Physics 114-01

Dr. Anna Wang-Holtzen

Fall 2026

Introduction

- Dr. Anna Wang-Holtzen
  - New teaching professor at UMass Dartmouth
  - Previous roles: Preceptor in physics at Harvard, graduate student researcher at Stanford
- Atomic, molecular, and optical physicist
  - How electrons interact inside atomic/molecular systems on ultrafast timescales
  - Properties of ultrafast light pulses and interaction with matter
- Teaching interests:
  - Helping students develop model-building skills
  - Improving abstraction skills
  - Building strong studying and learning skills

Why E&M?

- Electricity and power transmission
- Electronic devices
- Atomic and molecular properties
- Light and the electromagnetic spectrum
- Modern signals-based communication

Course goals

- You will develop an understanding of core concepts underlying the theory of electromagnetic interactions and how to apply them when analyzing a variety of physical scenarios. The overarching ideas are:
  - Electric charge: Sensitivity of materials to electromagnetic interactions
  - Electric fields: Distortions in space that exert electric force
  - Magnetic fields: Distortions in space that exert magnetic force
  - Induction: The dynamical generation of EM fields from one-another
- You will develop your analytical thinking abilities by learning how to apply key problem solving skills:
  - Applying a systematic approach to thinking through physical scenarios
  - Employing analytical tools: geometry, trigonometry, algebra, calculus

Course Info

https://annaliw.github.io/courses/P114-F26.html

- Lecture – attendance required
  - Turn in activities and quizzes for credit
  - Drop 3 lowest scores
  - No laptops in class! Please put them away now.
- Homework – due weekly on Physics LE
- Exams – two midterms and one final
- Lab – must pass to pass course
- Recitation – attendance strongly encouraged

Start next week

- See syllabus for more information!

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Homework

- Has anyone set up an account yet?
- Can you see HW0?

How we learn

- By listening? By reading? Important first steps, but not enough.
- By doing!

- Active learning
  - Keeps us engaged throughout class
  - Constructing your own knowledge creates higher-value learning
  - Productive struggle leads to knowledge retention

Active learning strategies

- Choral response
- Guided work in small groups
- Think-pair-share
- Think-pair-share with voting

TPS with voting

1. I will show you a question, and give you time to read and think.
2. I will count down, and everyone will vote at the same time.
3. I will ask you to discuss your vote with your neighbor and try to convince them of your position.
4. I will count down and you will re-vote based on your discussion.

How to use your voting card

- Take out your voting card.
- Fold it in four, along the white lines.
- Hold up your multiple-choice answer.

A. 

B. 

C. 

D. 

All of the above. 

None of the above. 

Voting example

What is your favorite ice cream flavor?

A. Vanilla
B. Chocolate
C. Strawberry
D. Mint-chip
E. All of the above
F. None of the above

TPS voting example

Let’s review some mechanics.

If an object is subjected to a constant force, which of the following are true?

A. The object’s velocity is constant.

B. The object’s velocity is changing linearly.

C. The object’s velocity is changing quadratically.

D. The object will not move.

E. All of the above.

F. None of the above.

Why do we do TPS voting activities?

- Committing to an answer makes you more engaged in the problem solving process.
- Peer instruction opportunity:
  - Did you know that when you explain something you learn it better?
  - Creating knowledge through discussion is much stronger than just taking my word for it.
- Revising your answer reinforces reasoning and knowledge.

Active learning needs active engagement!

- There are things that I need to do to make this time productive.
- There are things that YOU need to do to make this time productive.

- Let’s create a classroom agreement to make sure this time is used to its best capacity.

My responsibilities

- 8am is really early. It’s my job to structure this time to keep you awake and engaged.
- Speaking up and participating can be hard. It’s my job to make sure everyone feels safe to do that.
  - Give you enough time to think
  - Scaffold activities with enough information and examples
  - Don’t single anyone out
  - Supportive feedback on answers
- Participation is critical for this learning framework. I also can’t let you off the hook. I will wait an uncomfortably long time for volunteers.

Your responsibilities

- We will practice active engagement and whole-group discussion now!
- TPS: what are your responsibilities to make this time productive for yourself and your classmates?
- I will ask for volunteers to share what they discussed.
  - Open minds in conversation
  - Positive environment and respectful words
  - Come to class prepared
  - Eat breakfast, stay hydrated
  - Follow instructions and rules to keep class running smoothly
  - Set an example with active participation
  - Take notes, stay on task

Review: forces

- Forces explain changes in motion (acceleration)
- Forces are vector quantities
  - Magnitude
  - Direction
- A force model must explain magnitude and direction based on observable properties of the system
  - Gravity near earth: $F = -mg\,\hat{y}$. Depends on mass. Does not depend on position. Direction always down.
  - General gravitation: $F = \frac{-GMm}{r^2}\,\hat{r}$. Depends on two masses, separation distance. Direction is between objects. Sign is always towards each other.

Mechanics vs. E&M

- Mechanics: uses forces to describe observed motion
- E&M: explains where (two) forces come from and how they work

A new force: electrostatics