Physics 413: “Electricity and Magnetism”
(CRN 24555)
Pre-requisite: PHYS 412

Teaching Team

The preferred method of communication is through Canvas. If you must email us, please put [PHYS413] in the subject line.

Instructor:
Prof. Tien-Tien Yu (she/her): please call me “Prof. Yu” or “Dr. Yu” tientien@uoregon.edu
Office Hours: Mondays 4-5pm on Zoom
GTF Contact Information and Office Hours:
Haidar Esseili, hesseili@uoregon.edu
Tutorial session: TBD

Logistics

When: MWF 11:00am - 11:50am on Zoom: https://uoregon.zoom.us/j/93827214211?pwd=MUVRU3ZKSjRndjQ1WHlBazYvWFhkQT09
We will also utilize chat-based discussions on Canvas. Note that the lectures will be recorded and uploaded onto Canvas.


Course Platform:
All course communication will be done through Canvas. Here, you may also view announcements, course materials including the recorded lectures, homework assignments, and grades. Canvas has a handy chat function that we will use in this course. We will use Canvas for submitting coursework.

Equipment Required:
Each student is required to have their own computer to access the course materials. We will be using Canvas to communicate, to which you should be automatically enrolled. UO has a limited number of loaner laptops and webcams available; you can find more information about this program at https://remote.uoregon.edu/students.
Overview:
This course is the second term of a three-term sequence of classical electromagnetism. You will use the tools of vector calculus to solve for the static and dynamic properties of electromagnetic fields. PHYS 413 includes time-independent current distributions (magnetostatics), magnetic properties of matter, and initial coverage of fully time-dependent problems (Maxwell's equations, continued in PHYS 422).

Course Objectives

This course is a mixture of different topics in physics. The unifying theme is the first principles approach we take to solving problems.

- Interpret what equations mean to describe physical phenomena. It will not be necessary to memorize any equations, but you will need to know how and when to use equations to answer questions about nature.

- Explain how to solve problems to peers by motivating the process, describing the steps, and identifying pitfalls. (Or: I don't care if you have a correct answer, I care if you can clearly explain a correct method.) You will know that you understand something when you can teach your peers how to solve problems.

These two principle emphasize a type of learning that will carry over to your upper division courses and your careers. We don't need to memorize details---the real world has Google and Wikipedia. Being able to communicate technical ideas, on the other hand, is a critical part of nearly every modern profession.

The physics learning objectives of this course:

- Students will be able to:
  - Compute the force on a particle moving in a magnetic field
  - Apply the fundamental theorem for divergences in specific situations
  - Apply the fundamental theorem for curls in specific situations
  - Apply Biot-Savart Law and superposition to calculate the magnetic field due to a specific current configuration
  - Apply Ampère’s Law to compute the magnetic field due to a symmetric current configuration
  - Calculate the magnetic field from a vector potential
  - Use the appropriate boundary conditions to calculate the vector potential from a localized current distribution
• Use multipole expansion to determine the leading contribution to the vector potential at
distances far from a current distribution
• Understand the difference between paramagnetism, ferromagnetism, and diamagnetism
• Use bound currents to calculate the field of a magnetized object
• Articulate the difference between linear and nonlinear media
• Understand and apply both Ohm’s Law and Faraday’s Law
• Interpret Maxwell’s Equations for magnetostatics
• Articulate the conservation laws of electrodynamics and interpret their significance

The primary **personal development objectives** of this course:

• Increase your puzzle-solving skills and “working memory”.

• Learn to extract deep insights through deep contemplation of seemingly mundane
  things, like simple machines or the positions and movement of everyday objects.

• Develop a tolerance for being confused and confronted with a seemingly intractable problem.
  Learn to be excited by this instead of intimidated.

• Learn to work effectively in diverse groups.

• Become part of the community of other physicists and scientists at the UO.

• Learn about research being done in the department.

• Learn about what it is like to be a professional scientist.

**How will you be graded?**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework (due Wednesdays)</td>
<td>35%</td>
</tr>
<tr>
<td>Video explainer 1:</td>
<td>25%</td>
</tr>
<tr>
<td>Video explainer 2:</td>
<td>25%</td>
</tr>
<tr>
<td>Peer review of videos:</td>
<td>10%</td>
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<tr>
<td>Discussion Board participation:</td>
<td>5%</td>
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</tbody>
</table>

**Final Grade:**

- A 90% to 100%
- B 80% to 90%
- C 70% to 80%
- D 60% to 70%
- F lower than 60%

**Campus resources to support your learning:**

**Instructional Accommodations:** The Accessible Education Center ([http://aec.uoregon.edu](http://aec.uoregon.edu)) exists to help students achieve access to educational resources. If there are aspects of the instruction or design of this course that result in barriers to your participation, please contact me *as soon as possible* so we may discuss your situation.
Counseling Center: Call anytime to speak with a therapist who can provide support and connect you with resources. Located on the 2nd Floor of the Health Center (541) 346-3227.

