PHY 2049C-0002, Physics for Engineers and Scientists II

UNIVERSITY OF CENTRAL FLORIDA
Department of Physics

Term:	Fall 2016
Class Meets:	HPA 1, Room 112, TuTh 10:30–11:50 a.m.
Instructor:	Costas Efthimiou
Office:	MSB 331
Email:	costas@physics.ucf.edu
Office Hours:	TuTh 12.30–2.00 p.m.
Textbook:	Fundamentals of Physics (vol. 2) 10th edition, D. Halliday, R. Resnick, J. Walker.

General Information: Physics 2049 is the second part of a two-semester introductory calculus-based physics course. The course covers a fundamental core of topics essential to all those who will pursue careers in science (such as physics, chemistry, engineering, medicine, biology, etc).

Besides seeking a solid understanding of the basic principles that govern nature, special emphasis will be given to develop and enhance problem-solving skills (including graphing, estimation, and working consistently with physical units). Additional effort will be put to understand the workings of the abstract laws in everyday applications.

Prerequisites & Expectations: Physics I (*mechanics* including *oscillations* and *waves*) is assumed known. All concepts will be used heavily.

Knowledge of differential and integral calculus is essential. This includes, but it is not limited to, line, area, and volume integrals. Geometry, trigonometry, vector algebra, and vector calculus are vital. Magnetism requires skill in handling vector products of vectors.

The course is very interesting but challenging. It will have a *fast pace* and it will be covering a chapter every two (or, maximum three lectures). It is therefore advisable, to read the relevant material prior to attending the class, to attend all lectures, and to keep current with the homework. If you fall behind, it will be extremely difficult, if not impossible, to catch up.

Course Policy: The objective of the course is to help students acquire fundamental concepts and tools of physics, rather than to memorize certain amount of information or to learn how to solve certain type of problems. The textbook is the very important tool in your learning process. The instructor's job is to explain, to direct, to facilitate, to advise, to help and to evaluate your progress. Many of you may find that this is a *really challenging* class. Regular attendance is proven to be an important factor for your success in the class.

As a courtesy to the class, please inform the instructor in advance if you need to leave the class early or if you are expecting to be late. During lectures you should not use any electronic devices; in fact, they should be turned off. Action will be taken against people who disturb the class by any means.

Academic Dishonesty: The work submitted in this class is expected to be your own. Forms of cheating/academic dishonesty include (but are not limited to): communicating with another student during an exam (this includes giving information to another student as well as receiving that information), using an unauthorized calculator, bringing in and using unauthorized material of any sort during an exam, and communicating contents of an exam to another student.

The penalty for a academic dishonesty, no matter how small, will be rewarded with a grade of F for the course. UCF faculty members have a responsibility for your education and the value of a UCF degree, and so seek to prevent unethical behavior and when necessary respond to infringements of academic integrity. A report will also be filed with the Office of Academic Conduct which may impose additional penalties such as suspension or expulsion from the university, and/or a "Z Designation" on a student's official transcript indicating academic dishonesty, where the final grade for this course will be preceded by the letter Z. For more information about the Z Designation, please see http://www.z.ucf.edu.

Please notice that withdrawal from the course will not help you avoid the penalties.

Textbook: The textbook that we will use is

> Fundamentals of Physics (vol. 2) 10th edition, D. Halliday, R. Resnick, J. Walker. Published by Wiley, 2013.

This is one of the best textbooks for the introductory physics books. There is a more concise version for those who really want to know the bare physics:

> Physics (vol. 2) 5th edition, D. Halliday, R. Resnick, K. Krane. Published by Wiley, 2001.

The latter is a great textbook. Contrary to the most recent introductory texts that contain lots of colorful photos and are bulky, this textbook is printed in two colors only and thinner. Yet it is very precise; you learn the physics without being distracted by anything else.

If you want to use an earlier edition of the text, it is fine. The content is still the same. If fact if you can read in another language, you may be able to find it in your favorite language as it has been translated to most of the spoken languages.

Even if you want to use a different text is fine too. The material of the course is standard. So, if you would like to read another book, you are free to do so. Which book you select to read is not important. What is important is to study and learn the material. However, all references and discussions with be based on the required text just for convenience.

