EE/BME 374K, EE 385J.31, BME 384J.1
Class Syllabus
Fall 2019

Unique numbers: 16595, 14180, 16785, 14295

Lecture schedule: Tuesday & Thursday, 2:00 – 3:30 pm, ECJ 1.306

Instructor: Prof. Emily Porter
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Office Hours: Tu & Th 10 – 11:30 AM, Other times by appointment

Teaching Assistant: Mr. Ali Farshkaran, ali.farshkaran@utexas.edu Office hours: TBD.

Text: Webster; Medical Instrumentation, 4th Edition, John Wiley, 2009.
Supplemental: Principles of BME Instr. Webb

Grading Scheme: Homework total 100 pts + 3 tests @ 100 pts each + final @ 200 pts = 600 pts total.

Course Description: This course provides an introduction to basic concepts in biomedical instrumentation, and the application of electrical engineering principles in the design of electronic instrumentation for the measurement of pressure, temperature, flow, and impedance. Topics covered include key definitions in biomedical instrumentation, the fundamental biological processes and physiological effects of electric current, basic measurement sensors, amplifiers, along with common measurements such as of blood pressure, the electrocardiogram, and therapeutic devices including pacemakers and defibrillators. Design considerations specific to electro-medical environments, including safety and efficacy, will also be discussed. The course will help students to build and understand the foundations of biomedical instruments and to make connections between biology, physiology, and electrical engineering.

Lecture No	Date	Topic	Text Pages
1	8/29	Design Process, Measurements, Instrumentation systems, Calibration, Biostatistics	1 - 19
2	9/3	Static characteristics of instrument systems	19 - 25
3	9/5	Dynamic characteristics of instrument systems, 1st & 2nd order	25 - 35
4	9/10	Operational amplifier topologies, Difference amplifier (HW #1 is due)	91 - 100
5	9/12	Instrumentation amplifier. (Notes, Ch 2)	
6	9/17	Comparators, Rectifiers, Integrators, Differentiators, Filters (HW #2 is due)	101 - 110
7	9/19	Op-amp design considerations: GBW product, Offset (Notes, Ch 2)	110 - 117
8	9/24	Timers, Op amp design considerations, Noise processes, (HW #3 is due)	120 - 123
9	9/26	**Test No. 1** In class. (pp. 1 - 35 and pp. 91 - 123, as covered in class)	
10	10/1	Resistive, Inductive, Capacitive, and Piezoelectric transducers (Notes, Ch 3)	45 - 62
11	10/3	Temperature measurement, Thermocouples, Thermistors, Infrared devices	62 - 74
12	10/8	Optical transducers, Light sources, Photodetectors (HW #4 is due)	74 - 86

13	10/10	Introduction to biopotentials, Membrane physiology and depolarization	126 - 135
14	10/15	Nervous system organization, Signals	135 - 146
15	10/17	Cardiac physiology, ECG, Surface potentials, Arrhythmias (Notes, Ch 4)	147 - 158
16	10/22	Examples of biopotential measurements (Notes, Ch 4)	158 - 181
17	10/24	Electrodes, Metal-electrolyte interface, Electrode electrical model	189 - 202
18	10/29	**Test No. 2** In class. (pp. 44 - 84 and pp. 110 – 181 + Notes)	
19	10/31	Electrode circuit models, Surface, Needle, Active electrodes, Arrays	202 - 231
20	11/5	ECG amplifiers, Cardiac vector, Measurement problems (Notes, Ch 4)	241 - 263
21	11/7	Noise, **E** & **H** field interference, Tricks, Pre-amps & Power supply design	263 - 275
22	11/12	Blood pressure measurement, B.P. Catheter system response	293 - 315
23	11/14	Intro. to volume & flow, Indicator dilution, Electromagnetic flow meters	338 - 350
24	11/19	Impedance/Admittance methods (Notes, Ch 7)	364 - 372
25	11/21	Strength-Duration curve, Stimulation electrodes, (Notes, Ch 5)	590 - 606
26	11/26	**Test No. 3** In class. (pp. 183 – 372 + Notes)	
27	11/28	Thanksgiving Holiday … No Class	
28	12/3	Pacemakers, FNS Stimulators, Defibrillators, (Notes, Ch 5)	590 - 611
29	12/5	Electrical safety; Electromagnetic Fields and Public Safety	638 - 667

FINAL EXAM: Wednesday, December 18th, 2:00 pm-5:00 pm

Other information:

Pre-requisite for EE 374K / BME 374K: EE438, with a grade of at least "C-".

