PHYSICS 151 — COLLEGE PHYSICS I
UH MANOA — Spring Semester 2016

Course Information & Policies

Lecture
MWF 12:30–1:20 p.m.
Physical Science Building ("PSB" or "PhySci"), Rm. 217

Instructor
Mr. Michael Nassir
E-mail: `nassir@hawaii.edu`
Office: Watanabe Hall, Rm. 426, (808) 956-2922 (office hours by appointment)

Problem Sessions: *TO BE ANNOUNCED, starting second week of semester*

Free Tutoring/Help:

see "Getting Help" section below for more info

- Physics TA tutoring in Watanabe 421
  - — available approx. 20 hrs/week
  - — *starts week of Jan. 19*
- Natural Sciences Learning Emporium Physics tutoring in Bilger Addition 209
  - — available approx. 20 hrs/week
  - — *starts week of Jan. 19*
- Learning Assistance Center tutoring
  - — by appointment in Sinclair Library

Required Materials
TEXTBOOK: **OpenStax, *College Physics***, 1st ed. (2013), Chaps. 1–17
Available via: https://www.openstaxcollege.org/textbooks/college-physics/get
- PDF version (free — download either low- or high-resolution)
- Web-based version (free — requires real-time Internet access)
- Enhanced iPad version ($5) (available only for Apple tablets)
- Hardcover version ($48.50 new via Amazon.com)

ONLINE HOMEWORK ACCESS:
- Via **ExpertTA** — roughly $25 per semester
- *Details coming soon*

SCIENTIFIC CALCULATOR with scientific notation, trig functions, exponents, & logarithms — bring to lab & exams (necessary!) and lectures (needed for occasional in-class questions). *Graphing or programmable calculators are allowed, but NOT necessary.* ***Smart phones, tablets, computers, or similar devices are NOT permitted during exams!***

Optional Books
Gonick & Huffman, *The Cartoon Guide to Physics* (1990) paperback (~$18 new, ~$10 used at UH Bookstore)

Course Description

This course is the first half of a two-semester introduction to the fundamentals of physics, and will cover mechanics (kinematics, dynamics, gravitation, energy, momentum, rotation), waves, and thermodynamics. Lectures and problem-solving will regularly use the mathematical tools of algebra, geometry, trigonometry, and vectors, but *not* calculus.

Prerequisite: A grade of "C" or better in **MATH 140 (trigonometry & pre-calculus) or MATH 215 or higher**; or instead, a passing score on the Mathematics Department's Math Placement Exam (≥ 14 on Part I & ≥ 10 on Part II).

Lab: If you also need to take PHYS 151L lab, it is strongly recommended that you do so concurrently with the lecture; the lab provides a hands-on way of reinforcing and complementing many of the topics presented in lecture. However, concurrent enrollment in PHYS 151L lab is *not* mandatory for all students in PHYS 151 lecture.

PHYS 151 Learning Outcomes — General

At the conclusion of this course, students should be able to:

- Define and use the terminology of mechanics, waves, fluids, and simple thermodynamics.
- Apply the equations and principles of non-calculus-based physics to solve a wide range of problems in mechanics, fluids, and simple thermodynamics.
- Recognize how and where these principles occur in natural phenomena, technological and professional applications, and daily life.

PHYS 151 Learning Outcomes — Detailed

At the conclusion of this course, students should be able to:

