BME 1008: Introduction to Biomedical Engineering

Term: Fall – 2014 Class Days: Tu-Th Time: 5:00pm-6:15pm

Abbreviated Course Title: Intro to Biomed Eng
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Office Hours: 9:00am-12:00am Monday
Subject Area: BME, Catalog #: 1008
Class Section: U01, Class #: 90201
Period: August 18th – Nov 25th
Classroom: General talks - Chem & Physics 151 & Laboratories - EC 2710
2 Credit Hours

Course Description

Modern biology and medicine is undergoing a revolution as quantitative principles of measurement, analysis, and design are introduced to help solve a variety of scientific and medical problems. Over the years, quantitative approaches for medical research have been originating from the collegial work of Biomedical Engineers in collaborations with physicians. What does a Biomedical Engineer do? How does Biomedical Engineering originate as a hybrid field from traditional engineering disciplines, biology and medicine? What are the main scientific and technical knowledge required to work as a Biomedical Engineer? How do you differentiate creativity from innovation in technology? What are important ethical issues for biomedical engineers? What are palpable examples of the impact of Biomedical Engineering has on our health care system? What are the expectations for jobs in biomedical engineering? In this course, successful biomedical engineers in the academic, medical and business worlds will help us find answers to all these questions. The course will provide you the background and technical vocabulary required to understand topics in biomedical engineering. The use of quantitative principles will be illustrated through case studies of contemporary scientific and engineering problems. Emphasis will be placed on the advantages of a multidisciplinary approach and the need to understand a problem from both a biological and an engineering perspective. The course will be divided into lectures and practical exercises.

Lectures

From the first cycle of lectures, we will explore different ways to achieve an optimal career pathway in biomedical engineering. The course will provide you the means to develop skills which are crucial to communicate effectively as a biomedical engineer. We will debate the pathways to develop, validate, and introduce a biomedical device into the market. The second cycle of lectures will consist of guest talks by experts with different backgrounds and experiences [i.e. academic background (e.g. BME faculty), industrial viewpoints (e.g. CEOs of enterprises), and health care perspectives (e.g. physicians and practitioners in the medical & healthcare sectors)]. In this cycle, you will be able to create connections between the different sub-disciplines of biomedical engineering and gradually develop a conceptual view of the discipline.

Practical Exercises

We will work in teams to complete two practical exercises. In the first exercise, you will be able to establish communication between a computer and a simple medical device by using MATLAB commands through three different laboratory problems. You will be also exposed to the most important working principles of an AD/DA converter (National Instruments), which is essential to

achieve such a communication. You will use this knowledge to record two types of biological signals from your body (i.e. your pulse oximetry and your hand grip strength). In the second and final exercise, you will be part of a freshman-senior design team that will support particular tasks relevant to the senior design projects.

How will this course help you succeed?
To define a career path in BME that enhances your potentials while minimizing the overall cost, you need a proper guidance about our Biomedical Engineering program. This course will provide you useful clues for an efficient academic planning. It will help you build a conceptual map about the BME discipline, with enhancements on your BME technical vocabulary and proficiency to digest complex BME topics. You will hear from our faculty about opportunities for BME research in different laboratories. Moreover, the most important contribution of this course to your future succeed is on creating the foundations for an effective communication between you and your BME colleagues.

Where can you look for important information?
A variety of resources (e.g. handbooks, books, websites, peer-reviewed articles, and personal communications with colleagues) might be very useful to answer questions that we will formulate in this course. However, a peculiarity of this particular class is the use of both Teaching and Learning Assistants to promote active learning strategies during the entire semester. You could either contact them by email or direct questions during the class. We encourage you to approach to the course instructor during the weekly office hours.

