FIU | FLORIDA INTERNATIONAL UNIVERSITY

Course Syllabus
EEE 4393C Wearable Electronics
Fall 2022

PROFESSOR INFORMATION

Instructor: Prof. Vladimir Pozdin
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Office Hours: *To be determined*
or by appointment
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COURSE DESCRIPTION AND PURPOSE

The growth of consumer electronics has led to the rise of application-specific devices, which rely on novel materials and sensors. This course will first examine the fundamental electronic transport properties of inorganic and organic materials. The second part of the course will explore the design of electronic devices and the role of material selection on functionality, processing, and flexibility. The third part of the course will focus on the design of sensing platforms for wearable electronics, including sensors, circuitry, data processing and communication. Emphasis will be given to wearable health monitoring systems to demonstrate the rational for the growth potential and future directions in the field.

COURSE OBJECTIVES

This course will prepare students to design new devices for the growing wearable consumer electronics market. Upon the completion of the course, students should be able to describe electronic transport in inorganic semiconductors, organic semiconductors, and low-dimensionality carbon allotropes. Students should be able to describe the design criteria for biopotential sensors, LEDs, optical detectors, motion sensors and bioanalytical sensors. Students should be able to identify the proper sensors and fabrication methods for a sensing system given physiological parameters of interest. After completion of the course, the students should be familiar with the design criteria for wearable electronics and be able to critically evaluate sensing platforms.

ABET RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. an ability to communicate effectively with a range of audiences

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

COURSE PREREQUISITES

EEE 3110C or instructor permission. Familiarity with general biology and chemistry.

TEXTBOOK

Textbook
None

Research articles on groundbreaking and latest innovation in the wearable electronics will be assigned weekly and discussed during lectures.

Additional resources:

- "*Handbook of Flexible Organic Electronics: materials, Manufacturing and Applications*" Stergios Logothetidis.
- "*Medical Instrumentation: Application and Design, 5th Edition"* John G. Wester, Amit J. Nimunkar (2020).

GRADING

Letter	Range (%)	Letter	Range (%)	Letter	Range (%)
A	95 or above	B	83 - 86	C	70 - 76
A-	90 - 94	B-	80 - 82	D	60 - 69
B+	87 - 89	C+	77 - 79	F	59 or less

Grade components:

Class discussions	20%
Article reviews	30%
Project	25%
Exams	25%

Class discussions:

Participation in classroom discussion and asking questions about the points that are not clear is important for learning the materials. Students are expected to have completed assigned readings and be ready to discuss the material and share their own insights into the course topics.

Article reviews:

Journal articles on groundbreaking and current research will be assigned for weekly reading. Article critiques are due before the beginning of class and should follow the format posted on Canvas. **Unexcused late submission will not be accepted**; a grade of 0 points will be recorded.

Project:

Students will be tasked with designing a sensing platform or developing a detection algorithm based on an assigned topic. Grade for the project consists of an oral presentation at the end of the course and a written report.

Final exam:

Final exam will be cumulative.

Makeup policy:

All students are expected to attend class meeting in person or through Zoom at the time described in this syllabus. Each student is responsible for all assignments, announcements, and material covered in each class. If excused absences fall on a day that an assignment is due, the assignment may be turned in **prior** to the due date. Missed assignments due to an excused absence must be turned in before the next class. For extended excused absence, student will have 1 week to turn in missed assignments.

SCHEDULE*

Course meeting time: 14:00 – 15:05

Course meeting days: Wednesdays and Fridays

Week	Course Topics	Assignment due
Aug. 24	Introduction and objectives	
Aug. 26	Review of inorganic semiconductors	
Aug. 31	Charge transport in inorganic semiconductors	
Sept. 2	Crystal structure and inorganic devices	*Hoffman and Heeger papers*
Sept. 7	Charge transport in polymers 1	
Sept. 9	Charge transport in polymers 2	
Sept. 14	Charge transport in polymers and doping 1	Flexible silicon ribbons
Sept. 16	Charge transport in polymers and doping 2	
Sept. 21	Flexible semiconducting materials	
Sept. 23	Light emitting diodes	
Sept. 28	Photodetectors	Pulse Oximetry paper
Sept. 30	Optical techniques for wearable devices	
Oct. 5	Practical consideration for wearable electronics	
Oct. 7	Strain gauges	Dickey/PEDOT traces
Oct. 12	Liquid metals and conducting polymers	
Oct. 14	Motion and feedback sensors	
Oct. 19	Temperature measurements	Wearable temperature
Oct. 21	Electrochemical sensors 1	
Oct. 26	Electrochemical sensors 2	**Midterm Exam**
Oct. 28	Wearable system design	*Electrochemical sensor*
Nov. 2	Power management	
Nov. 4	*Guest Lecture: Optical System Design*	
Nov. 9	Biopotential measurements	PEDOT brain implants
Nov. 11	**Veterans Day**	
Nov. 16	Sensor fabrication techniques	
Nov. 18	Hybrid flex and beyond	Transfer printing
Nov. 23	*Lab Activity - OLEDs*	
Nov. 30	Wearable device packaging and evaluation	Peer-review
Dec. 1	Project presentations	
Dec. 9	**Cumulative Final**	

** due to the dynamic weather and other conditions this syllabus may change and changes will be posted on Canvas.*

Announcements regarding class interruptions or changes will be posted on Canvas. Based on individual Canvas settings, notifications may not be sent out, but students will be responsible for all posted material.

TECHNOLOGY ACCOMODATIONS

If students have difficulties meeting the minimum requirements for software or course delivery platform, please contact the instructor at soon as possible to find a solution.

