



## **ECE 4320/6320: Instrumentation**

Section 001

Spring 2023

MEETING TIME: 2.00 pm – 3.15 pm (TTh)

INSTRUCTOR(s): Goutam Koley; Email: [gkoley@clemson.edu](mailto:gkoley@clemson.edu); Office: C104 Duke Energy Building

OFFICE HOURS AND PROCEDURES: Monday; 2 – 3 pm and by appointment; zoom preferred.

COURSE MODALITY: In person

COURSE DESCRIPTION: Theory and analysis of transducers and related circuits and instrumentation. Generalized configurations and performance characteristics of instruments are considered. Transducer devices for measuring physical parameters such as motion, force, torque, pressure, flow, and temperature are discussed. Preq: ECE 3210 with a C or better.

COURSE PREREQUISITES: Preq: ECE 3210 with a C or better. Preq or concurrent enrollment: MATH 3110 or MATH 4340, each with a C or better

STUDENT LEARNING OUTCOMES: At the completion of the course, students should be able to: (i) understand and interpret mathematical description of sensors and transducers, (ii) understand fundamental guiding principles for designing chemical, physical, and biological sensors, and (iii) understand and utilize basic design principles for micro and nanoscale sensors for various applications including Internet of Things (IoT).

REQUIRED MATERIALS: Required Textbook: No fixed textbook, materials mostly based on research papers and the references given below.

References:

- Handbook of Modern Sensors: Jacob Fraden, Fourth Edition, Springer. ISBN: 978-1-4419-6465-6

Additionally, students are required to have a laptop computer, internet connectivity capable of transmitting and receiving video, a video camera, a microphone, and a cell phone.

TOPICAL OUTLINE:

- Fundamentals of sensors/transducers and sensing methodologies (1.5 weeks)
- Physical sensors (flow, pressure, temperature, strain, charge, electric and magnetic field, humidity) (4 weeks)
- Chemical sensors (toxic gases and vapors, explosives, etc.) (3 weeks)
- Biomedical sensors (including glucose, pH, blood oxygen, and other physiological parameters) (2 weeks)
- Micro and nanoscale sensors (including sensors based on nanowires, nanotubes, graphene, and micro/nanoelectromechanical systems) (2 weeks)
- Sensors for IoT applications (1.5 weeks)

CLASS CANCELLATION POLICY: Class is cancelled if the instructor is more than 15 minutes late to class.

#### GRADING POLICY:

Graduate students: G and Undergraduate students: UG

Assignments (3):	15%
Quizzes:	10% (UG: Best 2 of 4 will be considered; G: All 4 will be considered)
Midterm:	25%
Final exam:	25%
Project:	25% (UG: Project report 5 pages; G: Project report 10 pages)

Grading scale (UG):

A: [90-100]	B: [80-89]	C: [70-79]	D: [60-69]	F: [0-59]
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Grading scale (G)

A: [90-100]	B: [80-89]	C: [70-79]	F: [0-69]
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#### ATTENDANCE POLICY:

Lectures, quizzes and exams (both Midterm and Final), will be scheduled and conducted ONLY during the published meeting times. Regular attendance and participation in the class is strongly encouraged. If you cannot attend the class for some reason please notify me in advance by email. In case of inclement weather, all exams and due materials will be postponed till the next class.

ACCESSIBILITY STATEMENT: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing [studentaccess@lists.clemson.edu](mailto:studentaccess@lists.clemson.edu). Students who receive Academic Access Letters are strongly encouraged to request, obtain, and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: <http://www.clemson.edu/campus-life/campus-services/sds/>.

TITLE IX STATEMENT: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. The University is committed to combatting sexual harassment and sexual violence. As a result, you should know that University faculty and staff members who work directly with students are required to report any instances of sexual harassment and sexual violence, to the University's Title IX Coordinator. What this means is that as your professor, I am required to report any incidents of sexual harassment, sexual violence or misconduct, stalking, domestic and/or relationship violence that are directly reported to me, or of which I am somehow made aware. There are two important exceptions to this requirement about which you should be aware:

Confidential Resources and facilitators of sexual awareness programs such as "Take Back the Night and Aspire to be Well" when acting in those capacities, are not required to report incidents of sexual discrimination.

Another important exception to the reporting requirement exists for academic work. Disclosures about sexual harassment, sexual violence, stalking, domestic and/or relationship violence that are shared as part of an academic project, a research project, classroom discussion, or course assignment, are not required to be disclosed to the University's Title IX Coordinator.

This policy is located at <http://www.clemson.edu/campus-life/campus-services/access/title-ix/>. Ms. Alesia Smith is the Executive Director for Equity Compliance and the Title IX Coordinator. Her office is located at 223 Holtzendorff Hall, phone number is 864.656.3181, and email address is [alesias@clemson.edu](mailto:alesias@clemson.edu)

USE OF ANIMALS/HUMAN SUBJECTS: [See <http://www.clemson.edu/research/compliance/iacuc> or <http://www.clemson.edu/research/compliance/irb/> if applicable. Omit otherwise.]

SAFE CAMPUS: Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

- a. Ensure you are signed up for emergency alerts (<https://www.getrave.com/login/clemson>)
- b. Download the Rave Guardian app to your phone (<https://www.clemson.edu/cusafety/cupd/rave-guardian/>)
- c. Learn what you can do to prepare yourself in the event of an active threat (<http://www.clemson.edu/cusafety/EmergencyManagement/>)

ACADEMIC INTEGRITY: As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity. Further information on Academic Integrity can be found in the [Undergraduate Announcements](#) and in the [Graduate School Policy Handbook](#).

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MODIFICATION STATEMENT: Instructor reserves the right to modify any aspect of the syllabus at any time during the semester for reasons including but not limited to COVID-related situations.