Learning Goals
Learning in this course will be very collaborative, with students discussing challenging aspects of the material with each other and the instructors/TAs/LAs during the lectures and practical exercises. We will work together to define competent teams both with classmates and with senior students. Reports for the laboratory portion of the course will be completed in teams, and collaboration on the homework is encouraged. Therefore, during the entire enterprise you will develop skills to communicate effectively with peers. After successfully completing this course, you should be able to:

No.	**Course Learning Outcomes** **After completing this course, you should be able to:**	**Program Learning Outcomes**
1	Understand the differences between creativity and innovation in technology and apply this knowledge to develop an innovative thinking (**Foundational Knowledge**)	8
2	Use computers to record, visualize and store biological signals (**Application Goals**)	2, 5, 6
3	Make connections between sub-disciplines, medical needs, techniques, working principles and instruments associates with biomedical engineering (**Integration Goal**)	4
4	Collaborate with peers on project support and completion (**Human Dimension Goals**)	4, 6, 7
5	Value translational animal and human research to improve our health care system and learn how to perform it responsibly (**Caring Goals**)	8
6	Visualize an individualized career plan for you to become a biomedical engineer which fits your interests, abilities and financial needs (**Learning How-To-Learn Goals**)	8

Grading Scheme

Following is the grading methodology and the point distribution based on the objectives above.

First discussion in class (4%)

In the first cycle of lectures, you will be exposed to examples of creativity and innovation in technology through a fifteen minutes introductory talk. Afterward, you will organize in teams and discuss a possible proposal for an innovative BME product (30 minutes). Each team will discuss the proposal in front of a shark tank (30 minutes). Each shark tank will be composed of representative members from the other teams who will act as investors. You will discuss these concepts in a written report. This assignment will represent 2% of your grading. Each shark tank will provide a score for each proposal. The score will summarize: a) the clinical relevance of the proposal, b) the cost/profit ratio, and c) the team qualification. This score will represent 2 % of your grading.

Lessons for laboratory problems (21%)

Through four lessons (75 minutes each), you will learn a few MATLAB routines: a) recording data from an AD/DA converter and b) plotting/storing/reading these data. Through three lessons (75 minutes each), you will learn the basic working principle of a National Instrument AD/DA converter and how it should be connected to particular analog amplifiers. You will complete an on-line assessment after each MATLAB and NI lesson. Each assessment will represent 3% of your grading. This entire part of the class is facilitated by Learning Assistants (LA).

Two laboratory problems (15%)

Through two laboratories (75 minutes each), you will use the acquired knowledge about MATLAB and NI converter to record two basic biophysical signals from your body. You will present a **written (lab) report** discussing the data you have recorded and the techniques used for that purpose. You will use a template provided by the LA facilitator to prepare this report. Utilizing the concept map you are developing, you will describe which biomedical engineering sub-discipline fits to each lab exercise. Each written report will constitute 7.5% of your grading. This entire part of the class is facilitated by Learning Assistants (LA).

Sixteen guest talks (32%)

Biomedical professionals will share their expertise with us in class through a 15 minute PowerPoint presentation. They will have 15 minutes to answer questions related to their fields and career paths. During the semester, you will listen to 16 biomedical professionals in total. Each class will start with a focus question from the major instructor (15 minutes), which will be followed by interactions with two biomedical professionals. You will synthesize the information given in each talk by writing a concise 200-words essay (for eight talks) and by completing a partial conceptual map (for the other eight talks). A concept map is a visual tool that will help you form the connections between areas of biomedical engineering, common techniques used in the field, devices and working principles as well as between the most relevant medical needs these days. Each essay (or map) will constitute 2% of your grading, respectively.

Second discussion in class (5%)

You will learn about main laboratory good standards in the class, with particular emphasis on ethical issues relevant to IACUC and IRB protocols. In pairs, you will debate an example

provided by the instructor about misconduct in research regarding the use of either animals or humans. Given the needs of a particular research study, you will develop a **paragraph** that explains the rationale behind your decision to use of either humans or animals in this study. This assignment will constitute 5% of your grading.

