

SYLLABUS

Date/ Revision : 30 January 2017/0

Faculty : Life Sciences

Approval : Dean, Faculty of Life Sciences

SUBJECT : BIOMATERIAL ENGINEERING 1

1. Identification of Subject:

Name of Subject : Biomaterial Engineering 1
Code of Subject : BIEN-2910
SKS : 2
Semester : 4
Study Program : Biomedical Engineering
Lecturer : Zahrina Mardina, ST., M.Sc.



2. Competency

After having the course, students are expected to have/be:

- Basic characteristics of the most common materials used for biomaterial devices (Metals, polymers, hydrogel, natural materials, ceramic, glasses, glass ceramic)
- Concise technical methods to synthesize them as biomaterial devices.
- Shortcomings and advantages of choosing certain materials for certain applications.
- Biocompatibility aspects, such as the interaction of materials with cells, tissue, blood, proteins. As well as the events of inflammation, immunology, hypersensitivity, toxicity, implant infection and the risk of implant failure from the view of biocompatibility.
- Characterization methods *in vitro* for simulating the response of complex human body to biomaterial devices.
- An insight of artificial organs (hemodialysis system and artificial heart)
- Able to create a simple innovation in biomaterial engineering through the final group project
- Able to criticize a research in scientific papers and construct developing ideas through writing

3. Description of Subject:

This course is the continuity of the course "Material science". We are using the previous knowledge to create biomaterial devices. This class is about learning how to create a simple, yet promising innovation in biomaterial engineering. Thus, the modalities will be given systematically. We observe the characteristics of materials and available techniques deeper into details. Subsequently, this course provides the essential knowledge about how the body response to the implanted devices from

biocompatibility point of view. Additionally, we are going to talk about the *in vitro* evaluation methods to simulate what will happen if biomaterial devices are implanted. We are going to learn about the possible implant failures as well as how to avoid those from happening. Finally, we are going to get an insight of two of the most needed artificial organs, heart and hemodialysis (artificial kidney).

4. Learning Approach

Approach	: Expository, inquiry, collaborative
Method	: Lecture presentation, Focus group discussion
Student Task	: Appraisal, group presentation about biomaterial innovation
Media	: Power Point presentation, print out of journals

5. Evaluation

a) Absence maximum	: 25%
b) Discussion and appraisal	: 20 points
c) Pre/Post test	: 5 points
d) Daily Quiz	: 15 points
e) Final Examination (Project + Final test)	: 60 points
Total	: 100 points

6. Contents/ Topics of Lecturing:

Week	Topics	Content	Remark
1	Motivation : Biomaterial at the market and an insight to biomaterial engineering	-What is biomaterial? -Biomaterial requirements at the market -The promising future of biomaterial	-Migonney, Chapter 1, part 1.1, 1.2, -Chapter 2, part 2.1, 2.2, 2.3 -Some updates from recent published findings -Lecture + discussion
2	Metals	-Fabrication -Types -Microstructure -Properties of implant metals -Applications	- Migonney, Chapter 3, part 3.1, and 3.2 Lecture + discussion
3	Polymers 1	-Classes -Molecular weight -Synthesis -Tacticity -Crystallinity	- Migonney Chapter 3, part 3.4 Some papers

			Lecture + discussion
4	Polymers 2	<ul style="list-style-type: none"> -Mechanical properties -Thermal properties -Copolymers -Bioactive polymers -Applications 	<ul style="list-style-type: none"> - Migonney Chapter 3, part 3.4 Some papers <p>Pre-test/Post + test, Lecture + discussion</p>
5	Natural materials	<ul style="list-style-type: none"> -Sources -Collagen -Proteoglycans and glycosaminoglycans -Elastin 	<ul style="list-style-type: none"> - Migonney Chapter 3, part 3.4.2, and Ratner, Chapter 2, part 2.7 Some papers <p>Lecture + discussion +Quiz</p>
6	Hydrogel	<ul style="list-style-type: none"> -Structure of hydrogel -Swelling behavior of hydrogel -Applications 	<ul style="list-style-type: none"> - Ratner, Chapter 2, part 2.4 <p>Lecture + discussion</p>
7	Ceramic, Glasses & Glass ceramic 1	<ul style="list-style-type: none"> -Types of bioceramic -Tissue attachment -Characteristic and processing of bioceramics -Nearly inert crystalline ceramic -Porous ceramic -Glass ceramic 	<ul style="list-style-type: none"> - Migonney, Chapter 3, part 3.3 and Ratner, Chapter 2, part 2.6 <p>Lecture + discussion</p>
8	Ceramic, Glasses & Glass ceramic 2	<ul style="list-style-type: none"> -Bioactive glass -Calcium phosphate ceramic -Resorbable calcium phosphate -Carbon -Glass ionomer 	<ul style="list-style-type: none"> - Migonney, Chapter 3, part 3.3 and Ratner, Chapter 2, part 2.6 <p>Lecture + discussion</p>
9	Biocompatibility part 1	<ul style="list-style-type: none"> -Immunology -Toxicity -Hypersensitivity -Inflammation 	<ul style="list-style-type: none"> - Migonney, Chapter 4, and Ratner, Chapter 4, part 4.1, 4.2, 4.3, 4.4

			Pre-test/Post + test, Lecture + discussion
10	Biocompatibility part 2	-Blood and proteins interaction -Tumorigenesis -Implant infection	-Migonney, Chapter 4, and Ratner, Chapter 4, part 4.5, 4.6, 4.7 Lecture + Discussion
11	Testing Biomaterial : <i>In vitro</i> evaluation	-Physical, biological, and chemical evaluation techniques -Analysis of result	- Ratner, Chapter 5 Lecture + discussion
12	Appraisals presentation	-Selected topics from journals for appraisals	Papers Students presentation and discussion
13	Artificial organs	-Implantable pneumatic artificial heart, -Extracorporeal artificial organs (kidney)	Ratner, Chapter8 Pre-test/Post + test, Lecture + Discussion + Quiz
14	Innovation Group Project Presentation	-Selected topic of innovations by students	Students presentation and discussion
15-16	Final Exam		

7. Book Reference:

- [1] Migonney Veronique, Biomaterials. 2014. John Wiley & Sons.Inc.
[2] Ratner B.D., Hoffman, A.S., Biomaterials Science: an introduction to Materials and Medicine. 2013. 3rd edition. Academic Press.

Besides that, recent findings published in international journals will be used as the references during the class discussion, for creating appraisals and the innovation biomaterial group project.