

PHYSICS 221 – SPRING 2019 – SYLLABUS

All lectures are held in Physics Room 5

Course Coordinator:

Professor Alan I. Goldman

Contact info: A501 Zaffarano Hall 294-3585 phys221@iastate.edu

All correspondence related to the course, except content questions for your Recitation and Lab Instructors, should be sent to phys221@iastate.edu to be routed to the appropriate person.

Lecturers:

Professor Matthew Wetstein

Contact info: A426A Zaffarano Hall 294-8269 wetstein@iastate.edu

Lecture hours: MWF 8:00-8:50 AM

Office hours: Mondays 9:00 – 10:00 AM (or by appointment)

Dr. Anatoli Frishman

Contact info: 210 Physics Hall 294-9361 frishman@iastate.edu

Lecture hours: MWF 9:00-9:50 AM

MWF 10:00-10:50 AM

Office hours: Tuesdays 12:00 – 1:00 PM (or by appointment)

Professor David Johnston

Contact info: A209 Zaffarano Hall 294-5435 dcj99@ameslab.gov

Lecture hours: MWF 11:00-11:50 PM

MWF 3:10-4:00 PM

Office hours: Tuesdays 10:00 – 11:00 AM (or by appointment)

Dr. Dusan Danilovic

Contact info: A220 Zaffarano 294-4439 dusand@iastate.edu

Lecture hours: MWF 4:10-5:00 PM

Office hours: Mondays 12:00 – 1:00 PM (or by appointment)

Course secretary:

Deb Schmidt 12 Physics Hall 294-4936 debs@iastate.edu

Lab Supervisor:

Dr. Paula Herrera 15 Physics Hall 294-2607 siklody@iastate.edu

Course materials:

- *University Physics* (14th Edition – previous editions are also acceptable¹), Young and Freedman (Pearson, Addison Wesley).
- Optional: *Top Hat*
- Optional: *Student Solutions Manual* (available in the bookstore).

Web sites:

- Canvas. *Access through the ISU homepage with your ISU NetID and password*. There are two separate courses: one of the labs and another one for everything else.
- MasteringPhysics for 14th edition of the book. Access through Canvas.

Log in to all sites as soon as possible after the first class. If you experience any problem, please send an email to Alan Goldman (phys221@iastate.edu).

This course has evening exams. Note the exam dates and make no other plans for these evenings.

Wednesday, February 27

8:15 pm – 10:15 pm

Wednesday, April 17

8:15 pm – 10:15 pm

¹ NOTE: if you buy or have a used copy of the text you may need to pay a separate fee for access to the MasteringPhysics component.

CLASS SCHEDULE

Date	Class (lecture/recitation)	Assignments
M Jan 14	1. Units, significant figures, order of magnitude	
T Jan 15	Worksheet 1: Units, order of magnitude, trigonometry and geometry.	Read: 1.1-1.6
W Jan 16	2. Vectors, products, components	Read: 1.7-1.10
R Jan 17	No recitation	Homework 0
F Jan 18	3. 1D motion	Read: 2.1-2.4
M Jan 21	No classes – University holiday	
T Jan 22	Worksheet 2: Vectors; Quiz 1	Homework 1
W Jan 23	4. Free fall	Read: 2.5-2.6
R Jan 24	Worksheet 3: 1D motion	
F Jan 25	5. 2D motion. Projectiles	Read: 3.1-3.3
M Jan 28	6. Circular motion	Read: 3.4, 9.1-9.3
T Jan 29	Worksheet 4: 2D motion; Quiz 2	Homework 2
W Jan 30	7. Relative motion	Read: 3.5
R Jan 31	No recitation	
F Feb 1	8. Forces; Newton's 1 st and 2 nd Laws	Read: 4.1-4.4
M Feb 4	9. Newton's 3 rd law. Free body diagrams	Read: 4.5-4.6
T Feb 5	Worksheet 5: Newton's laws; Quiz 3	Homework 3
W Feb 6	10. Applications of Newton's laws	Read: 5.1-5.2
R Feb 7	Group Problem 1 (Mars probe)	
F Feb 8	11. Friction. Circular motion dynamics	Read: 5.3-5.4
M Feb 11	12. More Examples	
T Feb 12	Worksheet 6: Free-body diagrams; Quiz 4	Homework 4
W Feb 13	13. Work and kinetic energy	Read: 6.1-6.2
R Feb 14	No recitation	
F Feb 15	14. Work for varying forces. Power	Read: 6.3-6.4

