



Course Syllabus: Biomaterials and Biomedical Devices - B 319

Division	Biological and Environmental Sciences & Engineering Division
Course Number	B 319
Course Title	Biomaterials and Biomedical Devices
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	10:30 AM - 12:00 PM Tue , 01:00 PM - 02:30 PM Mon

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Khaled Nabil Salama	khaled.salama@kaust.edu.sa	+966128084420	3277, 3, Ibn Sina (bldg. 3)	
Jurgen Kosel	jurgen.kosel@kaust.edu.sa	+966128084360	3219, 3, Ibn Sina (bldg. 3)	
Sahika Inal	sahika.inal@kaust.edu.sa	+966128082501	4276, 2, Ibn Al-Haytham (bldg. 2)	every Monday between 14:30 and 15:30

Teaching Assistant(s)	
Name	Email

Course Information	
Comprehensive Course Description	<p>This course is about materials and electronic devices that are used in diagnosis of diseases and their therapy. It contains concepts ranging from cell biology to materials science and electrical engineering, focusing on materials that can be implanted in the body to restore a malfunctioning part of an organ and the devices that can electrically communicate with the human body. With this course, while providing basic cell biology knowledge to the students, we introduce what kind of solutions have been provided by engineers to change the way how healthcare is delivered or diagnostics are performed. We address in detail how certain tools and devices have been designed by engineers and how they operate at the interface with living organisms. Specifically, the course provides the necessary background to understand, firstly, the field of biomedical engineering, then basic cell biology and biophysical phenomena, followed by the design, function and engineering of biomedical devices. The course covers electronic biomedical devices (sensors and actuators) that constitute the core area of biomedical engineering. The students will learn how bio(chemical) sensors, biopotential measurements (such as EEG, ECG, EMG) and brain-machine interfaces (neural stimulators, prosthetics) operate. This is followed by the fabrication and scaling approaches: structuring of materials and micro/nano fabrication of a variety of biomedical devices with a particular focus on implantable and microfluidic devices. The course finally introduces the basics of integrated circuit components, transistors and circuit architectures, which are fundamental to build a biomedical device.</p>
Course Description from Program Guide	<p>The course is about the biomedical implants, the materials used in biomedical devices, and the operation and fabrication of electrical devices such as sensors or stimulators that are designed to communicate with human body. It will provide an overview of the research highlights in the field of biomedical engineering and design principles of the materials/devices currently employed in the clinic.</p>

Goals and Objectives	<p>At the end of this course, the students will be able to describe</p> <ol style="list-style-type: none"> 1. the characteristics of the materials (both active and passive components) that are used at the interface with biological systems and associated with biomedical devices 2. different concepts of biomedical electronics, and the operation principles of these devices. 3. the micro/nano fabrication techniques utilized in the development of biomedical devices, the circuit components, their function and rational design 4. the advances in the field of Medical Electronics 5. the benefits and consequences of scaling 6. microfluidic systems and devices
Required Knowledge	Basics of Electrical Engineering, Chemical Engineering, Material Science, Biology and Mechanical Engineering
Reference Texts	<ul style="list-style-type: none"> -Introduction to Biomedical Engineering, J.D. Enderle and J. Bronzino, 2012, Elsevier -Molecular Biology of the Cell, B. Alberts, ISBN10 0815341067 -Introductory Bioelectronics, R. Pethig and S. Smith, ISBN 9781119970873 -Implantable Medical Electronics, V. K. Khanna, ISBN 978-3-319-25446-3 -Fundamentals of Microfabrication, Marc Madou, ISBN 978131527422
Method of evaluation	<p>40.00% - Final exam 20.00% - Scientific review article presentation 40.00% - Midterm exam</p>
Nature of the assignments	Scientific article presentation (in depth investigation of current research highlights in biomedical engineering)
Course Policies	<ul style="list-style-type: none"> -Attendance at classes, exams and lab sessions is mandatory. -The students are responsible to be informed about all material covered in the lectures, and the supplementary materials assigned for reading or handed out in class.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Mon 01/28/2019 Tue 01/29/2019	Introduction to Biomaterials and Biomedical Devices (Prof. Sahika Inal)
2	Mon 02/04/2019 Tue 02/05/2019	Implantable and wearable electronic devices (Prof. Sahika Inal) Neural Interfacing (sensors, stimulators- brain-machine interfaces) : the case study on the evolution of neural prosthetics (Prof. Sahika Inal)
3	Mon 02/11/2019 Tue 02/12/2019	Basics of cell biology, building blocks of cells, biophysical concepts at cellular level, Probing electrical properties of cells (Prof. Sahika Inal)
4	Mon 02/18/2019 Tue 02/19/2019	Introduction to Microsystems for Biomedical Devices (Prof. Jurgen Kosel) Micro/Nano Fabrication Techniques and Biomedical Applications (Prof. Jurgen Kosel)
5	Mon 02/25/2019 Tue 02/26/2019	Micro/Nano Fabrication Techniques and Biomedical Applications (Prof. Jurgen Kosel) Micro/Nano Fabrication Techniques and Biomedical Applications (Prof. Jurgen Kosel)
6	Mon 03/04/2019 Tue 03/05/2019	Scaling Laws (Prof. Jurgen Kosel) Microfluidic Systems (Prof. Jurgen Kosel)
7	Mon 03/11/2019 Tue 03/12/2019	Microfluidic Systems (Prof. Jurgen Kosel) Implantable Microdevices (Prof. Jurgen Kosel)
8	Mon 03/18/2019 Tue 03/19/2019	Electrochemical Principles and Electrode Reactions (Prof. Sahika Inal) Mid-term exam
9	Mon 03/25/2019 Tue 03/26/2019	Spring Break
10	Mon 04/01/2019 Tue 04/02/2019	Diagnostics and Biosensors (Prof. Sahika Inal) Electrolyte gated Transistors (Prof. Sahika Inal)
11	Mon 04/08/2019 Tue 04/09/2019	Fundamentals of Electronic Circuits (Prof. Khaled N. Salama)
12	Mon 04/15/2019 Tue 04/16/2019	Integrated Circuit Components (Prof. Khaled N. Salama)
13	Mon 04/22/2019 Tue 04/23/2019	Basic Transistor Operation (Prof. Khaled N. Salama)
14	Mon 04/29/2019 Tue 04/30/2019	Sensor Circuit Architectures (Prof. Khaled N. Salama)/ Lab course 1
15	Mon 05/06/2019 Tue 05/07/2019	Lab course 2 / Lab course 3
16	Mon 05/13/2019 Tue 05/14/2019	Presentations (Advanced Topics in Biomedical Engineering) (Prof. Sahika Inal)
17	Mon 05/20/2019 Tue 05/21/2019	Final Exam Week

Note

The instructor reserves the right to make changes to this syllabus as necessary.