

OLLSCOIL NA hÉIREANN
The National University of Ireland

National University of Ireland, Galway

Trinity Examinations, 1998/99

B.E. Degree (Biomedical) Examination

MATERIALS AND DEVICES IN BIOMEDICAL ENGINEERING

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Attempt **THREE** questions.

Each question is worth equal marks.

Time allowed : 2 Hours

1. Answer the following questions concerning tissue-material interactions :
 - (a) Describe the four types of tissue-material attachment. Give one material or application as an example for each type, and discuss the advantages and disadvantages of each type. (15)
 - (b) Compare and contrast the body's physiologic response to bioactive glasses and calcium phosphate ceramics. (10)
2. Answer the following questions concerning material surface alteration methods for improving biocompatibility/thrombogenicity.
 - (a) What is the rationale behind the surface modification of materials used in biological applications? (5)
 - (b) Discuss four methods used to modify the surface of biomaterials. For each method, discuss the following:
 - (i) Mechanism of the attachment (i.e. overcoat, affinity, chemical, covalent bonding, etc.)
 - (ii) Surface thickness/uniformity
 - (iii) Delamination resistance/long-term stability
 - (iv) Commercialisability (20)

3. Your first project as a Biomedical Engineer is to design a coronary stent with a life time expectancy of 40-50 years. The stent is to remain patent and free of micro-thromboemboli formation over the projected life span. To begin this daunting task, outline the following:
- (a) What are the design considerations for a vascular implant ? (10)
 - (b) Discuss the advantages and disadvantages of controlling the adverse blood-material responses locally as compared to systemically ? (5)
 - (c) In the overall design, discuss the advantages and disadvantages of constructing a stent out of a polymer substrate as opposed to metal, as is the current market norm. (10)
4. Describe the structure and function of the following devices:
- (i) Nebulizer
 - (ii) Pleural drain
 - (iii) Liver biopsy needle
- How could each device be improved ? (25)
- 5(a) Define the following terms:
- (i) Drug
 - (ii) Formulation
 - (iii) Drug Delivery System (DDS) (5)
- (b) Describe three standard DDS and three novel DDS, stating their impact on patient compliance. (20)