Date	Class (lecture/recitation)	Assignments
M Feb 18	15. Potential energy. Conservation of energy	Read: 7.1-7.3
T Feb 19	Worksheet 7: Work and energy; Quiz 5	Homework 5
W Feb 20	16. Conservative and non-conservative forces	Read: 7.1-7.3
R Feb 21	Group Problem 2 (Ski jump)	
F Feb 22	17. Energy diagrams	Read: 7.4-7.5
M Feb 25	18. Impulse. Linear momentum.	Read: 8.1-8.2
T Feb 26	Worksheet 8: Energy diagrams; Quiz 6	Homework 6
W Feb 27	No lecture 8:15 PM – 10:15 PM EXAM 1 (Lectures 1-17)	
R Feb 28	No recitation	
F Mar 1	19. Collisions	Read: 8.3-8.4
M Mar 4	20. Center of mass	Read: 8.5
T Mar 5	Worksheet 9: Linear momentum; Quiz 7	Homework 7
W Mar 6	21. Rigid body rotation: moment of inertia	Read: 9.4-9.6
R Mar 7	Group Problem 3 (Car insurance)	
F Mar 8	22. Torque	Read: 10.1-10.3
M Mar 11	23. Rotations: work, power and examples	Read: 10.4
T Mar 12	Worksheet 10: Rigid-body motion; Quiz 8	Homework 8
W Mar 13	24. Angular momentum	Read: 10.5-10.6
R Mar 14	No recitation	
F Mar 15	25. Static fluids	Read: 12.1-12.3
March 18-22 Spring Break		
M Mar 25	26. Newton's law of gravity	Read: 13.1-13.3
T Mar 26	Worksheet 11: Static fluids; Quiz 9	Homework 9
W Mar 27	27. Orbital motion	Read: 13.4-13.6
R Mar 28	Group problem 4 (Katt the cat)	
F Mar 29	28. Simple harmonic motion: the spring	Read: 14.1-14.4

Date	Class (lecture/recitation)	Assignments
M Apr 1	29. The pendulum. Damped and forced oscillations	Read: 14.5-14.8
T Apr 2	Worksheet 12: Gravitation ; Quiz 10	Homework 10
W Apr 3	30. Mechanical waves, transverse waves	Read: 15.1-15.5
R Apr 4	No recitation	
F Apr 5	31. Sound waves. Energy, intensity. Beats	Read: 15.6, 16.1-16.3, 16.7
M Apr 8	32. Interference. Standing waves	Read: 15.7, 15.8, 16.6
T Apr 9	Worksheet 13: Oscillations; Quiz 11	Homework 11
W Apr 10	33. Temperature. Thermometers. Thermal expansion	Read: 17.1-17.4
R Apr 11	Group Problem 5 (Wind sculpture)	
F Apr 12	34. Heat and phase changes	Read: 17.5-17.6
M Apr 15	35. Ideal gas law and phase diagrams	Read: 18.1, 18.6
T Apr 16	Worksheet 14: Waves ; Quiz 12	Homework 12
W Apr 17	No lecture 8:15 PM – 10:15 PM EXAM 2 (Lectures 18-32)	
R Apr 18	No recitation	
F Apr 19	36. Heat transfer and kinetic model of ideal gas	Read: 17.7, 18.2-18.4
M Apr 22	37. Kinetic model of ideal gas	Read: 18.2 – 18.4
T Apr 23	Group Problem 6 (Ice chest)	Homework 13
W Apr 24	38. First law of thermodynamics.	Read: 19.1-19.4
R Apr 25	Worksheet 15: First law; Quiz 13	
F Apr 26	39. Thermal processes. Heat capacities.	Read: 19.5-19.8
M Apr 29	40. Heat engines and refrigerators.	Read: 20.1-20.4
T Apr 30	Worksheet 16: Isothermal vs. adiabatic; Quiz 14	Homework 14
W May 1	41. Second law of thermodynamics. Carnot cycle.	Read: 20.5-20.6
R May 2	Group Problem 7 (Elevator)	
F May 3	42. Entropy.	Read: 20.7, 20.8
<p style="text-align: center;">Day and time TBD FINAL EXAM Covers all lectures with an emphasis on lectures 33-42 and includes the laboratory final exam.</p>		

COURSE OBJECTIVES

The objective of this course is to provide a broad exposure to how humanity has created and applied the language of math to describe basic physical phenomena. Whereas the class schedule above provides a topic by topic list of specific subjects to be covered, broader goals are:

- To gain clear understanding of how to use basic vector algebra and calculus to describe and solve physical problems.
- Understand how to use basic 1-, 2-, and 3-dimensional kinematics.
- Know how to state, explain and use Newton's laws of motion.
- Understand and use concepts of momentum and energy as well as their conservation.
- Apply Newton's laws (and conservation laws) to point-like and continuous bodies.
- Understand and describe oscillatory motion and wave mechanics.
- Understand and use basic laws of thermodynamics.