- Understand the instantaneous and average relationships among position, velocity, and acceleration; construct and interpret graphs of all three; and calculate all three for the special case of constant acceleration.
- Recognize vector vs. scalar quantities; convert two-dimensional vectors from magnitude & direction to coordinates; perform scalar multiplication and addition of vectors.
- Understand the nature of force and the meaning and implications of Newton's Three Laws of Motion.
- Apply Newton's 2^{nd} Law to calculate the dynamics of systems for the special case of constant net force (including static equilibrium), including systems with ideal springs, contact friction, inclined planes, cables/pulleys, and uniform circular motion.
- Apply Newton's Law of Universal Gravitation to simple systems of masses.
- Apply Kepler's Laws of Planetary Motion to describe and calculate the properties of simple orbits.
- Understand and be able to calculate various forms of energy, including mechanical work, kinetic energy, and potential energies.
- Understand the meaning of Conservation of Energy and its relationship to conservative vs. non-conservative forces, and apply Conservation of Energy to determine kinematic properties of appropriate systems.
- Understand the relationship between force and impulse/momentum, and apply it to determine kinematic properties of appropriate systems.
- Understand the meaning of Conservation of Linear Momentum and its relationship to elastic vs. inelastic collisions, and apply Conservation of Momentum to determine kinematic properties of appropriate systems.
- Understand the analogy between rotational and translational kinematic & dynamic quantities, formulas, and conservation laws, and apply them to determine kinematic properties of rotating systems.
- Understand the definitions of density and pressure, and apply them (and related laws) to a variety of fluid-mechanical situations, including hydrostatics, buoyancy, and systems of confined fluid flow.
- Describe the kinematics and energy conservation of simple harmonic motion and similar systems.
- Understand the nature and simple equations of wave motion, superposition & interference, and formation of one-dimensional standing-wave modes.
- Understand the phases/states of matter, the kinetic basis of temperature, and the primary modes of heat/energy transport; use specific heat capacity and latent heat to quantitatively relate heat to temperature.
- Understand the basic kinetic theory of gases; apply the ideal gas law to various transformations of a confined gas; and find the work performed during isobaric expansion/contraction.
- Understand the 1^{st} Law of Thermodynamics in general, and apply it quantitatively to ideal gas transformations.
- Qualitatively and quantitatively define changes in entropy; describe the meaning of the 2^{nd} Law of Thermodynamics; understand the model of a heat engine and calculate its efficiency.

Grading & Course Work

• **Final grades** will be computed based on your **overall course percentage**, computed as follows:

Homework (Paper + Online)	**30%**
Midterm Exams #1 & #2	**17.5% each**
Final Exam	**35%**

Final letter-grade cutoffs:	90.0%	A+	75.0%	B+	60.0%	C+	47.0%	D+
	85.0%	A	70.0%	B	55.0%	C	43.0%	D
	80.0%	A–	65.0%	B–	50.0%	C–	40.0%	D–

At the end of the semester, these cutoffs may be lowered at the instructor's discretion, but they will not be raised.

After each major exam, I will publish grade sheets (listed by your "roster numbers," not names) displaying all of your scores, and I will provide a histogram showing the relative scores of everyone in the class. I urge you to double-check your scores on my grade sheets, as well as the score tallies on your individual papers. While I apologize in advance for any errors, they may well happen with such a large class — please help me to correct them. Final exam scores and final grades will be published (and grades will appear in MyUH) shortly after the term ends.

• **Paper Homework** assignments will usually be due on **Fridays** in lecture (with frequent exceptions due to holidays or exams), and will be graded either by our class grader or by me. Please see me outside of lecture with any questions about grading. **Late paper homework** will ***NOT*** be accepted *for any reason* **after solutions** for that assignment have been distributed online, usually shortly after the due date. All paper homework assignments will be worth the same number of points, and your **TWO lowest paper homework scores** will be **dropped**.

• **Online *ExpertTA* Homework** will usually be due on **Mondays** at the start of lecture, and will be graded automatically on the website. Your scores likewise will be reported to me automatically. **Late online homework** is allowed at a penalty of –10% per day. Details on how to log in and join our "course" will be provided soon in a separate handout.