Final exam (23%)

The final exam will consist of three parts. Completing a more general concept map provided by your instructor will be the first part and will constitute 5% of your grading. Based on knowledge about team dynamics, you will organize in teams (Week 6). You will help finding a leader for each team. You will learn about a particular design project through interactions with senior members (Week 10). With the support of your class instructor and TAs, you will be challenged to work on solving a particular task associated with the design project. Each team will present the design project at the end of the course to a biomedical engineering committee. This activity constitutes the second part of the final exam and will be 15% of your grading. You will follow a PowerPoint template while preparing the presentation. You will be evaluated by this committee (10%) taking into account the following criteria: a) Team performance and b) Individual performance. Your team members will evaluate (5%) your contribution to the entire design project through an anonymous questionnaire. You will learn the curriculum sequence for biomedical engineering through a flow chart in one of the introductory classes. Based on your current motivations and experience, you will create your own career path for biomedical engineering at the end of this course. It will be the third part of the final exam. It will constitute 3% of your grading.

Grading scale: 95-100 A; 90-94.9 A-; 86-89.9 B+; 82-85.9 B; 79-81.9 B-; 76-78.9 C+; 72-75.9 C; 69-71.9 C-; 67-68.9 D+; 63-66.9 D, 60-62.9 D

Textbook(s): N/A (They are NOT mandatory)

1- Introduction to Bioengineering. S. A. Berger (Editor), W. Goldsmith (Editor), E. R. Lewis (Editor). Oxford University Press, 2000.
2- An Introductory Text to Bioengineering. Edited by Shu Chien, Peter C Y Chen and Y C Fung. World Scientific Pub Co Inc; 2nd Revised edition edizione, 2008.

Contribution to Professional Component: Engineering Topics

Co-requisites: None

Prerequisites: None

Contact Hours per Week: Lecture: __1__, Lab: __1__, Field Work: __0__

Policy regarding student misconduct: Students at Florida International University are expected to adhere to the highest standards of integrity in every aspect of their lives. Honesty in academic matters is part of this obligation. Academic integrity is the adherence to those special values regarding life and work in an academic community. Any act or omission by a student which violates this concept of academic integrity shall be defined as academic misconduct and shall be subject to the procedures and penalties established by the university. Students violating academic integrity will receive a failing grade for the course and the incident will be forwarded to Student Academic Affairs. Academic misconduct includes, but is not limited to, copying homework, copying work on exams

either in-class or take-home, copying of projects, or plagiarism. Plagiarism is using others' ideas and words without clearly acknowledging the source of that information. This includes, but is not limited to, the internet, textbooks, journals, or any other material that is not your own work. It is the responsibility of students to report misconduct, which may include another student copying from your, or another student's exam, homework, projects or any other assignment. Therefore, if a student copies from you, it is your responsibility to report it, otherwise you are also responsible. Under no circumstances will any student be permitted to leave and return to the classroom during an exam.

As part of this course, students are grouped in teams by the instructor. The teams will remain intact through the following semester to complete their freshman-senior design course. Member exchange or substitution across the teams is not permitted. In extreme cases, exceptions may be granted by the instructor with a valid reason and proper documentation of the reason.

Any student who must miss an exam needs to notify the instructor and make arrangements (if possible) prior to exam time and have documentation for the reason. Students must follow instructions from senior students during the final Design Project.

Class Schedule

Week 1

Introductory talk 1 (first cycle of lectures)

- Introduction to our team
- Discussion of the syllabus
- BME history
- Current status and future directions of BME
- Monkey survey

Introductory to the laboratories (first exercise)

- Introduction to the Learning Objectives (LOs)
- Description of laboratories
- Organization of the labs groups (two sections) & advisors (each with 7 students)
- Defining the labs schedule for each section

Week 2

First discussion: Differences between creativity vs. innovation (first cycle of lectures)

- Introduction to these concepts and the particular clinical need (15 minutes)
- Conception of proposal by entrepreneur teams
- Presentation of proposal to the shark tanks

MATLAB lesson 1 (first exercise)

- Introduction to MATLAB
- Examples of applications
- Basics functions

Week 3

Second discussion: Laboratory good standards (first cycle of lectures)

- Major ethical issues for BME
- Introduction to IACUC and IRB
- Debate examples of research proposal

MATLAB lesson 2 (first exercise)

- Reading data in MATLAB from a file: ASCII and MATLAB formats
- Visualizing data in MATLAB
- Saving data to a file

Week 4

Introductory talk 2 (first cycle of lectures)

