SYLLABUS
Smart Sensors Technology I - College of Engineering (W 2018)

No: ECE 6570/BME 6470/PHY 6570
Title: Smart Sensor Technology I: Design

Credits 4
WSU Catalog Description:
Prereq: B.S. degree in engineering or science. Introduction to various types of sensors and the design of basic circuit building blocks.

Lecture Meeting Time & Location:
Location: 0120 Mano
Time: 2:30-4:10pm T, Th

Instructor
Prof. Mark Cheng
Office COE3140
Phone: 3135775462, email: mcheng@wayne.edu
Office Hours: Tuesday and Thursday 1:30PM-2:30PM

Goals: This course will focus on various physical phenomena behind the operation of different types of sensors and microsystems, including mechanical, optical, bio/chemical. magnetic, radiation, and etc. In general, the students are introduced to the current technology of sensors: electronic, microfluidics and new materials. The course emphasis is on the integration of electronics with sensors to provide a smart transducer or a system on a chip with multiple integrated devices.

Learning Objectives: At the end of this course, students will be able to:

1. Select the right sensor for a given application.
2. Understand physics and chemistry behind micro and nanofabrication
3. Simulate, synthesize, and layout a complete sensor or sensor system, MEMS device or microsystem ready for fabrication tools.

Textbook or Manual: Handouts posted on the Web

The following are references used in the class.
1. **Micromachined Transducers Sourcebook** 1st Edition by Gregory T. Kovacs
2. **Sensor Technology Handbook** edited by Jon Wilson

References: NA

Topics	Contents
1	Sensors characteristic, Performance of sensor in scaling
2	Electronics signals, simple circuit for signal amplification and conditioning
3	Mechanical behaviors of materials
4	Mechanical Sensors
5	Thermal Sensors
6	Optical and RF Sensors
7	Magnetic Sensors
8	Chemical and Biological Sensors
9	Senor Data

Assessment Methods:

Homework: Multiple homework will be assigned in the lecture. The homework will not be collected. However, you can submit your work on blackboard within one week after lecture for bonus points. The instructor will give away up to 10% bonus points.

Quiz: Multiple quiz will be given randomly during the semester. The quiz will be based on homework (30%).

Two Exams: Two exams will be given on March 1 (25%) and April 26 (25%).

A final project (20%) will be graded. You are expected to apply commercially available sensors to some applications. The scope of work includes (1) identification of an application (2) sensors calibration (3) interface sensors with DAQ boards/Arduino (4) field study and (5) collected data analysis. The following are examples for applications.

(1) Monitor the air quality on Anthony Wayne Drive for one day
(2) Compare body motion during sitting, walking, running or exercising
(3) Test if CO_2 sensors can be used as occupancy sensors.
(4) Test magnetic fields closed to various equipment (SEM, computers, refrigerators, microwaves)
(5) Please discuss with the instructor.

Grading Scale:

A	A-	B+	B	B-	C+	C	F
>=90	>=85	>=80	>=75	>=70	>=65	>=60	<55

Deferred Grades A grade of "I" will only be assigned if a student *IS NOT* currently failing the course and if there is *NOT* a substantial amount of work to be completed. An "I" grade *MUST* be made up within one year of assignment of the grade. Assignment of an “I” grade will be at the sole discretion of the instructor.

Attendance: You will be expected to attend class and participate in discussions regarding lectures by the instructor and your classmates. In order to do this, you should read the papers given to you prior to attending class. This will include handouts and reference lists or review articles as well as the papers written by your classmates.

Blackboard Blackboard will be used throughout the course for communication among students and with the instructor. Feel free to post both private and common questions. Written assignments will be turned in and distributed to other students via Blackboard. In order to use the system, you must log on through Pipeline.

Please activate your Wayne email address, forwarding it to your standard email if you wish. This will be the address with which the class communicates with you.

Withdrawal Policy The last day to drop any class with a tuition refund is the end of the second week of classes. The last day to withdraw from the class, without a notation of W on the transcript, is the end of the fourth week of classes. All drop/add activity during the first 4 weeks should be done through Pipeline. Between the end of the fourth and fifth weeks, withdrawals require the permission of the instructor and must be submitted on a Drop/Add form to the Registrar's Office. It is the policy of the College of Engineering not to allow withdrawals from courses after the end of the 5th week except under exceptional circumstances. Failing a class is not an acceptable excuse for withdrawal after the 5th week. Withdrawals after this time require the permission of the Associate Dean for Academic Affairs.

Policy on Cheating It is the policy of the Electrical and Computer, Biomedical Engineering Programs that any instance of cheating will result in a grade of F for the course. Cheating is defined by the University as "intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information, or assistance in any academic exercise." This includes any group efforts on assignments or exams unless specifically approved by the professor for that assignment/exam. Evidence of fabrication or plagiarism, as defined by the University in its brochure *Academic Integrity*, will also result in downgrading for the course. Please refer to the "Expectations for Citation in Biomedical Engineering" handout (attached and available on the web) and to the Departmental recommended book on scientific writing, for guidance. STUDENTS WHO CHEAT ON ANY ASSIGNMENT OR DURING ANY EXAMINATION WILL BE ASSIGNED A FAILING GRADE FOR THE COURSE.

Therefore avoid all appearance of improper behavior! Students who witness cheating should report the incident to the instructor as soon as possible. Students are also welcome to discuss any concerns related to cheating with the instructor.

Academic dishonesty ... tends to compromise the academic integrity of the institution or subvert the education process. All forms of academic dishonesty are prohibited at Wayne State University, as outlined in the Student Due Process Policy." -- from *academic Integrity: Important Information for Faculty and Students*

Outcome Coverage:

(a) An ability to apply knowledge of mathematics, science, and engineering. The laboratory exercises and projects require knowledge of mathematics, science, and engineering to successfully complete them.

(b) An ability to design and conduct experiments, as well as to analyze and interpret data. Students are assigned both individual and group projects, which require ability to conduct simulation, analyze and interpret results.

(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. Students learn the process of chip fabrication. The chips are designed to achieve design specifications. Also, students learn clean room facilities to fabricate sensors for their projects.

(d) An ability to function on multi-disciplinary teams. Students work in multi-disciplinary type projects. The student's population in the class is from different disciplines: Physics, Biomedical, Mechanical, and Electrical.

(e) An ability to identify, formulate, and solve engineering problems. Students are presented with engineering problems, like designing sensors for biomedical, automotive applications.

Last Updated 01/06/2018