This syllabus and course lectures and materials will be available on the Canvas website[1]. Canvas is a web-based course management system with password protected access, it is available at http://courses.utexas.edu. Attendance at lectures is recommended (although attendance/participation will not be used in determining your grade). Attendance helps bring together the various aspects of the class, and will help you identify what's important in the course and how to efficiently use your time. During lectures, please focus your use of electronics on participating in the lecture content.

Homework will generally consist of five problems per week, each counting ~2 points (10 pts total). Only the top ten homework assignments will count (dropping 2 or 3, depending on the schedule). Homework assignments can be hand-written then photographed/scanned, or completed digitally – either way they must be submitted to Canvas. Please ensure your submitted copies are clear and easy to read. Late homework is subject to a penalty of 1% per minute late.

You are expected to be present for every test and to take it. Do not worry about memorizing formulas for tests. For each test you can bring a single 4 X 6" card with hand-written notes on it (writing on both sides is permitted). You may bring four of them to the final exam. You are being graded primarily on the method of your solution. The final answer accounts for only about 10% of the problem score. Organize your problem solutions in a logical step-by-step fashion to get the maximum number of points. The easier it is to understand and follow the logic of your solution the more points you will receive. I'm looking for professional, organized, and polished EE designs and work.

[1] I thank Prof. John Pearce for sharing his syllabus, materials, and experiences.

This course will be evaluated using the standard Cockrell School of Engineering forms near the end of the semester. However, I am open to feedback at any time during the semester, and please feel free to email me or come talk with me.

Design Problem:

Students taking the graduate sections, EE 385J.31 / BME 384J.1, will — in addition to the above work — complete an instrument system design project during the semester. The choice of the particular measurement is generally left to the student as long as it is a standard medical measurement (clinical or laboratory), performed by electronic means and represents a substantial design effort. A complete design includes: 1) measurement criteria and constraints, 2) several design options considered, 3) a complete final design including circuit diagram, calibration methods **and** a DC power supply design.

Letter Grades: In this course, plus and minus letter grades may be assigned.

Grade Disputes or Corrections: If you discover an error in a grade assigned to you, you must submit your complaint, along with supporting evidence or arguments, to me (or to your TA or grader) within one week of the date that I (or your TA or grader) first attempted to return the exam or assignment results to you. Complaints about grades received after the one-week deadline will be considered only if there are extraordinary circumstances for missing the deadline. Exams submitted for re-grading will be completely re-graded.

Students with Disabilities: The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Services for Students with Disabilities at 512-471-6259 or email ssd@austin.utexas.edu or check the website at http://ddce.utexas.edu/disability.

Religious Holidays: By University policy, students must notify instructor of pending absence at least fourteen days prior to the date of observance of a religious holy day. If a student must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, the student will be given an opportunity to complete the missed work within a reasonable time after the absence.

Website and Student Privacy: Web-based, password-protected class sites are associated with all academic courses taught at The University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. By default, on Canvas, a student is able to see the names of all of the students enrolled in the same course, and can send them e-mail through Canvas. A student can change the display of their name by clicking the Account icon (profile picture) in the left navigation bar → Selecting Settings → Clicking Edit Settings → Changing the Displayed Name, Sortable Name and Full Name.

Academic Integrity: Plagiarism or any form of academic dishonesty (cheating includes, but is not limited to, copying another student's work, stealing another student's homework, bringing notes into a test and copying material directly from a book, article or web site without including appropriate references, falsifying data, doing someone's work) is a violation of University rules and may return a

grade of zero for each assignment in which it is detected or may incur even steeper penalties. For more information and University policies please see: http://deanofstudents.utexas.edu/conduct/academicintegrity.php

Mental Health Counseling: Counselors are available Monday-Friday 8am-5pm at the UT Counseling and Mental Health Center (CMHC) on the 5th floor of the Student Services Building (SSB) in person and by phone (512-471-3515). The 24/7 UT Crisis Line is 512-471-2255.

Behaviour Concerns Advice Line (BCAL): If you are worried about someone who is acting differently, you may use the Behaviour Concerns Advice Line to discuss by phone your concerns about another individual's behavior. Call 512-232-5050 or visit http://www.utexas.edue/safety/bcal

Important Dates:

The first lecture of this course will take place on Thursday, Aug. 29, 2019.

Sept. 3, 2019 is the last day of the official add/drop period, and after this date changes in registration may require approval of your department chair and student's dean.