Structure of the Course: In my lectures, I will follow the *order* of the book closely. I may expand on or add missing calculations and other details that are omitted in the book. Usually, I use transparencies to avoid drawing elaborate pictures on the blackboard and I do the calculations on the board.

During the lectures, besides the theory I will try to present as many demonstrations as I can in order to elucidate the principles, and solve a number of problems. Due to the limited amount of time, I cannot solve as many problems as I would like. Ultimately, as with any course, it becomes your responsibility to solve problems at home and become fluent in problem-solving.

Please note that my lectures are 'mathematically formal'. This means that I believe in structured presentations and I present all proofs. *You will have to know theorems and their proofs.* Also, I never use numbers before the end of a calculation. *All calculations are symbolic.* When numbers are given, the calculation is done symbolically and, only at the last step, numbers are inserted in the final formula. This is part of the correct scientific methodology. If you are not used in it, you may find it hard at the beginning However, when you get accustomed to it, you will realize the multiple benefits from it.

Goals: The objectives of this course is to teach

- the application of mathematical language in the physical world
- the use of scientific method
- creative thinking and imagination
- detailed and exact reasoning on the physical phenomena

This course will not support

- sterile use of formulas
- mechanical numerical substitutions

- memorization
- superficial knowledge of the subject

Labs: There is an associated lab for the course. There are seven different sections for the lab. You cannot take the course without registering in one of the lab sections.

The lab counts for 20% of your total grade. There is a separate syllabus for the lab that will be given to you by your lab TA. If you do not receive it, ask your TA explicitly to give you a copy of the lab syllabus. Read the lab syllabus very carefully for the rules governing the lab this term.

Homework: HW assignments will be given through the WebAssign. Students registered in all sections must buy their accounts from the campus bookstore or online through Webassign. No hard copies of the HW are accepted. To register for this course in webassign use the following class key:

ucf 4805 8068

Please notice that Webassign charges per course per semester. Therefore, you have to buy access for accounts in two courses (lab and course). Your lab TA will give you the class key for the corresponding lab section.

It is possible that some HW problems will be on material that is about to be covered in class. This will ensure that students read the material at home before the instructor presents it in the lectures.

It's very important to work these assignments: they are the primary means for learning the material for the exams. It's legitimate and desirable for you to discuss the problem sets with other students, but the final work of the problem should be yours.

Additional practice assignments may be posted on Webassign. These assignments should be treated as real HW but they will not be used for grading (and hence, you do not have to turn them in if you do not like doing so). Exam problems may be based on the practice assignments too.

Quizzes: Quizzes in this section will be given through Webassign. During lectures I will be announcing when a new quiz has been posted. Once an announcement has been made, you will have 24 hours to do your quiz. The quizzes will be simple problems. You will need no more that 30 minutes to solve them. However, if you miss the announcement in class or if you wait until the last moment to try a quiz and experience connection problems, and eventually you are not able to do it, this will be considered as a zero grade in the corresponding quiz. Therefore, act promptly.

Exams: There will be 2 mid-term tests and one final exam. The exams usually include 4 problems. One or more problems may be a proof of a formula from the theory. Each mid-term test will be on all the material covered up to the date of the exam with the main focus on the new material.

The final exam will cover all course uniformly. Additional information on the final will be provided in class.

If you miss a mid-term exam and you have a valid excuse (see below), your next exam will count for both. If you miss the final and you have a valid excuse, you will be given an incomplete and you will be given a make-up final during the following term. Otherwise a zero grade will be entered. No exam will be dropped.

The exams are closed-book and closed-notes. Calculators are not allowed either. The dates of the exams are:

Exam 1: Thursday, September 29, 10.30–11.50 a.m.

Exam 2: Thursday, November 3, 10.30–11.50 a.m.

Exam 3: Tuesday, December 6, 10.00 a.m.– 12.50 p.m.

Grading: A student's final score will consist of

- 20 pts for the lab
- 8 pts for the quizzes
- 15 pts for the homework
- 12 pts for the first midterm exam
- 15 pts for the for second midterm exam
- 30 pts for the final exam

Grade scale: Letter grades to the final score will be assigned according to the following rule:

88–100 pts	A
75–87 pts	B
60–74 pts	C
50–59 pts	D
$<$ 50 pts	F

"+" and "–" grades may be assigned in borderline cases.