Policies:

Course load: Per UO policy, 1 credit hour is approximately 30 real hours of student work, both in and out of class. This is a 4-credit course, which corresponds to about 120 hours over the fall term or 12 hours per week that you spend on lecture + discussion, reading course materials, asking questions, preparing your videos, and completing your homework problem sets. This number will vary from student-to-student, and week-by-week. However, if you find yourself spending significantly more time than this on the course, please contact the instructor.

Inclusivity: Open inquiry, freedom of expression, and respect for difference are fundamental to a comprehensive and dynamic education. We are committed to upholding these ideals by encouraging the exploration, engagement, and expression of divergent perspectives and diverse identities.

Don’t be a jerk: This course requires students to share work with one another; therefore, we must treat each other with respect in our constructive criticism and we will not share each others’ work without explicit and written permission. Bullying and trolling will not be tolerated by anyone in this course; the teaching staff reserves the right to punish misbehavior with zero credit on assignments or failure in the course.

Academic Integrity: All students are expected to complete assignments in a manner consistent with academic integrity. Academic dishonesty devalues the reputation of our institution, its faculty, its students, and the degrees we offer. Moreover, academic misconduct is particularly unfair for the students who do their work with integrity and honor. Students can find more complete information about the University of Oregon’s Policy on Academic Dishonesty in the University of Oregon Student Handbook. Suspected academic dishonesty will be reported.

Homework: late homework will not be accepted. Your lowest homework score will be dropped. If you are stuck on the homework:
1. Discuss with your classmates and/or ask a question on the discussion board.
2. If you and your colleagues are confused, contact the TA.
3. If you are all confused (or there's potentially an error on the homework), contact the instructor.

**Important Dates:** ([academic calendar](#))

- **Jan 9**  
  Last day to drop without a "W"
- **Jan 11**  
  Last day to add a class
- **Feb 21**  
  Last day to withdraw (drop with a "W") or change grading option to P/N
# Physics 413 - Tentative Course Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>M</th>
<th>W</th>
<th>F</th>
<th>Lecture - Griffiths</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 4</td>
<td>Jan 6</td>
<td>Jan 8</td>
<td>5.1, 5.1-5.2</td>
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<tr>
<td>2</td>
<td>Jan 11</td>
<td>Jan 13</td>
<td>Jan 15</td>
<td>5.3, cont.</td>
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<tr>
<td></td>
<td>Jan 18</td>
<td>Jan 20</td>
<td>Jan 22</td>
<td>5.4, cont.</td>
</tr>
<tr>
<td>3</td>
<td>Jan 25</td>
<td>Jan 30</td>
<td>Jan 1</td>
<td>MLK Holiday</td>
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<tr>
<td>4</td>
<td>Feb 1</td>
<td>Feb 3</td>
<td>Feb 5</td>
<td>6.1, 6.1-6.2 [Video #1 Due]</td>
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<tr>
<td>5</td>
<td>Feb 8</td>
<td>Feb 10</td>
<td>Feb 12</td>
<td>6.3-6.4 [HW #4 Due]</td>
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<tr>
<td>6</td>
<td>Feb 15</td>
<td>Feb 17</td>
<td>Feb 19</td>
<td>6.1-6.2 [Video #2 Due]</td>
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<td>Feb 22</td>
<td>Feb 24</td>
<td>Feb 26</td>
<td>7.1, 7.1-7.2</td>
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<tr>
<td>8</td>
<td>Mar 1</td>
<td>Mar 3</td>
<td>Mar 5</td>
<td>7.3, cont.</td>
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<tr>
<td>9</td>
<td>Mar 8</td>
<td>Mar 10</td>
<td>Mar 12</td>
<td>8.2, 8.3 [HW #7 Due]</td>
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<tr>
<td>10</td>
<td>Mar 15</td>
<td>Mar 18</td>
<td>Mar 20</td>
<td>last day of class</td>
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<tr>
<td>11</td>
<td>Mar 16</td>
<td>Mar 16</td>
<td></td>
<td>no final exam</td>
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The given schedule is tentative; changes will be discussed in class and posted online.