



**Jordan University of Science and Technology**  
**Faculty of Engineering**  
**Biomedical Engineering Department**

**BME 440 Introduction to Biomedical Materials**

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**2013 Course Catalog**

3 Credit hours (3 h lectures). Survey of materials intended for biological applications; Materials for both medical implants and dental restoration and appliances will be covered, Discussions of various aspects pertaining to the selection, processing, testing (in vitro and in vivo) and performance of biomedical materials, The biocompatibility and surgical applicability of metallic, polymeric, ceramic, and other implants and prosthetic devices are discussed.

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**Textbooks**

Ratner, B.; Hoffman, A.; Schoen, F.; Lemons, J,(2012) 3<sup>rd</sup> ed. Biomaterials Science; An Introduction to Materials in Medicine.

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**References**

**Books**

- 1) Park J.,& Lakes R. (992)" Biomaterials: An Introduction", 2<sup>nd</sup> Edition, Plenum Publication Corporation. Silver F. H.,& Christiansen D.L.(1999) Biomaterials Science and Biocompatibility, Springer- Verlag.
- 2) Park J. B., & Bronzino J. D.(eds.) (2003) "Biomaterials Principles and Applications", CRC Press
- 3) Beer F., Johnston E., & Dewolf J. (2001) "Mechanics of Materials" 3<sup>rd</sup> Edition, McGraw- Hill
- 4) Cheng F.(1996) "Statics and Strength of Materials" 2<sup>nd</sup> Edition, McGraw- Hill
- 5) Budinski K. G., & Budinski M. K.(2001) Edition, "Engineering Materials Properties and Selection" 7<sup>th</sup> Edition, Prentice Hall.
- 6) Benham P. P., Crawford R. J., & Armstrong C. G.(1996) "Mechanics of Engineering Materials" 2<sup>nd</sup> Edition, Addison Wesley Longman LTD
- 7) Bronzino J. D. (Ed) (1999), "The Biomedical Engineering Handbook", 2<sup>nd</sup> Edition, CRC Press.

**Journals**

- 1) Biomaterials
- 2) International Journal of Biomaterials
- 3) Journal of Biomedical Materials Research
- 4) Journal of Biomaterials Applications
- 5) Journal of Biomaterials Science

**Internet links**

- <http://www.bmecentral.com/publications/>

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**Instructor**

Instructor      **Dr. Ruba Khnouf**      , E-mail: rekhnouf@just.edu.jo

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**Prerequisites**

<b>Prerequisites by topic</b>	Biomechanics, Biochemistry
<b>Prerequisites by course</b>	BME 341, CHEM362
<b>Co-requisites by course</b>	-
<b>Prerequisite for</b>	Biomechanics and Biomaterials lab, BioMEMS and Nanotechnology

## Topics Covered

Week	Topics	Chapters in Text
1-2	Introduction to Biomaterials Bulk Properties of Materials	Chapter 1.1 Chapter 1.2
3	Surface Properties of materials	Chapter 1.4
4	Metals	Chapter 2.9
5	Polymers	Chapter 2.2
6	Hydrogels	Chapter 2.5

### First Exam (See Dept. Schedule)

7	Ceramics, glasses, and glass-ceramics	Chapter 2.10
8	Pyrolytic Carbon	Chapter 2.11
9	Biological materials	Chapter 2.8

### Second (See Dept. Schedule)

10-11	Host Reaction to biomaterials	Chapter 4.1-4.2
12- 13	Testing Biomaterials	Chapter 5.1-5.3
14- 15	Application of materials in medicine and dentistry	Chapter 7

### Final Exam

## Evaluation

Assessment Tool	Expected Due Date	Weight
Quizzes and Project	End of chapters and end of semester	15%
First Exam	According to the department schedule	20 %
Second Exam	According to the department schedule	25 %
Final Exam	According to the University final examination schedule	40 %

## Objectives and Outcomes<sup>1</sup>

Objectives	Outcomes
1. Appreciate the role of biomaterials in biomedical engineering [4]	1.1. Appreciate the role of biomaterials in the biomedical industry and in biotechnology [4, 7]
2. Introduce bulk and surface material properties essential to the understanding of biomaterials design, and application [1, 3]	2.1. Explain the role of state and bonding, microstructures, mechanical properties, on material behavior and function [3] 2.2. Differentiate between different surface characterization techniques of biomaterial surfaces [1]
3. Analyze the different classes of materials used in biomedical applications and the characteristics of each class [1, 3, 4]	3.1. Evaluate the use of metal s as biomaterials by addressing the steps involved in the fabrication of implants, the microstructure and properties, characterization techniques, and specific class types [1, 3, 4] 3.2. Explain the application of specific types of each material class in biomaterials. [1,2, 3,4]
4. Study the types of host reaction to biomaterials and biocompatibility [1, 2, 3, 4]	4.1. Identify the types of host reaction to biomaterials (inflammation, and foreign body response). [1,2,3,4] 4.2. Differentiate between the different types of host reaction: chronic and acute inflammation, granulation, fibrosis and fibrous encapsulation [1,4,,8]

<sup>1</sup> Lower-case letters in brackets refer to the Program outcomes

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| <p>5. Consider the application of various biomaterial testing protocols for both in-vitro and in-vivo assessment [1, 2, 3, 4]</p> <p>6. Correlate the properties of the different biomaterials to their applications in medicine and dentistry [1, 2]</p> <p>7. Encourage life long learning, foster teamwork and enhance student's communication skills. [3, 4, 5, 6, 7]</p> | <p>5.1. Perform in-vitro assessment of tissue compatibility using: assay methods, agar diffusion, and elution. Followed by interpretation of results and assessment of clinical use. [1,3, 4]</p> <p>5.2. Perform in-vivo assessment of tissue compatibility by studying: implant site, surgical protocol, controls, and the evaluation of tissue reaction [1, 3, 4]</p> <p>6.1. Identify the various applications of biomaterials in medicine and dentistry: cardiovascular applications (cardiopulmonary bypass, heart valves, vascular grafts, drug administration systems, stents, catheter and cannulas, pacemakers, IVCF, IABP, ventricular assist, and blood substitutes. [1, 4]</p> <p>7.1. Write a technical report and give an oral presentation on team project [2, 3, 4]</p> |
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### Contribution of Course to Meeting the Professional Component

The course contributes to building the fundamental basic concepts and applications of materials science and engineering in Biomedicine and Bioengineering.

#### Relationship to Program Outcomes (%)

1	2	3	4	5	6	7	8	9
28		8	16	8	8	8	16	8

#### Relationship to Biomedical Engineering Program Objectives

PEO1	PEO2	PEO3	PEO 4
√	√	√	√

Prepared by: Dr. Ruba Khnouf  
 Last Modified: February 4, 2020