduce their environmental impact. A UK-based automotive manufacturer has asked a group of METIIB students to help them reduce waste in their manufacturing operations over the coming year, under the broad headings of materials usage and energy usage. They asked the students to think about the operation of the building and the offices, as well as the manufacturing operations, while considering potential improvements to environmental impact and costs of introducing change. The target areas to be examined are:

- quality control in manufacturing operations;
- usage of paper and single-use catering items in office operations;
- equipment energy usage in manufacturing operations and office operations;
- space heating, both for the shop floor and for the office operations.

(a) (i) Write short guidance notes for each of the bullet-pointed target areas. In each case, outline briefly what would be needed to make improvements, discuss what the environmental impacts would be and indicate their magnitude relative to the other areas. [35%]

(ii) Describe other sustainability aspects the company might consider. [15%]

(iii) Explain how the financial implications could be estimated (e.g. costs of implementing new measures, energy pay-back period). [25%]

(b) Describe what is meant by the term '*Industrial Symbiosis*', giving one example of implementation. Discuss its relevance to this company. [25%]

2 (a) A firm has designed an implantable silicon device that contains a reservoir of chemotherapy drugs and slowly releases them through microfluidic channels into the body over six months. The firm makes a separate device kept in the home that the patient uses to take a small daily blood sample to monitor kidney and liver function. If organ function deteriorates, this monitor sends a message to the clinic immediately warning of this result.

(i) Explain what is meant by the term '*classification*' in terms of medical devices. In your explanation, include comments about the process of classifying a device in the EU, referring where possible to the example products described above. [25%]

(ii) The firm needs to run a clinical trial to research the safety of the implantable microfluidic device. Describe any four bioethical considerations when preparing for a trial. [25%]

(iii) List any three activities or processes where international standards will need to be followed when manufacturing a medical device. Explain why international standards are useful when manufacturing medical devices, referring where possible to each of the three activities noted. [25%]

(iv) Describe any two techniques that could be used to fabricate the microfluidic channels in silicon. [15%]

(v) For the implantable device, patients prefer a device that will break down within the body to avoid a second surgical procedure. Describe any two materials-related challenges that may be anticipated if the firm wants to develop this new version of the device. [10%]

3 (a) The UK government has made significant investments into tissue engineering research. It has announced it will support the building of a new facility to support translation and scale-up of new technologies coming from the research.

(i) The new facility will focus on technologies that have reached TRL4 and will support their development to TRL7. Explain why the government is targeting its support to these TRL levels. [35%]

(ii) The facility will work on innovation activities or scale-up dimensions. Describe any four dimensions where you think it is important that emerging products are supported. [25%]

(iii) A project management team will support new technologies by using risk management tools. Name two tools you recommend, provide a brief description of each and note their potential benefits. [25%]

(iv) Risk management tools support the delivery of a project but the final tissue engineering product may still face barriers to adoption. Describe any two potential barriers that may prevent the product from being a commercial success. [15%]

END OF PAPER