READING ASSIGNMENTS

Before and after each lecture, students should read the assigned sections in the book (see schedule above).

TOP HAT

Your Lecturer may, or may not, choose to use Top Hat to take attendance and employ as a teaching aid. **There are no extra credit points associated with the use of Top Hat, nor will its use impact your grade.**

HOMEWORK

Homework is online and computer graded. The assigned problems will be on MasteringPhysics

- Problem sets are due on **Tuesdays by 8:00 am**, except HW 0, which is due on Thursday Aug 23 at 8:00 am. HW 0 is not for credit. It is a basic training exercise to learn how to use MasteringPhysics. It is also the time to check that you can access the site correctly. Problems related to issues that are covered in that training set will not be valid reasons for late homework, later on, if you do not complete this set.
- Each assignment can be submitted **without penalty an unlimited number of times** before the deadline. After each submission you will be informed how many problems you have answered correctly so that if you want to recheck your work and resubmit your wrong answers, you may do so.
- Using the Hints **is not penalized**.
- The correct answers do not need to be entered again.

- If you click on “Give up”, you forfeit the credit associated to that question but you can see the solution and use it to learn more about the problem.

Access to MasteringPhysics:

Since we need the system to be linked to ISU accounts, **students must access MasteringPhysics through the main 221 Canvas page.**

- If this is your first time on MasteringPhysics, you will need to have your Student Access Code. This may have been packaged with your new textbook, or you may have purchased it separately from the bookstore or directly from Pearson. Make sure that you buy the code for the 14th edition of the book.
- You do **not** need a course ID. If the system asks for one, it’s because you did not access the system through Canvas!
- The MasteringPhysics access codes are good for two full academic years. If you have any trouble accessing the system, please contact our Pearson representative, **Carly Harryman (carly.harryman@pearson.com)**. **During the first week of classes Carly is available to assist students on-site:**

Tuesday, January 15th, Carver 385, 9:30-3:00
 Wednesday, January 16th, Bessey 248, 10:00-3:30
 Thursday, January 17th, Physics Hall 53, 10:00-3:00

RECITATIONS

There will either be two, 50-minute recitations (Tuesday and Thursday) or one, 50-minute recitation (Tuesday) during any given week. See schedule for details.

The recitations in this course are conceived as a hands-on / interactive activity. Students will work in small groups on a worksheet or problem provided by the recitation instructor. Discuss, sketch, ask, explain, disagree, think aloud... **but don’t sit back and wait for the instructor to solve the problem on the board.** Your instructor is there to help you through the problems, to answer your questions and to monitor your understanding of the material. Learning is done by doing, not by watching.

Group problems

- These recitations activities will be a complex problem to be solved in a group of 2 to 4 students.
- Attendance will be taken for these sessions.

Quizzes

- At the end of most Tuesday recitations, a 10-minute quiz will be given (**see schedule for precise dates**)

- The quiz will be based on material associated with the last homework assignment (Quiz N is based on the material in Homework set N). This is where serious effort on homework starts paying off! The quizzes are very similar, in format and spirit, to what you will encounter on the exams.
- Quizzes will be graded by the recitation TA and handed back to the students within a week.
- **Missed quiz:** If you miss a quiz for a good reason (*e.g.* being sick or being away due to an ISU related activity), you should bring some document to prove the reason of your absence to your TA who will give you an Excused Grade (*i.e.*, at the end of the semester your score for the missed quiz will be the average of all the other quizzes). At most, two quizzes can be excused during the semester.
- **PLEASE NOTE:** The total points associated with quizzes are almost as much as one of the two mid-term exams. A quiz also provides weekly feedback as to how well you can solve problems on your own (as you will have to during the exams). The path to a good final grade is paved by good quiz scores.

LABS

All lab-related information and material is in a **separate** Canvas course called **PHYS 221 LABS (Spring 2019)**. Access this page as soon as possible to:

- a. Read the Laboratory Organization and Policies;
- b. Take the Laboratory Policies Quiz (you need a **perfect** score on this quiz); and
- c. Figure out when your lab section meets for the first time.

