

# ECE 398R1

## *Fields and Waves* **Virtual Reality Laboratory**

PROF. RALUCA ILIE

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*Time: Wednesdays 2:00 pm - 2:50 pm (R11), 3:00 pm - 3:50 pm (R12), 4:00 pm - 4:50 pm (R15)*

*Place: 3014 ECEB*

✉ rilie@illinois.edu

### Course Description

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This course is designed to be taken concurrently with ECE 329 “Fields and Waves I” (or PHY 212 “University Physics: Electricity Magnetism”) to strengthen the student’s understanding of the concepts in electromagnetism and their applications through customized Virtual Reality (VR) experiences. Topics include static and quasi-static electric fields, polarization, static and quasi-static magnetic fields, dynamic fields and Maxwell’s equations, wave solutions of Maxwell’s equations in free space, and homogeneous media.

Student competencies around conceptual understanding of electromagnetism topics, as well as their understanding of mathematical concepts, will be measured via formative and summative assessments. Each lab period includes a multiple-choice test. Questions are designed to primarily measure conceptual understanding of the various topics, rather than measuring the ability to simply manipulate equations, and are tied to the specific contexts and topics of that lab’s instruction.

### Prerequisites

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Concurrent enrollment in ECE 329 or in PHY 212.

### Main References

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The lab’s instruction is aligned with that of ECE 329 and PHY 212.

### Laboratory Equipment

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Students enrolled in ECE 398 will be granted 24/7 access to the **ECE VR Lab located in ECEB 3014**. The VR Lab consists of 10 stations equipped with gaming-grade GPUs and Oculus Rift S headsets. All stations have Unity installed. During the instruction lab period, students will complete a quiz of the type described above while allowed to go back to the VR experience for guidance.

## Schedule

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Date	Topic of Instruction
01/17/2024	(a) <b>VR:</b> Oculus Headset Tutorial (b) <b>VR:</b> Coulomb's Law
01/24/2024	(a) <b>VR:</b> Gauss' Law (b) <b>VR:</b> Vector Calculus ( $\nabla \times \mathbf{A}, \nabla \cdot \mathbf{A}, \nabla f$ )
01/31/2024	(a) <b>VR:</b> Electrostatic Potential (b) <b>MD:</b> Conservative Fields, Path Independence <b>Final Project - team forming and discussion</b>
02/07/2024	(a) <b>VR:</b> Polarization Electric Field (b) <b>VR:</b> Fields in Media, Capacitance
02/14/2024	(a) <b>VR:</b> Ampere's Law (b) <b>VR:</b> Current Sheet, Solenoid, Current Loops (c) <b>VR:</b> Earth's Magnetic Field
02/21/2024	(a) <b>VR:</b> Faraday's Law (b) <b>VR:</b> Lentz's Law (c) <b>VR:</b> Motional EMF
02/28/2024	(a) <b>VR:</b> TEM Wave Propagation (b) <b>MD:</b> Current Sheet Radiator
03/06/2024	<b>Review of Maxwell's equations:</b> Imagine the narrative (in-class exercise).
03/20/2024	(a) <b>VR:</b> Wave Polarization
03/27/2024	<b>Final Project - Office Hours</b>
04/03/2024	(a) <b>MD:</b> Wave Reflection and Transmission (b) <b>MD:</b> Standing Waves (c) <b>VR:</b> Bounce Diagram: single and multi-lines
04/10/2024	<b>Lab Make Up</b> <i>Sign up required</i>
04/24/2024	<b>Final Project Presentations</b>

Table 1: MD = Mathematica Demo, VR = Virtual Reality experiences

Note: New VR experiences (in addition to the ones listed here), are currently under development, and we anticipate to use them as they become available.

## Grading Policy

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**In class quizzes (70%), Final Project (30%)**

**Extra Credit: After-class Survey (5%)**

### In Class Quizzes

- Each lab session is followed by an in-class quiz (10 quizzes in total). These quizzes are testing conceptual understanding and will be administered via Gradescope during class time.
- You are allowed to work with your lab partner, but the work you submit should belong to you.
- You are allowed to go back into the VR experiment to play and work out your answer.
- Note that if you have knowledge of a violation of the Honor Code, you are obligated to report it. By submitting this quiz, you are agreeing to the Honor Code: “I have neither given nor received unauthorized aid on this examination nor have I concealed any violations of the Honor Code.”

### Final Project Information

#### SCOPE

- Devise an experiment that demonstrates one (or more) of Maxwell’s equations. The experiment could use hardware, software, theoretical tools, or a combination of all of the above.

#### TEAMS

- Students will work in teams of two or three students.

#### EVALUATION

- Each team will have an oral presentation of their projects.
- Each team will submit a write-up of their project; the page limit is 10. A template will be provided to you and you are **required** to use it. The written portion of the project should be submitted via Gradescope no later than **April 23rd, 2024 at midnight**.
- You will be evaluated on creativity (40 points), oral presentation (30 points), and written presentation (30 points). Late written reports will be penalized 10% of the grade per day from the due date.

### Extra Credit: After-class Survey

We need your feedback to improve the development of the VR labs; therefore, you will be invited to complete an anonymous survey after the class is completed. To receive the extra credit, you will need to save the confirmation emails and submit the top portion as a document via Gradescope. You will be instructed on how to proceed in class.

## Class Philosophy

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- Research has demonstrated that the best learning occurs when the learner is actively involved. Thus the students are expected to come to class prepared to **think, participate in active learning activities, and learn.**

## Class Policy

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- The classroom is a learning environment. Please avoid distractions for yourself and others.
- Please turn off your cell phone during class. Do not keep your cell phone on your desk. NO TEXTING during class.

## **Academic Integrity**

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The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <https://studentcode.illinois.edu/article1/part4/1-401/>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

## **COVID Safety**

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Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community.

Students who feel ill must not come to class. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class.

Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non-compliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.

## **Students with Disabilities**

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To ensure equity for each student's educational experience, those with a documented disability and required accommodations should contact me early in the semester so that all learning needs may be appropriately met. If you have not yet contacted DRES, please do so as soon as possible.

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or go to <https://www.disability.illinois.edu>. If you are concerned you have a disability-related condition that is impacting your academic progress; there are academic screening appointments available that can help diagnose a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

## **Anti-Racism and Inclusivity Statement**

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This classroom is a place where you will be treated with respect. I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, national origins, religious affiliations, sexual orientations, abilities - and other

visible or non-visible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class.

The intent is to raise student and instructor awareness of the ongoing threat of bias and racism and of the need to take personal responsibility for creating an inclusive learning environment. The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity, national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://bart.illinois.edu/>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

## **Sexual Misconduct Reporting Obligation**

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The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality can be found here: <https://wecare.illinois.edu/resources/students/confidential>. Other information about resources and reporting is available here: <https://wecare.illinois.edu>.

## **Religious Observances**

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Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.

## **Family Educational Rights and Privacy Act (FERPA)**

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Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act

(FERPA) should self-identify with the instructor to ensure the protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.