• **Two Midterm Exams** will test you on material from each month of the course. Roughly one-third of the **Final Exam** will cumulatively review all of this midterm material, while two-thirds of the final exam will test new material from the last month of the course. The two midterm exams will be 50 minutes long (given during regular class periods):

Midterm #1	Friday, **February 19**	Chaps. 1–5
Midterm #2	Friday, **April 8**	Chaps. 6–10
Final Exam	Friday, **May 13, 12:00–2:00 p.m.**	Chaps. 11-17 & cumulative review

You are allowed to bring 1 sheet of **handwritten notes** (no printouts or photocopies) to the first and second midterms, and 2 sheets to the final exam. However, do NOT let your "cheat sheet" become a substitute for learning formulas and practicing problems! (Graduate school exams, like the MCAT or Physics GRE, do NOT allow open notes — you must memorize your formulas.) You will be allowed to retain your "cheat sheets" after each exam to build upon for later exams. *You must take all midterms and the final exam to avoid a failing grade in the course.*

• **Reading assignments** are listed in the attached table, and are also printed near the start of each Lecture-Tutorial. The listed reading assignments are the sections of the text that will be covered in lecture and that you will be responsible to know for exams. During lecture, most of the important formulas, concepts, and vocabulary related to each topic will be highlighted, and their correct applications will be demonstrated. I recommend that you skim-read a bit ahead of our current lecture topic, then go back and reread more carefully after lecture. Reading assignments are also valuable because they contain additional worked example problems beyond those of our in-class tutorials and homework assignments.

• For each of the assigned sections of our textbook, *I recommend that you attempt as many* **end-of-chapter problems** *as your time permits*. The small amount of assigned homework problems is simply insufficient to fully develop your ability to solve physics problems.

- **Brief answers** to ~50% of end-of-chapter problems are linked from the Web-based version of the text.
- **Full worked solutions** to ~15% of end-of-chapter problems appear in the free downloadable Student Solution Guide that accompanies our textbook.

PHYS 151 Spring 2016 Calendar & Reading Assignments

• This is our intended schedule of topics, however, *actual* subject matter covered during each lecture may vary or lag behind slightly. In that case, exams will only cover material actually discussed in lecture before each exam date. Relevant chapters and sections will be clarified before each exam.

• For all sections and topics listed below in regular type, you will be expected to know and understand the major formulas, concepts, and terminology, and how to apply them correctly to basic and intermediate-level problems. *Exception*: For sections/topics listed in *[[brackets]]*, you only need familiarize yourself *qualitatively* with their concepts and terminology. For these sections, you do NOT need to learn any specific formulas, NOR will you be asked to solve any numerical problems for those topics. (*Note*: Some of these topics do play important roles in PHYS 151L lab experiments.)