- Opportunities for job in BME
- Curriculum-vitae or resume
- Academy, industry and health systems

NI lesson 1 (first exercise)

- Introduction to AD/DA converters
- The National Instruments platform

Week 5

Introductory talk 3 (first cycle of lectures)

- A talk summary: Center for Excellence in Writing

Funds to support your undergraduate courses
Global Learning Medallion class

NI lesson 2 (first exercise)

Introduction to the NI USB-6009 device
Drivers and general device software

Week 6

Guest talk 1 (second cycle of lectures)

Introduction to topic 1: Electrophysiology
Speaker 1
Speaker 2

Group formation: The freshman-senior projects (second exercise)

Team dynamics
Group definition

Week 7

Guest talk 2 (second cycle of lectures)

Introduction to topic 2: BME Instrumentation
Speaker 1
Speaker 2

MATLAB lesson 3 (first exercise)

Introduction to DAT
Reading data from a NI USB-6009
Examples

Week 8

Guest talk 3 (second cycle of lectures)

Introduction to topic 3: Modeling
Speaker 1
Speaker 2

Two section part

NI Lesson 3 (first exercise) – Group A (50 students)

Discussion about sensors
Discussion about amplifiers

MATLAB Lesson 4 (first exercise) – Group B (50 students)

Definition of problems
Writing your own MATLAB program

Week 9

Guest talk 4 (second cycle of lectures)

Introduction to topic 4: Intellectual Property
Speaker 1
Speaker 2

Two section part

NI Lesson 3 (first exercise) – Group B (50 students)

Discussion about sensors
Discussion about amplifiers

MATLAB Lesson 4 (first exercise) – Group A (50 students)
Definition of problems
Writing your own MATLAB program

Week 10

Guest talk 5 (second cycle of lectures)
Introduction to topic 5: Entrepreneurial
Speaker 1
Speaker 2
Two section part
Design project discussion I (second exercise) – Group A (50 students)
Design projects: freshmen and seniors
Assessments: Analytic, Market, Regulatory and Material
Laboratory 1 (first exercise) – Group B (50 students)
Recording sections
Discussion sections

Week 11

Guest talk 5 (second cycle of lectures)
Introduction to topic 6: Clinical Rotation
Speaker 1
Speaker 2
Two section part
Design project discussion I (second exercise) – Group B (50 students)
Design projects: freshmen and seniors
Assessments: Analytic, Market, Regulatory and Material
Laboratory 1 (first exercise) – Group A (50 students)
Recording sections
Discussion sections

Week 12

Tue - Holliday (Veteran Day Observed)
Two section part
Design project discussion II (second exercise) – Group A (50 students)
Presentation rehearsals
Project discussion
Laboratory 2 (first exercise) – Group B (50 students)
Recording sections
Discussion sections

Week 13

Guest talk 6 (second cycle of lectures)
Introduction to topic 7: Regulatory, Standards and FDA
Speaker 1
Speaker 2
Two section part
Design project discussion II (second exercise) – Group B (50 students)

Presentation rehearsals
Project discussion

Laboratory 2 (first exercise) – Group A (50 students)

Recording sections
Discussion sections

Week 14

Guest talk 7 (second cycle of lectures)

Introduction to topic 8: Biostatistics
Speaker 1
Speaker 2

Thu - Holidays (Thanksgiving)

Week 15

Guest talk 8 (second cycle of lectures)

Introduction to topic 9: Optical Imaging
Speaker 1
Speaker 2

Warning: This class schedule could have some modifications

Log-in Package

Log-in Information with Zyante
1. Sign up at zybooks.zyante.com
2. Enter zyBook code: **FIUBME1008MatlabFall2014**

Login Information for Computer Lab:
Please, attempt to login using the default option shown below:
Username: FIU email (without the "@fiu.edu")
Ex: Jsmit002
Password: Fiu + Panther ID
Ex: Fiu331021

If this option did not work please use temporary account provided by us, this account would only work for the **FIRST** week of school. After the first week if the default option does not start working, please go to rooms 2801 or 2805 to turn in the "New Account Registration Form"