University of Southern Maine — Dept. of Physics

Physics 123 Syllabus — rev 141-May-2024

Instructor

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(and please ask :-)

Course Description: Physics 123 is a calculus-based introductory physics course that focuses on electricity and magnetism, and optics. Because this is the second semester of general physics, I assume that everyone is familiar with differential and integral calculus, so the general mathematical level of this course will be **more rigorous** than in physics 121. I expect you to attend class, read the textbook (or any calculus based physics text you would like), and most importantly, *work carefully through each homework problem assigned, or as many as possible :-)*. I cannot emphasize enough the importance of struggling with each homework question, and to come and see me for help.

You must have passed Physics 121k with a C or better (or its equivalent) in order to enroll in Physics 123k. This is a difficult class that will require you to work hard to succeed. As a summer course, you should expect to spend at several hours per day on homework in this class.

Textbook: Although I made the OpenStax text the required text (primarily because it is free) you may get any calculus based book you like as a reference. Certainly, do NOT waste money buying a new edition of a textbook. You may use *any calculus based introductory physics text you like as a reference*. The homework problems are posted as a pdf file on the course website at `http://portlandphysics.me/phy-123/`. The problems are taken from Physics for Engineers & Scientists, Third Edition, by Randall Knight
If you want to get this edition (used, from the usual online sources, or, I am told, as a pdf file) we need Chapters 20 - 34, so if you have either the hardcover edition with Ch. 1–35 or the extended edition with Ch. 1–42, you will be good to go. If you want separate volumes, you want the following:
Volume 3 (Ch. 20-24) : ISBN-10: 0321753178 — ISBN-13: 9780321753175
Volume 4 (Ch. 25-36) : ISBN-10: 032175316X — ISBN-13: 9780321753168

Attendance/Participation Policy: I expect that all of you will attend class and actively participate; if you are late to class or miss a class when a test is given, you **will not** be given a makeup exam and will receive a zero. NO EXCEPTIONS except in documented extenuating circumstances. However, at the end of the semester, I will pro-rate your lowest exam score by replacing it with the average of all three hour exam scores.

Outside Help/Office Hours

I will remain on campus for an hour or two after class on most days; if you cannot see me during this time, I can also come in before class for help. Please ask for help when you need it!

Students with disabilities

If you have any disabilities that I should know about, please inform me as soon as possible (i.e. not the day before the first exam). I will make every effort to accommodate any special needs you may have.

Expectations: My expectations of you in this course are as follows:

- I expect you to be an active, engaged, thinking, participant in class.
- Reading a physics textbook is an activity that involves taking notes and thinking and working through problems and examples with paper and pencil; it's not like sitting down to read a good novel. I may elect to give a short quiz in class, so come to class prepared.
- I expect you to keep a homework notebook with detailed solutions to the questions. I will collect this notebook at the end of the semester as part of your in-class grade (200 pts).
- I expect you to study and construct a working *content* knowledge of the physics topics we discuss in class; to assess this, I will be looking at your *problem solving* skills. The goal is to be able to understand the *underlying concepts* and be able to apply them to systems you have *never* seen before. This course is **not** about memorization and regurgitation of facts.
- I expect the utmost academic integrity; please read the University Honor Code at https://usm.maine.edu/community-standards-mediation/academic-integrity. If you cheat on an exam or a quiz, you will be given a grade of F for the course.
- In addition—since many of you will also concurrently enroll in the laboratory course (Physics 116), you should know that the same rules of academic integrity apply. Plagarism is unacceptable and may result in a failure for the course.

Assessment Your grade for this course will be determined by your score on 3 exams, homework & quizzes. To do well on these exams, you will have to work through many homework problems; homework assignments are listed at the end of this syllabus.

Exams will consist of conceptual and quantitative questions (perhaps with multiple parts) where you have to show and explain your reasoning. Partial credit will obviously be awarded when possible. Due to the pace of summer school, there will be no comprehensive final.