DATE	EVENT	READ: OpenStax *College Physics*
M Jan 11	Lect #1	*[[§1.1: Intro to Physics, Science & Sci. Method]]* §1.2: Metric Units & Prefixes, Sci. Notation, Unit Conversion
W Jan 13	Lect #2	§1.3: Uncertainty & Significant Figures *[[§1.4: Approximation]]*
F Jan 15	Lect #3	§2.1–2.3: Position & Displacement, Speed & Velocity
(M Jan 18)	HOLIDAY	
W Jan 20	Lect #4	§2.8: Graphing Position & Velocity
F Jan 22	Lect #5	§2.4: Acceleration; §2.8: Graphing Acceleration
M Jan 25	Lect #6	§2.5–2.6: Kinematics with Constant Acceleration
W Jan 27	Lect #7	§2.7: Freefall
F Jan 29	Lect #8	§3.1-3.3: Vectors vs. Scalars, Vector Notation, Vector Components
M Feb 1	Lect #9	§3.1-3.3: Vector Arithmetic
W Feb 3	Lect #10	§3.5: Adding Velocities & 2-D Kinematics
F Feb 5	Lect #11	§3.4: Projectile Motion
M Feb 8	Lect #12	§4.1–4.5: Common Forces, Newton's Laws of Motion
W Feb 10	Lect #13	§4.6–4.7: Free-body Diagrams, 1-D & 2-D Force Problems §16.1: Elastic Force (Ideal Springs) & Hooke's Law *[[§5.3: Stress & Strain]]*
F Feb 12	Lect #14	§5.1: Surface Friction *[[§5.2: Fluid Drag]]*
(M Feb 15)	HOLIDAY	
W Feb 17	Lect #15	§4.5: Inclines §9.5: Simple Machines & Mechanical Advantage §4.8: Four Fundamental Forces of Nature
F Feb 19	**MIDTERM #1**	**Chaps. 1–5 (plus §9.5 & §16.1)**
M Feb 22	Lect #16	§16.2: Period & Frequency §6.1–6.3: Uniform Circular Motion, Centripetal Acceleration & Force *[[§6.4: Fictitious Forces: Centrifugal & Coriolis]]*
W Feb 24	Lect #17	same
F Feb 26	Lect #18	§6.5: Newton's Law of Universal Gravitation
M Feb 29	Lect #19	§6.6: Orbits & Kepler's Laws
W Mar 2	Lect #20	§7.1: Work & Energy §7.2: Kinetic Energy & Work-Energy Theorem §7.7: Power *[[§7.8–7.9: Energy in Humans & Society]]*
F Mar 4	Lect #21	§7.3: Gravitational Potential Energy §16.1: Elastic Potential Energy §7.4–7.5: Conservative vs. Non-conservative Forces
M Mar 7	Lect #22	§7.6: Conservation of Energy
W Mar 9	Lect #23	§8.1–8.2: Momentum & Impulse
F Mar 11	Lect #24	§8.3: Conservation of Momentum §8.4–8.5: Elastic vs. Inelastic 1-D Collisions *[[§8.6: 2-D Collisions and §8.7: Rocket Propulsion]]*
M Mar 14	Lect #25	*not in textbook:* Center of Mass, Velocity of CM

W Mar 16	Lect #26	§10.1–10.2: Rotational Kinematics §10.3: Moment of Inertia
F Mar 18	Lect #27	§10.4: Rotational Kinetic Energy, Rolling Objects §9.1–9.2: Torque
Mar 21–25	**HOLIDAY**	**SPRING BREAK**
M Mar 28	Lect #28	§10.3: Rotational Dynamics §9.3–9.4: Static Equilibrium & Stability §9.5: Mechanical Advantage of Levers *[[§9.6: Human Body Forces & Torques]]*
W Mar 30	Lect #29	§10.5 & 10.7: Angular Momentum, Conservation of Ang. Mom., Gyroscopes *[[§10.6: Collisions of Extended Bodies in 2-D]]*
F Apr 1	Lect #30	§11.1: States of Matter §11.2: Density §11.3 & 11.6: Pressure §11.5: Pascal's Principle *[[§11.9: Pressure in the Human Body]]*
M Apr 4	Lect #31	§11.4: Hydrostatic Pressure Increase with Depth §11.7: Archimedes' Principle & Buoyancy
W Apr 6	Lect #32	§12.1: Continuity Equation §12.2–12.3: Bernoulli's Equation & Principle *[[§12.4–12.6: Viscosity]]*
F Apr 8	**MIDTERM #2**	**Chaps. 6–10 (plus §16.2)**
M Apr 11	Lect #33	§16.3 & 16.5–16.6: Simple Harmonic Motion
W Apr 13	Lect #34	§16.4: Simple Pendulums §16.7–16.8: Damped Oscillations, Driven Oscillations, Resonance
F Apr 15	Lect #35	§16.9: Continuous Waves *not in textbook:* Speed of Waves on a String §17.1–17.2, 17.6: Sound Waves §16.11: Wave Energy & Intensity *[[§17.3: Sound Intensity & Decibel Scale]]* *not in textbook:* Reflection & Transmission
M Apr 18	Lect #36	§16.10: Superposition Principle, Interference, Beats, Standing Wave Modes (Normal Modes) on a String
W Apr 20	Lect #37	§17.5: Standing Wave Modes in Air Columns §17.4: Doppler Effect & Shock Fronts
F Apr 22	Lect #38	§13.1: Temperature §13.5: *PT* Phase Diagrams §13.2: Thermal Expansion of Solids & Liquids
M Apr 25	Lect #39	§13.3: Ideal Gas Law §13.4: Kinetic Theory of Gases & Maxwell-Boltzmann Distributions
W Apr 27	Lect #40	§14.1: Heat §14.2: Heat Capacity & Specific Heat
F Apr 29	Lect #41	§14.3: Latent Heat & Phase Transitions *[[§14.4–14.7: Heat Transfer Methods: Conduction, Convection, Radiation]]* §15.1: 1st Law of Thermodynamics
M May 2	Lect #42	§15.2: Work Done by/on a Gas, *PV* Diagrams, Constant-Value Processes §15.3–15.4: Heat Engines *[[§15.5: Heat Pumps & Refrigerators]]*
W May 4	Lect #43	§15.6 *[[and §15.7]]*: Entropy & 2nd Law of Thermodynamics
F May 13	**FINAL EXAM**	**Cumulative, with emphasis on Chaps. 11–17**