POLICIES

Students are required to have an FIU Onecard. This card must be presented to the professor and/or proctors for face-to-face exams, Honorlock exam, and/or oral exam on Zoom. You will not be allowed to take an exam without confirming your identity with an FIU Onecard and will receive a 0 (zero) for that exam. If you do not have an FIU Onecard, prior arrangements need to be made with the instructor at least 48 hours before the exam.

Please review the FIU's Policies webpage. The policies webpage contains essential information regarding guidelines relevant to all courses at FIU, as well as additional information about acceptable etiquette for courses.

i. **Please check your FIU email account and your Canvas course at least once a day.** Email and Canvas are the official ways for the university, and your professors, to contact you.
ii. If you are experiencing symptoms and/or have tested positive for COVID-19, **please *do not come to class, immediately notify the COVID Response Team and contact me by email as soon as you can.*** If directed to stay home that email notification will serve as your excused absence when you forward it to me. The make-up policies are outlined in this syllabus.
iii. FIU is following current CDC Guidance. Please refer to the link where you can access their most current information.
iv. Please take every precaution to keep yourself and others healthy. Per CDC guidelines, you are encouraged to get vaccinated and strongly advised to wear a mask indoors and in public including all FIU facilities.
v. Missing excessive days may lead to failing a class or a grade of incomplete.
vi. For me to assist you in achieving your goals, it is important for you to contact me as soon as you experience any events that might disrupt your course participation. For up-to-date information about COVID-19, please see the fiu.edu FAQs.
vii. Please be advised that classes may be audio and visually recorded and/or subject to course capture for future access by students in this course. Your attendance/participation in this course constitutes consent to such recordings, which will only be used for educational purposes by students in the course and securely stored in University systems. If there is a concern regarding the recording and use of such recording, please contact FERPA@fiu.edu.

FIU CORE Values: Responsibility, Truth, Freedom, Respect & Excellence

• All students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the core values.

• All students should understand that if they are found responsible for academic misconduct, they will be subject to the FIU Academic Misconduct Policies & Procedures. The FIU Academic Integrity home page provides information on the informal and formal resolution process. The Informal Resolution Form is available for completion online.

The instructor abides and endorses the university's policy on academic integrity. Any form of academic misconduct is considered a **serious** offense. Should you have academic or personal problems that are getting in the way of your academic success, please contact your instructor.

FIU's Policy for academic misconduct includes these definitions for these intentional acts or omissions:

Cheating: The unauthorized use of books, notes, aids, electronic sources; or unauthorized use of on-line exams, library materials or assistance from another person with respect to examinations, course assignments, field service reports, class recitations; or the unauthorized possession of examination papers (or on-line examination) or course materials, whether originally authorized or not. Any student helping another cheat may be found guilty of academic misconduct.

Plagiarism: The deliberate use and appropriation of another's work without any indication of the source and the representation of such work as the student's own. Any student, who fails to give credit for ideas, expressions or materials taken from another source, including internet sources, is guilty of plagiarism. Any student helping another to plagiarize may be found guilty of academic misconduct.

Self-Plagiarism: This is using your own work for another assignment without providing a citation indicating that this work was previously used. When **citing yourself**, use cite in-text citations to identify yourself as the author.

Misrepresentation: Intentionally lying to a member of the faculty, staff, administration, or an outside agency to gain academic advantage for oneself or another, or to misrepresent or in other ways interfere with the investigation of a charge of academic misconduct.

Misuse of Computer Services: The unauthorized use of any computer, computer resource or computer project number, or the alteration or destruction of computerized information or files or unauthorized appropriation of another's program(s).

Bribery: The offering of money or any item or service to a member of the faculty, staff, administration or any other person in order to commit academic misconduct.

Conspiracy and Collusion: The planning or acting with one or more fellow students, any member of the faculty, staff or administration, or any other person to commit any form of academic misconduct together.

Falsification of Records: The tampering with, or altering in any way any academic record used or maintained by the University.

Academic Dishonesty: In general, by any act or omission not specifically mentioned above and which is outside the customary scope of preparing and completing academic assignments and/or contrary to the above stated policies concerning academic integrity.

ACCESSIBILITY AND ACCOMMODATIONS

The Disability Resource Center collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The DRC provides FIU students with disabilities the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact the Center at 305-348-3532 or visit them at the Graham Center GC 190.

Please visit our ADA Compliance webpage for information about accessibility involving the tools used in this course. For additional assistance please contact FIU's Disability Resource Center.

FIU PANTHERS CARES AND CAPS SERVICES

If you are looking for help for yourself or a fellow classmate, Panthers Care encourages you to express any concerns you may come across as it relates to any personal behavior concerns or worries you, for the classmate's well-being or yours; you are encouraged to share your concerns with FIU's Panthers Care website: http://PanthersCare.fiu.edu/.

Counseling and Psychological Services (CAPS) offers free and confidential help for anxiety, depression, stress, and other concerns that life brings. Learn more about CAPS at caps.fiu.edu. Professional counselors are available for same-day appointments. Don't wait to call 305-348-2277 to set up a time to talk or visit the online self-help portal.

INCOMPLETE GRADES

To qualify for an *Incomplete*, a student must:

1) Contact (e.g., phone, e-mail, Canvas, etc.) the instructor before or during missed portion of the class
2) Be passing the course prior to the part of the course that is not completed
3) Make up the incomplete work through the instructor of the course
4) Meet the instructor to complete the missing coursework. All missed work must be completed before the last two (2) weeks of the following term.

[1] Updated 09/15/2022