University of Jordan
College of Engineering & Technology
Department of Electrical Engineering
1st Semester – A.Y. 2018-2019

Course:	Medical Electronics – 0903561 (3 Cr. – Core Course)
Catalog Data:	Sources and properties of biomedical signals, Analog circuits and systems in biomedical instrumentation, Multistage amplifiers, Frequency response, Operational amplifiers, Biomedical Instrumentation Amplifier, Integrators, and differentiators. Applications of operational amplifiers in Biomedicine, Oscillator types and their medical applications, Active Filters (Special filters for ECG, EMG, EEG), Noise removal in medical systems, Digital Interfaces (A/D and D/A converters). Students should work on a theoretical design for one of the medical electronic systems during the semester as a term project.
Prerequisites by Course:	0903361 - Electronics II.
Prerequisites by topic:	Students are assumed to have a background of the following topics: • Circuit analysis techniques. • Specialized Measurements. • Solution of ordinary differential equations. • Integrated Circuits is recommended.
Textbook:	1. Donald A. Neaman (2010). **Microelectronics**: Circuit Analysis and Design, 4th Edition, Mc-Graw-Hill. 2. John G. Webster, Editor (2010). **Medical Instrumentation: Application and Design**, 4th Edition, John Wiley & Sons, INC. 3. Carr Joseph J. (2001). **Introduction to Biomedical Equipment Technology**, Prentice Hall.
References:	1. Robert B. Northrop**, Introduction to Instrumentation and Measurements**; Second Edition; Taylor and Francis. 2. D. Prutchi and M. Norri (2005), **Design and Development of Medical Electronic Instrumentation**, Wiley-Interscience. 3. Lecture Notes and Handouts
Schedule & Duration:	• 16 Weeks, (including exams), 48 lectures, 50 minutes each, or 32 lectures, 75 minutes each.
Minimum Student Material:	Text book, class handouts, scientific calculator, and an access to a personal computer.
Minimum College Facilities:	Classroom with whiteboard and projection display facilities, library, and computational facilities.

Course Objectives:

Students will be able to apply the principles of electronic circuits and devices to the use and design of instrumentation in the biomedical area. They will gain a basic knowledge of the operating principles of electrical and other transducers, analog and digital instrumentation, applied signal acquisition and processing, electrical safety in the medical environment, electrical properties of nerve and muscle physiology; and instrumentation used in cardiopulmonary, neurological, surgical, and rehabilitation areas of medicine.

Course Outcomes and Relation to ABET Program Outcomes:

Upon successful completion of this course, a student should be able to:

1. Introduce the analysis and design of general medical electronic circuits.
2. Develop a working knowledge of medical instrumentation devices in a variety of configurations using models appropriate for the area of application.
3. Analysis and design of amplifiers based on both DC and the ac response of the system.

4. Introduce the frequency response of electronic filter circuits.
5. Design and analysis of active filters.
6. Design and analysis of biomedical application specific circuits.

Course Topics:

Topic	Description	Contact Hours
T.1.	Practical Operational Amplifiers 1. Op-Amp Circuits (Inverting and non-inverting, summing amplifiers, Op Amp circuit design). 2. Biomedical Instrumentation Amplifier, Integrators, and Differentiators. 3. Medical Isolation Amplifiers. 4. Active filters and its applications. 5. Digital Interfaces in measurement systems; Sampling Theorem; Quantization Noise; Digital to Analog converters; Analog to digital converters	14
T.2.	Measurement systems 1. Origin of Biopotential Signals. 2. Measurement of Electrical potentials from the Body surface Electrodes. 3. Half-Cell Potential and its Equivalent Circuit. 4. Noise and coherent interference in measurements. 5. Analog signal conditioning. 6. Biopotential amplifiers.	10
T.3.	Electrical Functioning of the heart, the muscles, and the neural system. 1. The ECG; Electrode placement; 2. The ECG; Vector cardiography; Driven-Leg ECG amplifiers; Design Example: QRS complex segmentation 3. The EMG. 4. The EEG.	14
T.4.	Sensors commonly encountered in biomedical applications 1. Temperature sensors. 2. Automatic non – invasive blood pressure measurements 3. Design Example: Design a non-invasive blood pressure measurement system 4. Optical sensors – Pulse Oximetry	5

Attendance: In accordance with the University Regulations, it is the student responsibility to be punctual and to attend all classes. An absentee withdrawal notice will be issued and the student will be deemed to have withdrawn from the course if a student is absent for more than 15% of the total contact hours.

Assessments: Exams, Quizzes, project, and Assignments.

Grading policy:

1st Exam	20 %
Midterm Exam	30 %
Term Project	10 %
Final Exam	40 %
Total	100%

Instructor:

Instructor Name	Office	Ext.	E-mail
Dr. Hani Jamleh	EE 301		h.jamleh@ju.edu.jo

Last Updated: September 16, 2018