You MUST take every exam. If you do not take an exam, it will count as a zero. No makeup exams will be given unless they are extremely extenuating circumstances or you have pre-arranged due to a conflict (forgetting that there was an exam doesn't count as an extenuating circumstance). I will, however, replace your lowest exam score with the average of your three exam scores.

You may have one letter or A4 sized paper with crib notes and you may use a scientific or graphing calculator. No cell phones or web enabled devices may be on or at your desk during the exam. Here are the important dates for the semester and the point values for each item:

Exam # 1	Thursday 23 May 2024	09:00–11:30 am	200 pts
Exam # 2	Thursday, 13 June 2024	09:00–11:30 am	200 pts
Exam # 3	Thursday, 27 June 2024	09:00–11:30 am	200 pts
HW	collected at each exam		200 pts
Quizes/Problem Sets	at various times		200 pts
		TOTAL Points:	**1000 pts**

Weekly Homework, Reading, Lecture Assignments Here are the homework problems for the entire summer term; you will see that there is a pretty hefty set of questions to do, so don't wait to start. You should be working problems *every day*, or you will not get through them all! The more effort you put into understanding the homework, the better your exam scores will likely be. Historically, the highest exam scores correspond very strongly with thorough homework solutions.

Some notes on homework problems: Good homework solutions will restate the questions, draw figures as needed, and will include short explanations leading the reader through your thinking process. Homework solutions with just equations are not good solutions.Think of your audience as a student at another university taking the same class and who is stuck trying to understand the question and therefore needs words of explanation leading them from step to step. I will collect homework on the day of each exam, so keep your homework well organized by chapter. There will be time in class to ask questions on homework as well as office hours, so please avail yourself of extra help if needed.

In what follows, you will see that I have provided two different sources of extra lectures for you to watch should you be interested. It is my professional opinion that Walter Lewin's physics lectures are the most engaging and well thought out, but I do not condone the personal behavior described here and here. Because of this I have also provided a link to alternate lectures lectures from Ramamurti Shankar (Yale University).

13 May

Electric Charges and forces, Coulomb's Law, Polarization;
Electric field lines, superposition, inductive charging, calculating electric fields from continuous distributions of charge.
Lewin: Lectures 1 and 2 Shankar: Lectures 1 and 2
Reading (OpenStax) Chapter 5
Reading and HW (Knight 3rd Ed):
Ch. 25: 1, 3, 5, 13, 15, 17, 21, 27, 29, 33, 35, 39, 47, 56, 59, 61
Ch. 26: 1, 3, 5, 7, 9, 11, 13, 19, 21, 25, 29, 37, 41, 45, 51, 65

15 May

Electric Charges and forces, Coulomb's Law, Polarization;
Electric field lines, superposition, inductive charging, calculating electric fields from continuous distributions of charge.
Lewin: Lectures 1 and 2 Shankar: Lectures 1 and 2
Reading (OpenStax) Chapter 5
HW (Knight 3rd Ed):
Ch. 25: 1, 3, 5, 13, 15, 17, 21, 27, 29, 33, 35, 39, 47, 56, 59, 61
Ch. 26: 1, 3, 5, 7, 9, 11, 13, 19, 21, 25, 29, 37, 41, 45, 51, 65

16 May

Electric Flux, Gauss's Law (spherical, cylindrical, planar symmetry), conductors in electrostatic equilibrium.
Electrostatic potential, electrostatic potential energy, equipotential surfaces
Lewin: Lectures 3, 4, and 5 Shankar: Lectures 3, 4, and 5
Reading (OpenStax) Chapter 6, 7
HW (Knight 3rd Ed):
Ch. 27: 1, 3, 5, 9, 11, 13, 21, 27, 31, 33, 37, 43, 49, 51, 57
Ch. 28: 1, 3, 5, 7, 9, 11, 13, 15, 17, 21, 25, 27, 29