In particular, make sure you understand the make-up lab policies.

If you have problems accessing the lab Canvas page, please contact the lab supervisor, Paula Herrera (siklody@iastate.edu).

Completing the lab requirements is a mandatory part of PHYS 221. Failure to do so will result in an F for the entire course, independently of your performance in other components.

The final exam will contain four questions about the labs.

Lab waivers:

- If you have completed the laboratory part of the course successfully during a previous semester at ISU, you may request a lab waiver **during the first week of classes**. This is done through the LABS Canvas.
- If this waiver is granted, your old lab grade will be used.

The importance of the recitation and laboratory classes cannot be over-emphasized. You will not understand the material in this course if you cannot apply it to the solution of the assigned problems. The laboratory is essential to your efforts to understand the experimental foundations of physics as well as of scientific instrumentation.

EXAMS

Mid-semester exams

This course has evening exams, see the ISU Bulletin and/or the following ISU web-page:

<http://www.registrar.iastate.edu/students/exams/spring-night-exams>

Note the exam dates:

Wednesday, February 27

8:15 pm – 10:15 pm

Wednesday, April 17

8:15 pm – 10:15 pm

and make no other plans for these evenings. Evening exams are used in this course so that all students can take the same exam at the same time and thus be graded on the same basis.

Final exam

May 6 - 9, time and day TBA 120 minutes

If you have a conflict with the scheduled time for the final exam or any other reason why you cannot take it at the assigned time, you must notify Professor Goldman before **5pm Monday, April 15**, so that an alternative arrangement may be found.

- Room assignments and instructions will be posted and discussed in advance of each exam.
- Material to bring to the exam:
 - a number 2 pencil,
 - a scientific calculator. Graphing calculators are not necessary but may be used.
Laptops, cellphones, smartwatches and tablets are not allowed.
 - your student ID card.
- Each exam will include the values of any physical constants you may need, a formula sheet and scratch paper.
- Exams will be multiple-choice and consist of 27 problems (including 2 for extra credit),

- Approximately 40% of the problems will emphasize understanding of the physics concepts, whereas the remainder will be numerical problems to test your ability to apply these concepts.
- **Make-up exam:**
 - **A single, end-of-semester, make-up exam will be allowed only in exceptional circumstances, such as illness, family emergencies (not anniversaries, family vacations, etc.), or official university-sponsored activities.**
 - Students who know in advance that they will miss an exam as a result of one of these university-sponsored activities must explain the circumstances to the lecturer well before the exam and seek permission to take the make-up exam. After the fact, such permission will not be granted.
 - Students who miss an exam because of illness or other unforeseen emergencies should send a message (by phone, voice-mail, e-mail, or through a friend) to the lecturer or the course secretary before the start time of the exam in order to receive permission to take the make-up exam. If you feel unwell, please arrange to take a makeup exam. If you take the exam, you cannot, with hindsight, request a makeup.
 - This make-up exam will be held during the week before finals week and will be a comprehensive exam.
 - **Clearly only one exam can be made-up in this manner.**
- **Exams and quizzes serve many vital purposes.**
 - As a student, you should use them to identify weak spots in your knowledge and skills. Especially for quizzes and the two mid-semester exams, use any missed question as a key study guide that identifies an area or idea that needs further study.
 - As instructors, we use the class's quiz and exam results as guides to further focus and improve the presentation of material, both for this semester, as well as future ones.

GRADING

Total point breakdown

Concept	Points
Evening exam 1	75
Evening exam 2	75
Final exam	100
Recitation quizzes	70
Homework	30
Laboratory	50
Total	400

Initial scale for letter grades

Total score	Letter grade
≥ 325	A- or better
≥ 285	B- or better
≥ 245	C- or better
≥ 215	D- or better
< 215	F

The above point scale for letter grades for the course will not be raised, but may be lowered (but only slightly).

A failing course grade (F) will be given if:

1. any laboratory has not been satisfactorily completed, or
2. the student has engaged in any form of academic dishonesty.

