Version AEM/3

EGT2
ENGINEERING TRIPOS PART IIA

Friday 29 April 2016 2 to 3:30

Module 3G5

BIOMATERIALS

*Answer not more than **three** 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.*

STATIONERY REQUIREMENTS
Single-sided script paper

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

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

1 (a) Describe the stages of normal wound healing and their function. For each stage, include timescales and the cells involved. [60%]

(b) What are the consequences of chronic inflammation during wound healing? In this context, explain what is meant by fibrosis. [40%]

2 (a) Bioactive molecules can be incorporated with biomaterials to influence the biological response to implants. Describe two such approaches and give examples of the bioactive molecules used in each case. [50%]

(b) Explain the potential advantages of using nanoparticles to deliver drugs in biomaterials. [10%]

(c) Describe two techniques used to manufacture such nanoparticles. [40%]

3 (a) *Briefly* explain the following:

(i) the Sterility Assurance Level when sterilising biomaterials; [10%]

(ii) the difference between surface erosion and bulk erosion of polymers; [20%]

(iii) the medical device classification. [10%]

(b) You are in a company that uses polyurethane for angioplasty balloons. A recent batch of the final product has failed the mechanical quality tests and burst under low testing pressures. Discuss the polymer properties and characteristics that could be responsible for the change in mechanical performance. Explain your reasoning. [30%]

(c) Your company has developed a new polymer coating for an existing vascular stent.

(i) Describe any three important steps that must be completed as part of the regulatory approval process. [15%]

(ii) Describe in detail two different measurements or tests you would carry out as part of the regulatory approval process. [15%]

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4 (a) Explain the function of a cardiovascular stent and describe the two main methods by which they are expanded. In each case, state the mechanism responsible and list the material(s) used. [25%]

(b) Describe the procedure of balloon angioplasty and explain how the outcome of this procedure relates to stenting. [20%]

(c) Figure 1 shows part of the wall structure of the New Intra-vascular Rigid flex (NIR) stent, in the unexpanded state, once it is "unwrapped" so that it is planar.

(i) Sketch the "unit cell" of the planar wall structure, with sides parallel to the axial and hoop directions, in the unexpanded state. Estimate the unit cell dimensions using the information provided in the Figure. [20%]

(ii) Sketch the same unit cell after optimal expansion of the stent. Estimate the relative increase in the stent radius. [20%]

(iii) Discuss the main advantages of this particular stent design from a surgical point of view and also in terms of patients' long-term health. [15%]

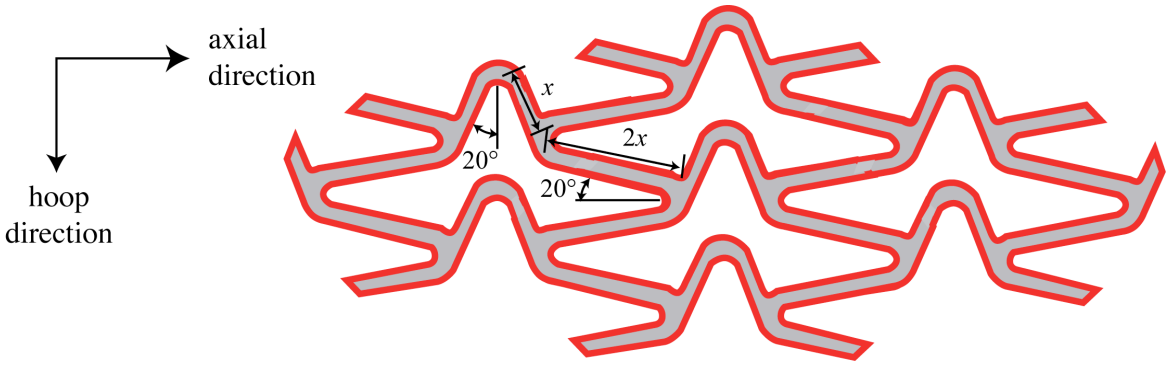

Fig. 1

END OF PAPER