



# **ECE 4990: CI: Radio frequency analysis and control of biological cells Spring 2022**

**MEETING TIME:** Ad-Hoc

**MEETING LOCATION:** Ad-Hoc

**INSTRUCTOR(s):** Dr. Pingshan Wang; Fluor Daniel 301; pwang@clemson.edu; 864-656-2117

**OFFICE HOURS AND PROCEDURES:** 1 hour/week. Additional office hours must be arranged via email.

**COURSE MODALITY:** in person.

**COURSE DESCRIPTION:** Radio frequency (RF) techniques have been a technology foundation for our daily life, from cellular phone to home protection gadgets. The well-developed techniques are also promising to provide new methods for noninvasive and label-free analysis of microorganisms as well as noncontact manipulation and control of biological cells, thus, open the door for many applications. Additionally, potential RF health effects, beneficial or detrimental, are controversial or unknown. This CI is dedicated to open RF-cell interactions to all levels of undergraduate students in relevant fields of science and engineering. Through this CI, we explore how an RF system is constructed for single cell studies, what RF and microfluidic instruments and components are needed, what data analytics are used for data analysis, how to optimize or improve them. The students can choose to focus on one of the topics: (1) RF measurement of single cells, (2) machine learning for cell species and physiological state determination, (3) microfluidic techniques for cell sorting and transport, and (4) nonthermal RF effects on cell physiology. This CI is intended to introduce undergraduate students to an interdisciplinary field early in their undergraduate experience. Skills and knowledge gained through hands on activities, research, and trainings will prepare students for undergraduate research, and provide skills to help students stand out and succeed in graduate school.

**COURSE PREREQUISITES:** None.

## **STUDENT LEARNING OUTCOMES (for 2-semester):**

- Learn about basic RF concepts, microfluidic devices, and RF measurement instruments
  - The instructors will provide a few introductory lectures and some electronic reading materials
  - Students will conduct their own reading, hands-on learning, and research on different aspects of system design and operation
  - Students will write a 1-page report on their finding and identify focus topics (report 1).
- Learn about RF-cell interactions:
  - Students will conduct their own research on their chosen topic. The students will perform literature review, prepare measurement system or identify machine learning resources, prepare biological/particle samples, conduct experiment and collect experimental data, which includes details of the RF system.

- The students will write 1-page reports on their efforts and results (reports 2 and 3)
- Learn about data processing
  - Students will process and analyze their obtained data. When needed, the students will reproduce or add additional data.
  - The students will write a 1-page report on their efforts and results (report 4)
- Learn about technical writing for professional conferences and/or journals
  - The students will work with the instructors to prepare manuscripts for submission to professional conferences and/or journals to disseminate the research finds (report 5)
- Students will write final summary report over what they learned and its potential impacts on their careers and society (report 6)

**REQUIRED MATERIALS:** Textbook: None.

**CLASS CANCELLATION POLICY:** Class is cancelled if the instructor is more than 15 minutes late to class and there is no email message or Canvas post explaining otherwise.

**COURSE MANAGEMENT SYSTEM:** Canvas will be used to make class announcements, turn in assignments, and provide students access to additional course materials (e.g., PowerPoint slides, assignments, gradebook, papers discussed).

**GRADING POLICY:** Scale. A: [90%, 100%]; B: [80%, 90%]; C: [70%, 80%]; D: [60%, 70%]; F: [0%, 60%]

Report 1:	10%
Report 2-4:	20%
	× 3
Report 5	25%
End of Year Summary:	5%

*Note: discuss with the instructors for semester grading details.*

**LATE ASSIGNMENTS:** Late assignments will have 1 letter grade deducted for each day that they are late. Examples of excused absences include a death in the immediate family or personal conditions requiring hospitalization or emergency treatment. Personal illnesses such as colds, general fatigue, or general sickness are not typically excused. If you are unsure if your situation will be excused, contact the professor in a professional manner prior to or as soon as possible after the missed assignment.

**EMAIL POLICY:** To receive a response, emails must be sent from your Clemson University email address to the professor's @clemson.edu email and must include the course number in the subject line. The professor will respond within 24-hours during weekdays unless on travel.

**ATTENDANCE POLICY:**

The students are expected to manage their own time schedules as long as they are compliant with university policies. For group activities, they students are required to attend on time.

1. Please note that the University may convert to a purely online mode at any time.

**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.

**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](#).

**COPYRIGHT STATEMENT:** Materials in this course are copyrighted. They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Students should be reminded to

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**MODIFICATION STATEMENT:** The professor 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.