20 May

High voltage breakdown, Lightning, capacitance, dielectrics, capacitors
Lewin: Lectures 6, 7, and 8 Shankar: Lecture 6
Reading (OpenStax) 7, 8
Chapter HW (Knight 3rd Ed):
Ch. 28: 31, 33, 35, 37, 39, 47, 61, 67, 69
Ch. 29: 1, 3, 7, 9, 11, 17, 19, 21, 23, 25, 31, 40, 41, 47, 51, 53, 65

22, & 23 May

Electric current, resistivity, conductivity, Ohm's Law
Batteries, power, Kirchhoff's rules, circuits
Lewin: Lectures 9, 10, and 12 Shankar: Lectures 6, 7, and 8
Reading (OpenStax) Chapter 9, 10
HW (Knight 3rd Ed):
Ch. 30: 1, 6, 9, 11, 19, 27, 29, 39, 48
Ch. 31: 1, 3, 5, 7, 13, 15, 19, 21, 23, 25, 29, 49, 59, 63

Exam 1: 23 May 30 minutes of review before exam

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28 May

Magnetic Fields, Lorentz force, torques, electric motors
Moving charges in B-Fields, cyclotrons, mass spectrometers.
Lewin: Lectures 11, 13, 14, and 15 (optional: lecture 21) Shankar: Lectures 8, 9, and 10
Reading (OpenStax) Chapter 11
HW (Knight 3rd Ed):
Ch. 32: 5, 11, 13, 15, 19, 23, 24, 27, 33, 55, 60, 65

29 May

Electromagnetic induction: Faraday's Law, Lenz's Law, Motional EMF, eddy currents, inductance, RL circuits, magnetic field energy
Lewin: Lectures 16, 17, 19, and 20 Shankar: Lectures 11
Reading (OpenStax) Chapter 12, 13
HW (Knight 3rd Ed):
Ch. 33: 1, 3, 5, 7, 9, 11, 13, 15, 19, 23, 25, 29, 31

30 May

Electromagnetic induction: Faraday's Law, Lenz's Law, Motional EMF, eddy currents, inductance, RL circuits, magnetic field energy
Lewin: Lectures 16, 17, 19, and 20 Shankar: Lectures 11
Reading (OpenStax) Chapter 13, 14
HW (Knight 3rd Ed):
Ch. 33: 33, 35, 37, 39, 43, 45, 51, 63, 67, 73, 77

3 June

Maxwell's equations, displacement current, electromagnetic waves, poynting vector, polarization, radiation.
Lewin: Lectures 18, 22, 28, and 23 Shankar: Lectures 14 and 15
Reading (OpenStax) Chapter 16
HW (Knight 3rd Ed):
Ch. 34.2-34.7 : 7, 11, 13, 15, 23, 25, 27, 45, 50, 51, 58

5 June

Traveling waves, standing waves, destructive resonance, electromagnetic waves, Doppler Effect
Lewin: Lectures 26 and 27 and 35
Reading (OpenStax) VOL 1: Chapter 16, 17
HW (Knight 3rd Ed):
Ch. 20: 1, 11, 13, 21, 25, 37, 67, 76
Ch. 21: 1, 7, 9, 17, 19, 21

6 & 10 June

Snell's Law, Index of refraction, Huygen's Principle, Polarizers, Malus' Law, light scattering, why the sky is blue
Lewin: Lectures 29, 30
Reading (OpenStax) VOL 3, Chapter 1, 2
HW (Knight 3rd Ed):
Ch. 23: 5, 7, 9, 11, 15, 17, 19, 20, 27, 29, 37, 39, 57, 59, 61, 71
Ch. 24: 1, 2, 23
Exam 2: 13 June; 30 minutes of review before exam

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17 & 20 & 24June

Double slit interference, interferometers, diffraction gratings, resolving power
Lewin: Lectures 33 and 34
Reading (OpenStax) VOL 3, Chapter 3,4
HW (Knight 3rd Ed):
Ch. 22: 1, 3, 5, 7, 9, 13, 15, 17, 21, 23, 25, 33, 37, 39, 43, 48

26 & 27 June

Rainbows?
Exam 3: 27 June; 30 minutes of review then exam