- **Homework scores:** Homework is an investment –the “direct” credit from homework is only 7.5% of the final score, but this is the most important learning tool in the course. Homework is your opportunity to make mistakes and learn from them. Then you will be able to answer the exam and quiz questions correctly, which carry 80% of the total points.
- **Recitation and lab scores:** **The precise number of recitation/lab points you receive from your instructors during the semester will not necessarily be the same as the number that counts towards your final grade.** Some instructors grade "hard" during the semester and some grade "easy". Thus, in the interest of fairness to all the students, scores for hand-graded material may be slightly adjusted at the end of the semester to compensate for these differences. This means you will not automatically get a higher grade because you have an easy grader, or a lower grade if you have a hard grader.
- **Grade book:** You should regularly check that all your scores are correctly entered in the online grade book on Canvas. It is **your responsibility** to bring any problems to the attention of your section instructor immediately.
- **Exam scores:** If you believe there has been an error in the grading of an exam or in the final grade assigned to you, you need to contact Dr. Goldman **no later than one week after the results are released.**

DROPPING THE CLASS OR SECTION CHANGES

If you decided to drop the class, please bring the form to the course secretary, Deb Schmidt, 12 Physics (Main Office), debs@iastate.edu, 294-4936.

STUDENTS WITH SPECIAL NEEDS

Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. Students requesting accommodations for a documented disability are required to meet with staff in Student Accessibility Services (SAS) to establish eligibility and learn about related processes. Eligible students will be provided with a Notification Letter for each course and reasonable accommodations will be arranged after timely delivery of the Notification. **Students should deliver Notification Letters to Prof. Goldman and they should do so as early in the semester as possible.** SAS, a unit in the Dean of Students Office, is located in room 1076 Student Services Building or online at www.sas.iastate.edu. Contact SAS by email at accessibility@iastate.edu or by phone at 515-294-7220 for additional information.

HARASSMENT AND DISCRIMINATION

Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email dso-sas@iastate.edu, or the Office of Equal Opportunity and Compliance at 515-294-7612.

RELIGIOUS ACCOMMODATION

If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and your instructor or supervisor will review the request. You or your instructor may also seek assistance from the [Dean of Students Office](#) or the [Office of Equal Opportunity and Compliance](#).

CONTACT INFORMATION

If you are experiencing, or have experienced, a problem with any of the above issues, email academicissues@iastate.edu.

HOW SHOULD I STUDY FOR THIS CLASS?

- **Keep up with the class!** In physics, the material often builds upon what was covered the week before. If you start falling behind, do something immediately.
- Read the indicated reading assignments before each lecture. The reading assignments are essential to understanding the material presented in the lecture. A second reading after lecture helps cement key ideas into place.
- **Solve problems!** It is the single most important activity in a physics class. If you cannot solve the problems, you did not really understand the concepts. In addition to homework, recitation is devoted to problem solving. Redo (without looking at the solution) the examples shown in lecture.
- Be honest with yourself: if you solved a problem without really understanding *why* what you did worked, it is a waste of time (chances are that you just got lucky).
- Check the solutions and lectures posted online. Be sure you understand all of the concepts as well as steps associated with each problem.
- Complex problem solving requires order: Always work with a pencil and paper, and be neat, even if the problem does not need to be turned in. When problems involve many steps and concepts, it is easy to get lost if all you have is a collection of numbers randomly scattered on a sheet of paper. Do not try to do calculations in your head unless they are trivial. Label quantities in a meaningful way (don't call everything x !) Keep your work for future reference (see next point in this list!).
- **Learn from your mistakes:** focusing on your mistakes is the most effective way of identifying misunderstandings, weak areas, etc. Keep a list of the problems you missed, or did not completely understand, or simply struggled with. Make sure that you understand the solution, and *make sure that you understand why what you did was wrong!* A few days after all this, try to do the problem again.
- As needed, reread the chapter summaries in the textbook. Review the appropriate sections and/or go over your lecture notes.
- Solve extra questions and problems in the textbook (the odd numbered problems have the answers in the back of the book).
- Join a study group. You will benefit both from other students' insight and from how explaining something to another person tests and refines your understanding of a topic.
- ...but be careful: being able to follow a problem solved by another person is not the same as being able to solve it on your own! Group work should always be followed by some individual work. **Remember, you have to solve the problem on your own for the exam.**
- Use the help room. This is the perfect time to get one-on-one time with an instructor.

STUDENT ASSISTANCE

There are several opportunities for students to receive assistance with the material of this course:

- Room B54 Physics will be the Physics 221 Help Room. The staffing schedule will be posted on the door and on Canvas.
- Instructor office hours.
- Supplemental Instruction (SI): <http://apps-dso.sws.iastate.edu/si/>
- Tutoring: <http://new.dso.iastate.edu/asc/tutoring>

It is to your advantage to work with other students to learn the material. This can often help you to do better on the exams and homework. We encourage you to work together and perhaps form a study group. You may meet in the Physics 221 help room, if you wish. Please see the academic honesty statement for guidelines about working on homework assignments in a group.