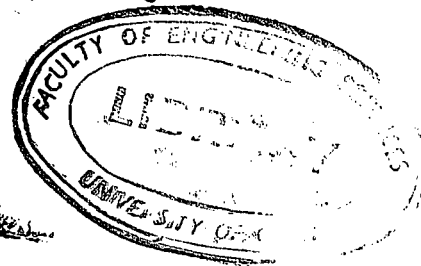


UNIVERSITY OF GHANA
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FIRST SEMESTER EXAMINATIONS: 2012/ 2013
LEVEL 300: BACHELOR OF SCIENCE IN ENGINEERING
BIEN 307: BIOMATERIALS (3 Credits)

Total Marks: 100. Time allocation: $2\frac{1}{2}$ Hours

Attempt all questions.

1. A cancer patient has a bone tumour that is going to be removed from the leg. This will require a metal implant to replace the missing tissue and restore the patient's ability to walk. The surgeon asks you, as a biomedical engineer, whether it is better to remove an entire section of the bone, or if he should leave half of the cross section intact and implant only a half cylinder adjacent to remaining bone instead of a full cylinder of metal.

(a) What do you advise, and why?

[6 marks]

(b) (α) How does corrosion affect medical implants? Give two examples.

(β) How do Biological entities influence corrosion? How is corrosion prevented in implant devices?

[10 marks]

- (c) A standard electrochemical cell is formed to mimic a medical implant situation where the half-cell reactions involve Pb^{2+} and Sn^{2+} at standard electrode potentials of -0.126 V and -0.136 V respectively.

(α) Which way does the reaction go?

(β) What is the cell potential? If you change the concentration of tin ions in solution by a factor of 100, what change do you expect to see? [9 marks]

Examiner: BO. Asimeng



2. (a) Explain the following

- (α) Haemostasis
- (β) Inflammation
- (γ) Innate and adaptive immunity

[12 marks]

(b) (α) What are the **different types** of adverse local tissue responses (ALTRs) regarding metal-on-metal (MoM) bearings?

(β) Why do ALTRs develop in some patients and not in others? [13 marks]

3. Historically, metal has been the most popular material for fracture fixation. Whilst it has excellent results, it is not without its problems. However, biodegradable materials (Lactide / glycolide polymers) have been attractive for many years, as used in the biomedical industry for making sustained - release systems for drugs or implantable, biodegradable devices. The benefits to patients and surgeons are obvious economic advantages to avoiding an expensive removal operation. But there are issues, which have given way to introducing degradation into inert polymers (polyolefin) to overcome these concerns.

(a) (α) Mention **any two concerns** with Lactide / glycolide polymers

(β) Give **an example** of a **polyolefin** polymer and **elaborate** briefly on how degradation will be introduced into it.

(γ) How will your answer in (β) **justify** your answer in (α) [10 marks]

(b) Outline any **three** parameters and **one** analytical technique of monitoring degradation. [8 marks]

(c) What are the **effects of pH** and **copolymer composition** on polymer degradation? [7 marks]

4. (a) Why are polymers finding increasing use in medical implants? Give three reasons with suitable examples.

[9 marks]

- (b) Discuss how biomaterials in the next generation may differ from those presently used for biomedical applications.

[4 marks]

- (c) The table below shows the properties of some biomaterials. **Indicate** whether the material exhibits **EXCELLENT, MODERATE OR LOW** in a property.

General Options	Non Toxic/ Immunogenic/ No Disease transmission?	Mechanical Properties?	Bioactive?	Degradable?
Autograft				
Allograft				
Metals				
Ceramics				
Polymers				
Composites				

[12 marks]