50:750:361- Introduction to Mechatronics

Instructor	Dr. Sean O'Malley	E-mail	omallese@camden.rutgers.edu
Phone	856-225-6159	Office Hours	TBA
Office	CNS 216F	Final Exam	TBA

Class time: Tues & Thurs. 9:35am – 10:55am

Co-requisite: Introduction to Mechatronics Lab (50:750:364); M 12:30-3:30pm
(*Note, many of the labs will utilize Arduino, an open-source electronic prototyping platform*)

Pre-requisites:
- Elements of Physics II (50:750:132), and Introduction to Scientific Computing (50:750:140)

Text: The course will be based on the following text; however, the course notes will be heavily supplemented by the instructor. Hence, the lecture notes should be the primary study source for the course.
- David Alciatore, "Introduction to Mechatronics and Measurement Systems", 5th ed., ISBN10: 1259892344

Other useful books:
- Horowitz & Hill, "The Art of Electronics", ISBN 0-521-37095-7. (*The electronics reference book)*
- Hummel, "Electronic Properties of Materials", ISBN 0-387-95144-x. (*Good reference book for the physics behind electronic devices without getting into too much detail*)
- "Low Level Measurements" by Keithley Corporation. (*Reference for electrical measurements, contains techniques for reducing external noise*)

Software:
- QUCS (free circuit simulator program). You can download a copy of the program here: http://qucs.sourceforge.net/
- MATLAB/Simulink; available for free from Rutgers software portal.

Description:
Fundamental tools for analysis, design, implementation, and integration of functional elements of modern mechatronic systems, including: analog and digital circuits, sensors, actuators, data acquisition systems, microprocessors, system modeling and signal processing, introduction to control design. The course includes both lecture and lab work.

Learning goals:
Upon completion of this course a student should have acquired the following knowledge:
- Gain competency in the design of electric circuits.
- Become adept at designing low, high, and bandpass filters with a given set of parameters.

- Understand the fundamental operation and construction of diodes and transistors.
- Understand the basic types and operation of regulated power supplies.
- Comprehend the role played by transducers and their fundamental operation.
- Become competent in the design of basic op-amp circuits with desired gain and impedance characteristics.
- Gain familiarity with analog-to-digital and digital-to-analog converts.
- Develop an understanding of Boolean logic and logic networks.
- Basic understanding of microcontroller implementation and programming
- Acquire knowledge of the operation of various motors
- Practical grasp of proportional, integral, and derivative (PID) control theory

Details:
1) There will be **two semester exams** plus a **final** pertaining to the material covered during lecture. (100 pts ea.)
2) There will be several directed **homework assignments** and **quizzes**. (up to 20 pts ea.)

Grading:

A	90-100%		C	67-75%
B+	87-89%		D	55-66%
B	80-86%		F	<55%
C+	76-79%			

Instructor's Statement:

Do not engage in any form of academic dishonesty. If you do not know what academic dishonesty is, please consult this statement:
http://www.camden.rutgers.edu/RUCAM/info/Academic-Integrity-Policy.html.
I will report any violations of this policy to the campus Judicial Officer.

Please note that it is necessary to explain all steps that you take on exams – make an effort to *clearly* show your work. Answers without justification will not be accepted! You may be asked to explain your reasoning.

Do not bring cell phones to class or disrupt class in any way. If you do so, you will be asked to leave and will not be welcomed back for the rest of the class period.   The use of computers will be at my discretion – in general they will not be necessary or welcome.

Attendance is strongly suggested at all class meetings in accordance with the policies and guidelines set forth in the student manual.

Attending the lecture is not enough. Take notes in class and read-up on the relevant topics on the web or in relevant textbooks.

Class Resources:

https://canvas.rutgers.edu/

Class Outline:
1) Basic components (a review of resistors, capacitors, and inductors)
2) Kirchhoff's laws, Thevenin's and Norton's theorems
3) RLC circuits, filter design, system response

4) Basics of semiconductor physics
5) Diodes, transistors, and their various forms
6) Transducers e.g., temperature sensors, pressure sensors, light detectors, etc.
7) Operational amplifiers
8) Digital electronics, Boolean algebra, truth tables, TTL & CMOS circuits
9) Analog-to-digital convertors (ADCs), and digital-to-analog convertors (DACs)
10) Microcontrollers, programming, and interfaces
11) Actuators e.g., solenoids, AC motors, DC motors, stepper motors, servo motors
12) Introduction to control theory, PID