

Justification: ECE 576 Sensors

The lab-on-chip (LoC) theme involves integrating on-chip sensors with microfluidic technology to build miniaturized devices that can monitor bio/chemical responses in real time without a bulky and complex laboratory setup. In this context, the sensors domain focuses on the appropriate design of detectors for seamless integration with other components on chip. In a LoC device, the sensors need to be compact, cost-effective, and consume low power without compromising on data quality. The sensor portfolio for a LoC device will involve the study of microsensor fabrication/manufacturing techniques, sensor testing, reliability analysis, and sensor packaging.

It does not affect other units in Pullman and other campuses.

ECE 576 Sensors

Fall 2018

Description: Classification of sensors, Sensing Modalities, Comparison; Figures of Merit; Sensing Parameters; Sensor Miniaturization; Sensor Manufacturing; and Case Study: Pressure Sensor, Gas Sensor, Temperature Sensor, and Biosensor.

Credits: 3 (2-3)

Prerequisite by Topic: None

Required Text: Handbook of Modern Sensors, Jacob Fraden, 4th Edition, ISBN: 9781441964656. The book can be found in WSU Vancouver bookstore.

Sensors: An Introductory Course, Kouros Kalantar-zadeh, ISBN: 9781461450511.
The book can be found in WSU Vancouver bookstore.

Supplementary Materials: Will be posted on Blackboard.

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Office hours: Open Door Policy (E-mail Appointments Preferred)

Lecture Times and Location: M, W 9:00-9:50 AM, VECS 122

Lab Time: Tu, 12:10 – 3:00 PM, VECS 220

Graduate Learning Outcomes (GLO)

Students will be able to:

GLO-1: Classify sensors based on the transduction principle and choose a sensor for a specific application.

GLO-3: Research topics on emergent sensor technologies and present a paper on the design and development of a sensor system for gas sensing and biosensing application.

Grading Policy

Lab Report	10%
Homework	10%
Term Paper	20%
Oral Presentation	20%
Midterm Exam	20%
Final Exam	20%

A	94-100	B	83-86	C	73-76	D	60-66
A-	90-93	B-	80-82	C-	70-72	F	< 59
B+	87-89	C+	77-79	D+	67-69		

Grades will be rounded up to the next point as letter grades for the course are assigned at the end.
Composition of final grade: 50% of the grade will focus on GLO-1 and 50% will focus on GLO-3.

Learning Outcomes and Assessment

Student Learning Outcomes for this Course: At the end of the course, the students should be able to:	Course Topics/Dates: The following date(s) will address this outcome :	Evaluation of Outcome : This outcome will be primarily evaluated by:
Understand the different sensing mechanism and sensor parameters to identify the appropriate sensor for a specific application.	Week 1, 2, 3 (sensor classification, figures of merit, principles, characteristics)	Quiz, Homework, Tests, Lab Reports
Review the different sensor related case studies to comprehend the sensor design, fabrication, and testing challenged and limitations.	Week 10-16 (Case study: temperature sensor, pressure sensor, gas sensor, and biosensor)	Quiz, Homework, Tests, Lab Reports
Prepare lab reports and analyze sensor performance from raw data	Week 1 to 14 Lab Sessions	Lab Reports
Design and fabricate sensor for a specific application.	Week 1 to Week 15	Homework and Tests

Descriptions of Required Assignments/Term Paper

Majority of the homework assignments stem from the exercises in the required textbooks. The assignments are due exactly one week after they are assigned. The format of the lab report will be posted online during the first week of the class. The term paper is due the 10th week of the class.

The term paper should follow the guidelines listed below:

1. **INTRODUCTION.** Begin by stating the issue that you will discuss and explain why the issue is important. The issue should be one that arises out of the course readings and will require you to discuss and criticize the views of at least one of the authors in the course readings.
2. **CRITICAL SUMMARY.** Summarize the relevant views and the arguments in the course readings or in other readings that you believe are of importance. Usually in a critical discussion of a philosophical view it is not sufficient to merely summarize the view. Your attention should be focused on the author's

development of the view--that is, on his/her arguments, in the broadest sense of the word. In most cases, an author will begin from statements that s/he expects the audience to agree with, and will use them to support conclusions that s/he expects to be more controversial. The argument need not be a purely deductive one, though it may be. In critically evaluating the author's view, you must reconstruct how the author reaches the conclusions s/he does and must evaluate whether the considerations that s/he takes to support her conclusions do in fact support them.

