



## BME 551 Cellular and Molecular Biotechnology

### 2013 Course Catalog

3 Credit hours (3 h lectures). Biotechnology in an engineering context, nucleic acid structure and function, DNA replication, transcription, translation, chromosome structure and remodeling, and regulation of gene expression, applications of such knowledge in laboratory instrumentation, gene sequencing and expression techniques, genetic and protein engineering and therapy.

### Textbooks

Lodish, H., Berk, A., Kaiser, C. A., and Krieger, M. Molecular Cell Biology, (2016) WH Freeman

### References

#### Books

- Alberts, B., Johnson, A., Lewis, J. and Martin Raff "Molecular Biology of the Cell", Garland Science, NY, NY
- Karp, G., "Cell and Molecular Biology: Concepts and Experiments", Wiley, NJ
- Cooper, G.M., Hausman, R.E., "The Cell: A Molecular Approach" Sinauer Associates Inc, Stamford, CN.
- Waite, G.N., Waite, L.R., Balcavage, W.X., and Worrell, M.B. "Applied Cell and Molecular Biology for Engineers", Mc Graw-Hill,
- Wolfe, S.L., "Introduction to Cell and Molecular Biology", Brooks Cole,
- Renneberg, R., Demain, A.L., "Biotechnology for Beginners", Academic Press,
- Yarmush, M.L., Toner, M., Plonsey, R., Bronzino, J.D., "Biotechnology for Biomedical Engineers", CRC Press,

#### Journals

- Nature
- Nature methods
- Nature cell biology
- Nature biotechnology
- Molecular biology
- BMC molecular biology
- Applied microbiology and biotechnology

#### Internet links

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

### Instructor

Instructor **Dr. Ruba Khnouf** , E-mail: [rekhnouf@just.edu.jo](mailto:rekhnouf@just.edu.jo)

### Prerequisites

Prerequisites by topic            Biomaterials  
Prerequisites by course        BME 440  
Co-requisites by course        -  
Prerequisite for

### Topics Covered

Week	Topics	Chapters in Text
1	Introduction, emergence and principles of Biotechnology	Chapter 1
2-3	Proteins (structure, function, folding, purification, and characterization), introduction to proteomics	Chapter 3
4-5	DNA (structure, transcription, replication, recombination), RNA decoding, and Protein Synthesis First Exam (See Dept. Schedule)	Chapter 4
6-7	DNA cloning and characterization, gene suppression and engineering	Chapter 5
8-9	Eukaryotic gene structure and chromosomal organization Second Exam (See Dept. Schedule)	Chapter 6
10-11	Special Topic 1: Cancer	Chapter 25 & Handout
12-13	Special Topic 2: Next-Generation Sequencing	Chapter 21.1 & Handout

**Final Exam****Evaluation**

Assessment Tool	Expected Due Date	Weight
Quizzes and Project	End of chapters and end of semester	10%
First Exam	According to the department schedule	25 %
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 cell and molecular biology and the emerging role of biotechnology in biomedical advancement [4, 8]	1.1. Appreciate the field and great advancement in molecular biology which led to emergence of the field of biotechnology. [4,8]
2. Introduce basic concepts in both cellular and molecular biology [1,8, 9]	2.1. Understand the structure/ function relationship of proteins [1,8,9] 2.2. Understand the structure/ function relationship of nucleic acids [1] 2.3. Learn basic cellular processes such as transcription and translation [8] 2.4. Introduce DNA replication and repair mechanisms [1] 2.5. Introduce genetic structure and chromatic organization [1]
3. Introduce the field of biotechnology and understand the major contributions of the field [6, 8, 9]	3.1 Understand modern biotechniques that revolutionized biotechnology such as polymerase chain reaction, DNA sequencing techniques, and genetic engineering [6,8,9]
4. Understand the role of engineering and physics concepts in the advancement of biotechnology [ 4, 6, 8, 9]	4.1 Understand the physical and engineering principles of nucleic acid and protein purification [1, 2,4,9] 4.2 Understand the physical and engineering principals of protein and nucleic acid characterization [1, 2,4,9] 4.3. Apply advanced engineering principles for the improvement of biotechnological techniques [1, 2,4,9]
5. Study the different applications of biotechnology in diagnostics and therapeutics [1, 4, 8]	5.1. Understand the role of biotechniques in diagnostics and therapeutics [1, 4, 8] 5.2. Concentrate on specific cases such as the development of cancer, cancer detection, and the development of treatments such as gene therapy[2, 4, 8] 5.3 Investigate new discoveries related to the role of biotechnology in understanding disease on the molecular and cellular level, and presenting findings to the class [4, 2, 8]
6. Apply modern engineering concepts such as BioMEMS, microfluidics, and microelectronics to the field of biotechnology to enhance the outcomes of the field [1, 2, 4, k, 8]	6.1. Utilize knowledge in modern engineering techniques and principles as a tool for both developing investigatory techniques in molecular biology and in improving existing biotechniques in both therapeutics and diagnostics [1,2] 6.2 Overview of current applications of engineering in the field of biotechnology such as microarrays, and microfluidic protein separation [1, 2, 4, 8]
7. Encourage life long learning, foster teamwork and enhance student's communication skills. [1, 3, 4,5,7]	7.1. Write a technical report and give an oral presentation on team project [1,3,4, 5,7]

**Contribution of Course to Meeting the Professional Component**

The course contributes to building the fundamental basic concepts and applications of cell and molecular biotechnology in Biomedical Engineering.

**Relationship to Program Outcomes (%)**

1	2	3	4	5	6	7	8	9
16	8	8	8	8	14	14	16	8

**Relationship to Chemical Engineering Program Objectives**

PEO1	PEO2	PEO3	PEO 4
√	√	√	√

Prepared by: Dr. Ruba Khnouf  
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<sup>1</sup> Lower-case letters in brackets refer to the Program outcomes