Webcourses: This class will not use webcourses at all. However, I will publish the course on webcourses and, at the end of the week, I will add an attendance roll where I will place checkmarks for all those people who will have created webassign accounts by that time. This attendance roll will be used by the registrar to determine who is in the class and disburse financial assistance to those eligible.

Allowed Absences: The only acceptable excuses for absences accepted by the Physics Department are:

- religious holidays
- participation in official UCF events
- medical emergencies
- unexpected death in the family.

For all absences proper and timely documentation must be submitted:

- For religious holidays submit a signed letter prior to the holiday.
- For official UCF events submit the UCF form signed by the supervisor of the event prior to the event. Please note that SGA and Greek events are *not* official UCF events. Sometimes SGA downloads and uses the official form found on the UCF's official site. Submitting this form signed is not official documentation. In fact it is an illicit action.
- For medical emergencies submit a doctor's note stating that you were not in condition to attend the exam. Please note that the medical emergency must be such that it warrants an absence. For example, a running nose is not a valid excuse.
- For unexpected death in the family you must notify the instructor that you plan to miss class activities. When you return you must bring a copy of the funeral program and a document (e.g. plane ticket) that proves that you traveled to the destination of the funeral.

Excuses that relate to your personal scheduling and behavior are not valid. Examples of invalid excuses are: work schedule, weddings, honeymoons, speeding tickets, traffic jams, flat tires, engine malfunction, oversleeping, single parent, helping a friend/boyfriend/girlfriend with an unexpected situation, participating in a protest, etc.

Attending a conference is also personal scheduling. However if it is related to the work/research you do for a faculty and you present a *oral talk* at the conference, you can ask to be excused.

Withdrawal deadline: Monday, October 31

Holidays: Monday, September 5; Friday, November 11; Thursday, November 24; Friday, November 25.

Disclaimer: The instructor maintains the right to make any changes to the above syllabus if he finds them appropriate for the course and/or believes them to be beneficial for the students. Changes may be announced orally in class and/or by editing the syllabus and redistributing it. Any changes announced will take effect immediately and will supersede any previous rules.

USEFUL COMMENTS FOR EXAMS

What you should read:

1. The theory from the textbook. You may be asked to derive any formula.
2. If you keep class notes, use them in conjunction with the text.
3. Go over the HWs (required and optional ones). Understand how and when you apply the formulæ.

The following formulæ will be given during the exam:

$$\vec{v} = \vec{v}_0 + \vec{a}\,t\ , \quad \vec{r} = \vec{r}_0 + \vec{v}_0\,t + \frac{1}{2}\,\vec{a}\,t^2\ , \quad v^2 = v_0^2 + 2ax\ ,$$

$$a_r = \frac{v^2}{r}\ ,$$

$$\vec{p} = m\,\vec{v}\ , \quad \vec{F} = \frac{\Delta\vec{p}}{\Delta t}\ ,$$

$$F = -\,kx\ , \quad f = \mu\,N\ , \quad F = G\,\frac{m_1 m_2}{r^2}\ ,$$

$$W = \vec{F}\cdot\vec{s}\ , \quad K = \frac{1}{2}mv^2\ , \quad U = mgh\ , \quad U = \frac{1}{2}kx^2\ ,$$

$$P = \frac{\Delta W}{\Delta t}\ , \quad P = \vec{F}\cdot\vec{v}\ , \quad W = -\,\Delta U\ ,$$

$$\omega = \omega_0 + \alpha\,t\ , \quad \theta = \theta_0 + \omega_0\,t + \frac{1}{2}\,\alpha\,t^2$$

$$I = \sum_i m_i r_i^2\ , \quad I = I_{CM} + md^2\ , \quad K = \frac{1}{2}\,I\,\omega^2\ ,$$

$$\vec{\tau} = I\,\vec{\alpha}\ , \quad \vec{L} = \vec{r}\times\vec{p}\ , \quad \vec{\tau} = \vec{r}\times\vec{F}\ , \quad \vec{L} = I\,\vec{\omega}\ , \quad \vec{\tau} = \frac{\Delta\vec{L}}{\Delta t}\ , \quad \tau = -\,\kappa\,\theta\ ,$$

$$\omega_0 = \sqrt{\frac{K}{m}}\ , \quad \omega_0 = \sqrt{\frac{g}{\ell}}\ , \quad \omega_0 = \sqrt{\frac{\kappa}{I}}\ , \quad \omega_0 = \sqrt{\frac{mgh}{I}}\ ,$$