3. CARE IN CITATIONS. Make sure you accurately state the position of any author you discuss and always include page references for each quotation or attribution.

5. USE CARE IN INTERPRETING AN AUTHOR, PARTICULARLY SOMEONE YOU DISAGREE WITH. If on your interpretation of an author, the author either is inconsistent or has made an obvious error of reasoning, begin by assuming that you have misinterpreted the author. Reread the relevant passages carefully to see if you can put together a consistent position that is not obviously erroneous. If you cannot do so, make an appointment to talk to me so that I can make some suggestions.

6. CRITICAL EVALUATION. A purely expository paper is not acceptable in this course. Your exposition--even a critical exposition--of an author's views should NEVER take up more than half of your paper. At least half of your paper must be devoted to a critical evaluation of the views of the authors you are discussing. A satisfactory critical evaluation will require you to raise objections to the views of the authors you are discussing and to critically discuss them.

7. REPLY TO THE RELEVANT RESPONSES. After you have formulated the best response(s) that you can to your objection(s) (8 above), reply to the response.

8. CONCLUSION. Conclude by summarizing the results of your argument and their significance for the relevant issues.

9. ALL PAPERS SHOULD BE TYPED OR PRINTED DOUBLE-SPACED. Although papers are evaluated chiefly on their philosophical merits, grammar, spelling, and diction will also be evaluated. You are expected to express your thoughts in clear, grammatical, English sentences.

10. AVOID PLAGIARISM. Whenever you turn in any assignment in this course, the understanding is that what you are turning in is your own original work, except to the extent that you explicitly credit others for their contributions. You have an obligation to avoid even the appearance of impropriety, by always attributing any argument or idea that you have borrowed, even if you have modified it, to its source. The source may be written or oral. For example, if an argument was suggested by a fellow student, include that information in a footnote.

Instructional Methods

The instructional methods include instructor lectures, video demonstrations, and student lead discussions.

Instructor Specific Expectations

1. Work cooperatively and effectively with others in class and on group assignments.
2. Participate fully in class activities and discussions.
3. Prepare thoroughly for class sessions by doing the necessary readings. All reading assignments will be posted on the course web site.

4. Treat the instructor with courtesy and respect and maintain decorum in the class.
5. Carefully read the syllabus that is passed out on the first day of class and follow all instructions included in the syllabus.
6. Expect students to let instructor know if they are having problems understanding or working with the material.
7. Expect students to submit assignments on time and according to instructions.
8. Avoid the use of cell phones or laptops in class.
9. Understand the concepts to solve problem apart from textbook exercises.

Attendance Policy

Since majority of the course content is presented in a problem-solving format, daily attendance is preferred. **Lecture attendance is not mandatory.** Each class utilizes tools and concepts learned from previous classes. Please be sure to arrive on time and stay till the end of the class. Not only do excessive absences, tardiness, and early departure suggest a lack of professionalism and commitment, but they also guarantee that you will not attain the objectives of this course.

Website

All course materials (lecture notes, assignments) will be available on the course Blackboard website at learn.wsu.edu

Make-up Exam/Assignment Policy

No make-up exam, assignments or quizzes will be given unless a medical or other emergency was the reason for missing the exam or the assignment. For any other reason you must first contact the instructor **before** missing an exam, a quiz or an assignment.

Late Homework Submission Policy

Late homeworks will not be entertained unless dire circumstances warrant it. Without a valid reason, there will be a 10% deduction grade for submitting late by a day. If the submission is two days late, a 20% deduction in grade will be enforced. The homeworks will not be accepted after three days of original submission.

