

Wednesday 25 April 2007 9 to 12

PAPER 1

*Answer not more than **four** questions.*

Answer each question in a separate booklet.

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

8 page answer booklet x 4

Rough work pad

SPECIAL REQUIREMENTS

Engineering Data Book

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

1 A new product, a top-of-the-range electric shaver, is at the design and development stage. This new shaver adds to an existing range of shavers, which up to now have been of electro-mechanical design with no software functionality. The new product will, for the first time, contain electronics and software to give enhanced charge control, condition monitoring features, and communication to the user via a LCD display. This informs the user about the state of battery charge, and when the product should be cleaned and serviced.

(a) Discuss the issues to be considered when embedding software in this product, in the situation where the existing development team has no software experience. [30%]

(b) Discuss the product design methods and techniques that can be used to help deliver product value to the end-user and benefits for the manufacturer. [40%]

(c) Discuss the factors to be considered in deciding how and where the product is to be assembled. [30%]

2 (a) Identify the advantages and the disadvantages of using pneumatics as the working medium in automation systems. [20%]

(b) A pneumatic cylinder is used to eject parts from the bottom of a gravity part feeder into a part pick-up location for a robotic part transfer system (see figure 1). This cylinder should operate when a part is present at the detector at the bottom of the part feeder and the part pick-up location is empty. The forward speed of the cylinder should be adjustable and allow smooth movement; the retraction speed should be rapid.

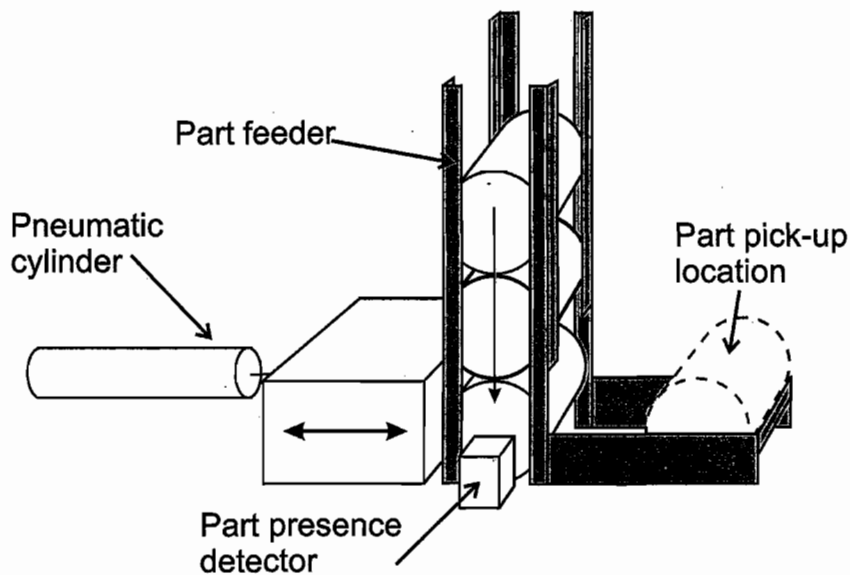


Figure 1

- (i) Design a circuit to perform this operation using pneumatic components only, and ensuring that you specify all components required. You can assume that only one part will pass through the feeder during the eject cycle. [60%]
- (ii) When the part feeder was commissioned it was found that occasionally multiple products would pass through the feeder simultaneously. Describe any alterations you would make to the pneumatic control system and any additional actuators that would be required to ensure that only one part is ejected in each ejection cycle. You are not expected to design the circuit in detail for this case. [20%]

3 (a) What is meant by the term *Triple Bottom Line*? Explain, with specific examples, why satisfying all criteria may cause conflicts of interest within a company. [30%]

(b)

(i) Different issues arise when considering recycling of industrial waste and post-consumer waste. Discuss why this is so, explaining what the main problems are in each case, and whether they are mainly technical, economic, logistical or social. [30%]

(ii) To what extent is paper recycling environmentally beneficial? Briefly discuss means by which it can be improved. [10%]

(c) What is meant by the concept of *Industrial Symbiosis*? Discuss, with examples, what benefits arise from the practical implementation of this concept. What are the conditions that favour the establishment of industrial symbiotic networks? [30%]

4 (a) There are composite materials that can offer attractive properties for certain applications in the transport sector. These can include polymer and metallic matrices reinforced with chopped or continuous fibres, or particles (carbon or silicon carbide). Give examples of such materials and their potential applications, explaining which properties make them particularly suitable for these purposes. Discuss the extent to which they are already being used, and the obstacles to their more extensive introduction. [50%]

(b) A plant in Cambridge, UK, manufactures a specialist chemical which it ships in one-litre blow-moulded polymer bottles closed with injection-moulded polymer screw caps. Routine monthly deliveries have been made to a distributor on the east coast of the USA without problems. Suddenly it is reported that in the latest shipment of 200 bottles, 30 bottles have leaked, and there are serious potential consequences for safety and damage to property. Write a report, based on the information given above, for the manufacturing company outlining the steps they should take to investigate this problem. In your report, indicate areas in which further information would be useful, together with any immediate action you would recommend. [50%]

5 The scope of process manufacturing includes food and drink, personal care products, pharmaceuticals, paper, paint, chemicals, oil and gas.

(a) Describe what is meant by the term “process” in this context and explain why the sector is important to the UK economy. [25%]

(b) What is meant by the terms “primary” and “secondary” process products? [25%]

(c) What are the manufacturing drivers for primary and secondary processing operations? [30%]

(d) When processing continuous and discrete media, what are the approaches one would take in handling, automating and inspecting the resultant products? [20%]

6 (a) Describe the basic elements of a supply chain for a company making Fast Moving Consumer Goods (FMCG). [20%]

(b) Explain the term “make-to-stock” and explain why forecasting is important to a company operating under these conditions. [20%]

(c) Describe the benefits to the company when implementing the following operations:

- (i) Master Production Scheduling;
- (ii) Materials Requirements Planning;
- (iii) Finite Capacity Scheduling. [60%]

END OF PAPER