$$U = \frac{1}{2}kA^2\,\cos^2(\omega t + \phi_0)\ , \quad K = \frac{1}{2}kA^2\,\sin^2(\omega t + \phi_0)\ , \quad E = \frac{1}{2}kA^2\ ,$$

$$\lambda = v\,T\ , \quad v = \frac{\omega}{k}\ , \quad k = \frac{2\pi}{\lambda}\ , \quad v = \sqrt{\frac{F}{\mu}}\ ,$$

$$y = y_0\,\cos(kx \pm \omega t + \phi_0)\ , \quad I = \frac{P}{A}\ ,$$

$$F = k\,\frac{q_1 q_2}{r^2}\ , \quad \vec{E} = \frac{\vec{F}}{q_0}\ , \quad E \ = \ k\,\frac{Q}{r^2}\ , \quad E \ = \ \frac{\sigma}{\varepsilon_0}\ ,$$

$$k \ = \ \frac{1}{4\pi\varepsilon_0}\ , \quad \Phi_E = \sum (E\cos\phi)\Delta A\ , \quad \Phi_E = \frac{Q}{\varepsilon_0}\ ,$$

$$W_{AB} \ = \ -\Delta E_p\ , \quad V = \frac{E_p}{q_0}\ , \quad \Delta V \ = \ \frac{-W_{AB}}{q_0}\ , \quad E \ = \ -\frac{\Delta V}{\Delta s}\ ,$$

$$C \ = \ \frac{q}{V}\ , \quad \kappa \ = \ \frac{E_0}{E}\ , \quad C \ = \ \kappa\,\varepsilon_0\,\frac{A}{d}\ ,$$

$$E_p = \frac{1}{2}\,C\,V^2\ , \quad u_E \ = \ \frac{1}{2}\,\kappa\,\varepsilon_0\,E^2\ ,$$

$$I \ = \ \frac{\Delta q}{\Delta t}\ , \quad R \ = \ \frac{V}{I}\ , \quad R \ = \ \rho\,\frac{L}{A}\ , \quad R \ = \ R_0\,\left[1 + \alpha\,(T - T_0)\right]\ , \quad P \ = \ IV\ ,$$

$$A_{rms} \ = \ \frac{A_0}{\sqrt{2}}\ , \quad \overline{P} \ = \ I_{rms}V_{rms}\ ,$$

$$R \ = \ R_1 + R_2 + \cdots\ , \quad \frac{1}{R} \ = \ \frac{1}{R_1} + \frac{1}{R_2} + \cdots\ , \quad C \ = \ C_1 + C_2 + \cdots\ , \quad \frac{1}{C} \ = \ \frac{1}{C_1} + \frac{1}{C_2} + \cdots\ ,$$

$$\sum I_{in} \ = \ \sum I_{out}\ , \quad \sum \mathcal{E} \ = \ \sum IR\ ,$$

$$q \ = \ q_0\,\left[1 - e^{-t/RC}\right]\ , \quad \tau = RC\ ,$$

$$F \ = \ q\,v\,B\,\sin\theta\ , \quad F \ = \ ILB\,\sin\theta\ , \quad \tau \ = \ N\,I\,A\,B\,\sin\theta\ ,$$

$$B \ = \ \frac{\mu_0 I}{2\pi r}\ , \quad B \ = \ N\,\frac{\mu_0 I}{2R}\ , \quad B \ = \ \mu_0 n I\ ,$$

$$\sum B_{\parallel}\,\Delta\ell \ = \ \mu_0\,I\ , \quad \mathcal{E} \ = \ -\frac{\Delta\Phi_B}{\Delta t}\ , \quad \mathcal{E} \ = \ BvL\ ,$$

$$M \ = \ \frac{N_s\Phi_s}{I_p}\ , \quad \mathcal{E}_s \ = \ -M\,\frac{\Delta I_p}{\Delta t}\ , \quad L \ = \ \frac{N\Phi}{I}\ , \quad \mathcal{E} \ = \ -L\,\frac{\Delta I}{\Delta t}\ ,$$