<u>OMITTED:</u>
§11.8: Surface Tension & Capillary Action
§12.7: Molecular Transport: Diffusion & Osmosis
§13.6: Humidity, Evaporation, and Boiling
§17.7: Ultrasound

Solving Physics Problems

• You will need a **calculator** with **scientific functions** (trigonometric & exponential/logarithmic functions, and power-of-10 notation) for homework AND EXAMS. (Graphing calculators are not necessary.)

• On all assignments and exams that call for free-response answers, you must **SHOW YOUR WORK**. Writing only the correct final answer without showing your steps is *not* acceptable and will result in little or no credit. It is a central notion in science to show your method along with your results, so that others can follow your reasoning and can question any steps or assumptions. Also, clear and complete explanations will only help you later when you review your own work and study for exams. It is never possible to "show too much work," but it is easy not to show enough!

Always display your major mathematical steps from your initial formula(s) to your final answer, and annotate your reasoning with sketches and verbal explanations where appropriate. Mathematical steps should read sequentially and logically. Final answers must include **UNITS** and use an appropriate number of **SIGNIFICANT FIGURES**, and sometimes should be written in **SCIENTIFIC NOTATION**. To receive full credit, your answers to **free-response problems** MUST contain the following:

1. **initial formula**, followed by major algebraic rearrangement steps (if necessary)
2. **substitution** ("plugging in" known values), followed by major calculation steps (if necessary)
3. **final answer**, underlined or boxed, with proper **units**, **sci. notation** (if needed), & **significant figures**
4. additional **diagrams** or **comments**, as needed to define quantities (…a picture is worth 10^3 words!)

• **Organization** and **neatness** matter! Both will result naturally if you follow the above format. Disorganized or illegible work will be penalized.

• Please do NOT use **red ink** on any assignments or exams — we reserve that color for grading.

Collaboration

Working in pairs or groups is common in science, and indeed is encouraged: teamwork can help you to make more efficient measurements and to catch errors, and explaining something to another person is a great way to learn it yourself. However, if you are working with a classmate while completing a physics assignment (or while making measurements in lab), there are a few guidelines to follow:

(1) You are strongly encouraged **first to attempt each homework problem YOURSELF, individually** (or, in lab, to make some of your lab measurements yourself). That way, you will get the educational value and the experience that comes from working the problem (or using the equipment) and "seeing for yourself." Then, after you have tried first on your own, you can compare your answer (or lab results) to others' work as a "sanity check."

<u>On homework:</u> If you are stuck on a homework problem, you should seek just enough help to get unstuck. It is unwise to let someone simply feed you the entire solution, since you lose the educational value of working through the problem on your own. If necessary, try changing the numerical values in the problem and attempting it again by yourself, to ensure that you understand completely how to do the problem if you were to encounter it again on your own… say, on an exam.