WSU Academic Integrity Statement

Academic integrity is the cornerstone of the university and will be strongly enforced in this course. Any student found in violation of the Academic Dishonesty Policy, which can be found at <http://studentaffairs.vancouver.wsu.edu/student-affairs/academic-dishonesty>, will be given an “F” for the course and will be referred to the Office of Student Conduct. For additional information about WSU’s academic integrity policy/procedures, please contact (360) 546 9573.

WSUV Reasonable Accomodation Statement

Accommodations may be available if you need them in order to fully participate in this class because of a disability. Accommodations may take some time to implement so it is critical that you contact Disability Services as soon as possible. All accommodations must be approved through Disability Services, located in the Student Resource Center on the Lower Level of Student Services Center (360) 546-9138.

Emergency Notification System

“WSU has made an emergency notification system available for faculty, students, and staff. Please register at ZZUSIS with emergency contact information (cell, email, text, etc.). You may have been prompted to complete emergency contact information when registering for classes at ROnet. In the event of a building evacuation, a map at each classroom entrance shows the evacuation point for each building. Please refer to it.

Finally, in case of class cancellation campus-wide, please check local media, the WSU Vancouver web page and/or <http://www.flashalert.net/>. Individual class cancellations may be made at the discretion of the instructor. Each individual is expected to make the best decision for his or her personal circumstances, taking safety into account. Please refer to the WSU Vancouver safety plan website for more information (<http://www.vancouver.wsu.edu/safety-plan>).

Week to week Course Outline

The tentative weekly schedule is listed below.

ECE 576 Weekly Schedule

Week	Lectures		HW Due Dates
	Date	Topic	
1	TBD	Sensors: Introduction	
	TBD	Sensors and Actuators, Difference	
2	TBD	Classification of Sensors	HW 1
	TBD	Physical Sensor Principles	
3	TBD	Sensor Characteristics	
	TBD	Figures of Merit and Comparison	HW 2
4	TBD	Transduction Platforms	
	TBD	Sensor Miniaturization Techniques	
5	TBD	Microfabrication	
	TBD	Microfabrication	HW 3
6	TBD	Nanofabrication	
	TBD	Nanofabrication	
7	TBD	Review for exam	
	TBD	Mid-Term	
8	TBD	Sensor Manufacturing Techniques	
	TBD	Interfacing Methods and Circuits	HW 4
9	TBD	Data Acquisition	
	TBD	Interfacing to Microprocessors	
10	TBD	Interfacing to Microprocessors	Term Paper
	TBD	Case Study: Pressure Sensor	
11	TBD	Case Study: Pressure Sensor	
	TBD	Case Study: Pressure Sensor	HW 5
12	TBD	Case Study: Gas Sensor	
	TBD	Case Study: Gas Sensor	
13	TBD	Thanksgiving Break	
	TBD		

14	TBD	Case Study: Temperature Sensor	
	TBD	Case Study: Biosensor	HW 6
15	TBD	Case Study: Biosensor	
	TBD	Review for final exam	
16	TBA	Finals (Closed Book)	

ECE 576 Lab Schedule

Week	Date	Topics	Lab Report Due Dates
1	TBD	Introduction to NI LabView	
2	TBD	Read Microphone Data	Lab 1
3	TBD	Analyze Microphone Data	Lab 2
4	TBD	Read Temperature Data	Lab 3
5	TBD	Build a Sensor Control Program	Lab 4
6	TBD	EKG Sensor	Lab 5
7	TBD	Blood Pressure Sensor	Lab 6
8	TBD	Strain Gage Measurements	Lab 7
9	TBD	Gas Sensor	Lab 8
10	TBD	pH sensor	Lab 9
11	TBD	UV Sensor	Lab 10
12	TBD	Light Sensor	Lab 11
13	TBD	Thanksgiving break	
14	TBD	Salinity Sensor	Lab 12
15	TBD	Force Sensor	Lab 13

Important Dates and Deadlines

Students are encouraged to refer to the academic calendar often to be aware of critical deadlines throughout the semester. The academic calendar can be found at www.registrar.wsu.edu/Registrar/Apps/AcadCal.ASPX. Questions regarding the academic calendar can be directed to the Office of Student Affairs in VSSC 100 or call 360-546-9559.