$$U \ = \ \frac{1}{2}\,L\,I^2\ , \quad u_B \ = \ \frac{B^2}{2\mu_0}\ ,$$

$$\frac{V_s}{V_p} \ = \ \frac{N_s}{N_p}\ , \quad \frac{V_s}{V_p} \ = \ \frac{I_p}{I_s}\ , \quad A_{RMS} \ = \ \frac{A_0}{\sqrt{2}}\ ,$$

$$X_L \ = \ \omega L\ , \quad X_C \ = \ \frac{1}{\omega C}\ , \quad Z \ = \ \sqrt{R^2 + (X_L - X_C)^2}\ , \quad \tan\phi \ = \ \frac{X_L - X_C}{R}\ ,$$

$$\overline{P} \ = \ I_{RMS}V_{RMS}\cos\phi\ ,$$

$$E \ = \ E_0\sin(kx \pm \omega t)\ , \quad B \ = \ B_0\sin(kx \pm \omega t)\ ,$$

$$c \ = \ \frac{1}{\sqrt{\varepsilon_0\mu_0}}\ , \quad f \ = \ f_s\,\left(1 \pm \frac{v}{c}\right)\ , \quad \overline{S} \ = \ \overline{S}_0\,\cos^2\theta\ ,$$

$$f \ = \ \pm R/2\ , \quad \frac{1}{f} \ = \ (n-1)\,\left(\frac{1}{R_1} - \frac{1}{R_2}\right)\ , \quad m \ = \ -\frac{d_I}{d_O}\ , \quad \frac{1}{d_I} + \frac{1}{d_O} \ = \ \frac{1}{f}$$

$$n \ = \ \frac{c}{v}\ , \quad n_1\sin\theta_1 = n_2\sin\theta_2\ , \quad \tan\theta \ = \ \frac{n_2}{n_1}\ ,$$

$$d\sin\theta \ = \ m\,\lambda\ , \quad d\sin\theta \ = \ (2m+1)\,\lambda\ , \quad w\sin\theta \ = \ m\,\lambda\ , \quad \theta_{min} = 1.22\,\frac{\lambda}{D}$$

In the following list, all objects are assumed uniform. The axis of rotation goes through the CM.

$$\begin{aligned}
\text{thin rod; axis perpendicular to rod}: \quad I &= \frac{1}{12} M\ell^2 \ , \\
\text{solid sphere}: \quad I &= \frac{2}{5} MR^2 \ , \\
\text{spherical shell}: \quad I &= \frac{2}{3} MR^2 \ , \\
\text{solid cylinder; symmetry axis}: \quad I &= \frac{1}{2} MR^2 \ ,
\end{aligned}$$

If I have missed any formula that you will need and it is not one of the formulæ you should know, I will add it in the list.

What will not be given, and what you should know additionally:

1. The definitions of some fundamental quantities, such as velocity, acceleration, angular velocity, angular acceleration, will not be given.

2. The following important formulæ will not be given:

$$\vec{F} = m\,\vec{a} \ , \quad \vec{W} = m\,\vec{g} \ ,$$

   All these formulæ can be used without any explanations.

3. Any theorems proved in class and/or book will not be given. These, among others, include the work-energy theorem, conservation of energy, conservation of angular momentum, and conservation of angular momentum. An exception to this is the parallel axis theorem which is given in the formulæ list (without labeling).

4. You should know how to apply any given or not given formulæ in all cases.

5. You should know to work with vectors. This includes the dot product $\vec{a} \cdot \vec{b} = ab\cos\theta$ and cross prodect $\vec{a} \times \vec{b}$.

Some comments for a successful exam:

1. It is a good idea to know the interpretation of the symbols and not be stuck to a particular letter. For example, the equation $\vec{r} = \vec{r}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$, may be written $\vec{d} = \vec{d}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$. If you remember that $\vec{d}$ or $\vec{r}$ stands for the displacement of the moving object, no confusion will arise. Symbols are not important, but *their interpretation is.*

2. The same letter may stand for different physical quantities in different formulæ. For example, a drag force may be indicated by $\vec{R}$ and its magnitude by R. The symbol R is also used to indicate electrical resistance. Hence, be careful!

3. Related to the above comment is the following: Do not use a formula just because it contains a letter which is given in a problem. The similarities may be superficial. Think of the meaning of the symbols.

4. The order of the given equations may change slightly. This means that you should learn to recognize the equations and not try to remember them according to their order in the formulæ sheet.