<u>In lab:</u> If your results differ from other students' results by only a bit, then *you should keep your own results* — most scientific measurements vary slightly due to "random error" (this will be discussed in lab), so you should *not* change yours to match your classmates' results exactly. After all, how do you know which result is "correct," yours or your classmates'? Record what *you* see or measure. (If your results differ *wildly*, then it is appropriate to try to figure out "what went wrong." Small variations, however, are common and are a natural part of the random error inherent in making measurements.)

(2) All free-response solutions on all submitted assignments should ultimately be **in your own words**, reflecting ***your own understanding*** of the problems. You should plug numbers into your calculator and attempt (or re-attempt) all calculations *yourself*, even if you receive assistance from others along the way.

Any passages or calculations that are **directly copied or plagiarized** from another student (or portions lifted from any other uncited source) will be given a score of **zero**. Again, your submitted work should reflect *your own understanding* of the problems.

<u>In lab:</u> If you make measurements together with a lab partner, make a note in your lab report of who your lab partner was for any particular experiment. Then, be sure that your calculations and the written passages of your lab reports are ***in your own words***, even if your initial data or measurements are identical to your partner's.

(3) During **in-class exams**, **NO collaboration** of any sort is allowed; exams must be *entirely your own work*. Exams copied from another student, even partially, will be given a score of **zero**. Cases of cheating or plagiarism may be referred to the Office of Judicial Affairs for disciplinary review.

Getting Help

• **Regularly-scheduled problem sessions** (solving homework problems, answering questions, etc.) will be held every Wednesday & Thursday afternoon. Thursday's session is mostly a repeat of Wednesday's session. See p. 1 for location & times.

• The **Physics Learning Center in Watanabe 421** is open whenever Watanabe Hall is open, for all students to use to study (alone or together) on physics homework. There are tables, sofas, blackboards, etc., available for your use.

All Physics lab TAs schedule their two weekly office hours in Watanabe 421 as **tutoring hours** — FREE help with any physics homework problems or other physics questions (although lab TAs will give first priority to their own students with lab-related questions). Go to Wat 421 and check the posted schedule for tutoring times.

• The **Natural Sciences Learning Emporium** in Bilger Addition 209 is open M–F, approx. 8am–5:30pm, for all students to seek help with lower-division math or science classes, or just to use the group study tables to work together. Schedules of tutors for physics and all other subjects are posted on the door to BilA 209 and online:
http://www.hawaii.edu/natsci/learningemporium.php

• The **Learning Assistance Center** in Sinclair Library offers free, one-on-one tutoring for PHYS 151 & 152 and many other large math & science courses. Appointments are made online, at least 24 hours in advance:
http://manoa.hawaii.edu/learning/tutoring.html

• You may also drop by to see me in **my office, Watanabe 426**, during afternoons at times other than the regularly scheduled help sessions. I suggest that you call first (956-2922) to make sure that I am in. Please forgive me if I happen to be busy and ask you to return at another time. You may also make an appointment with me if you wish. For questions about physics problems & concepts, please first try to attend my problem sessions or use one of the above tutoring resources.

• The Department of Physics & Astronomy Office (Watanabe 416) maintains a list of grad students and others who are available for hire as **private tutors** — please stop by Wat 416 and ask the Department secretary for a copy of the list.

Extra Handouts

Extra copies of all handouts from the two or three previous lectures will be brought to every lecture. Most handouts will be available as PDF files in my course Dropbox folders.

Graded Papers

Graded papers will be circulated in lecture once they are graded. Any papers that are not picked up in lecture will be left in the **wooden cubby boxes outside the rear of our lecture hall, PSB 217**. Look for "PHYS 151 Spring 2016," and find the box for your roster number. <u>Please leave the boxes tidy and organized</u> for your classmates' benefit! Mahalo.