Engineering Physics II
PHYS 212

Fall 2024, FHSU

MWTF 12:30 - 13:20 , TH 124

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Textbook: *University Physics Volume 2 and 3*; OpenStax

ISBN: 1-947172-21-2
1-947172-22-0

URLs: https://openstax.org/details/books/university-physics-volume-2
https://openstax.org/details/books/university-physics-volume-3

Requisites:

Co-Requisite: PHYS 212L, MATH 235
Pre-Requisites: PHYS 211

Course Description:

This course introduces electricity, magnetism, circuits and optics. It follows on to the topics covered Physics I, which is a pre-requisite. Electricity is a concept that describes the interaction between charged particles. Magnetism arises from electricity when the charges are in motion. The theory of electric and magnetic fields is important in understanding electronics, light, and even the theory of relativity.

Learning Outcomes:

After taking this course, students will be able to:

- Determine the electric field due to one or more charged particles.
- Determine the magnetic field due to one or more currents.
- Calculate the force exerted on a charged particle by an electric field.
- Calculate the force exerted on a moving charged particle by a magnetic field.
- Apply Kirchoff's rules to analyze direct current circuits.
- Use phasor diagrams to analyze alternating current circuits.

- Determine the position, magnification, and orientation of an image formed by one or more lenses or mirrors.
- Articulate solutions to physics questions about electric charge, fields, electricity, and optics in plain English without performing calculations.

Textbook:

This course uses Volumes I and II of University Physics by OpenStax (https://openstax.org/subjects/s This is a free and open calculus-based physics textbook and the assigned reading quizzes will align with this text. You may find it useful to purchase an inexpensive used copy of one or more other text books to study from. There are several books available. The following books are recommended:

- *Fundamentals of Physics* by Halliday and Resnick
- *Physics for Scientists and Engineers* by Serway and Jewett
- *Physics for Engineers and Scientists* by Ohanian and Markert
- *University Physics* by Young, Freedman, and Ford

These texts will contain additional examples that you can study. You do not need to purchase the latest edition of these books, any edition will suffice.

Assignments:

All assignments will be worth four points in the grade book and can be taken multiple times. Points will be awarded as follows:

- 4 pts: score 75% on the first attempt before the assignment due date.
- 3 pts: score 75% on any attempt after the first or the assignment due date.
- 2 pts: complete attempt(s) with no attempts above 75%.
- 1 pts: incomplete attempt(s)
- 0 pts: did not attempt the assignment.

Baseline Quizzes:

At the beginning of each module, you will take a short, multiple-choice "baseline quiz". The purpose of this quiz is to focus your reading in preparation for each module before you come to class. These quizzes may ask questions about vocabulary defined in your book, conceptual questions covered in the reading, or simple calculations that can be done based

on a basic understanding of the module. The intent is to allow the time in class to be spent on conceptual development and problem-solving. The questions that will be on this quiz will usually be posted on Blackboard the day prior to the start of each module.
Baseline quizzes can be attempted an unlimited number of times.

Online Homework:

A problem set will be assigned for each module. The problem set will consist of questions and problems related to the topics covered by the current module, and may integrate topics covered in previous modules or courses. You will answers these questions online, either through a Blackboard quiz, or an online homework service.
Online homework can be attempted an unlimited number of times.

Example Problem Write-ups:

For each module, you will be assigned one problem to be solved and written up by hand. These problems should be written in the style of an example from a text book, i.e. the write-up could be given to another student learning the material to understand how to solve the problem. Example problem write-ups should be organized, clear, and complete.
Example problems must be formatted as follows:

- Each page must contain the problem number at the top-left of the page.
- Each page must contain the course name at the top-center of the page.
- Each page must contain the student's name at the top-right of the page.
- Each page must shall contain the page number and total number of pages at the extreme top-right corner of the page.
- The first page must include a copy of the problem statement.

The example problem write-ups will be graded with the following rubric:

- Formatting (2 points): The write-up must conform to the format described above.
- Neatness (2 points): The write-up must be clean and easy to follow. Your handwriting should be easy to read and follow the grid lines of the paper. It should not contain scribbles or partially erased work.
- Explanation (2 points): The write-up must include written explanations for key steps in the solution. It should not start with a set of equations followed by some algebra with an answer at the end. Rather, there should be an explanation of why the equations you start with are relevant and why you perform the required mathematical operations.

- Math/Physics (3 points): The math and physics used to solve the problem must be correct.

The score will determiend by dividing the number of points earned off the rubric by 9.
Example problem write-ups can be resubmited once.

Module Quizzes:

Module quizzes will be taken in class. These quizzes will consist of conceptual questions and problem simlar to homework problems and example problems worked in class.
Module quizzes can be resubmitted twice.

Course Grade:

The course grade will be based on four weighting categories: baseline quizzes, online homework, example problem write-ups, and module quizzes. The category weightings are as follows:

Module Quizzes	50%
Example Problem Write Ups:	20%
Online Homework:	20%
Baseline Quizzes, In-class Quizzes:	10%

The score in each category will be computed by averaging the points for all assignments in the category, which will result in a number between zero and four. The weighted average of each category will be comupted using the weights above, and a course letter grade will be assigned as follows:

$3.5 \leq$	A	4
$2.5 \leq$	B	< 3.5
$1.5 \leq$	C	< 2.5
$0.5 \leq$	D	< 1.5
	U	< 0.5

Tenative Schedule:

The following is the list of learning modules for this course.

1. Electric Charge
2. Module Quiz I
3. Electric Field
4. Gauss' Law
5. Module Quiz II

6. Electric Potential
7. Current and Resistance
8. DC Circuits
9. Module Quiz III
10. Magnetic Force
11. Sources of Magnetic Fields
12. Magnetic Induction
13. Module Quiz IV
14. Geometric Optics I: Light Rays
15. Geometric Optics II: Images
16. Wave Optics
17. Module Quiz V
18. Comprehensive Module Quiz

Academic Honesty:

Academic honesty is expected according to FHSU policy, stated on page 24 of the FHSU student handbook (http://www.fhsu.edu/studenthandbook)

Students with special needs:

Students are reminded of the FHSU policy on students with special needs, which can be found in the FHSU Catalog. Students with disabilities will be provided assistance in obtaining reasonable accommodations to meet their academic needs.

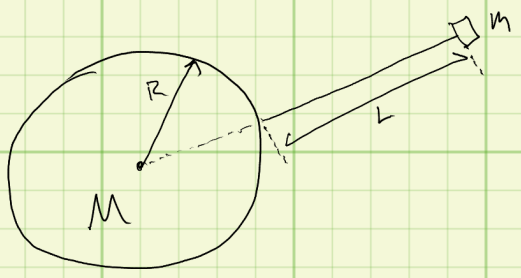
Title IX:

FHSU is committed to fostering a safe and productive learning environment. Title IX makes it clear that violence and harassment based on sex, gender, and gender identity are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. This includes all types of gender and relationship violence, sexual harassment, sexual misconduct, domestic and dating violence, and stalking. If you wish to report an incident or have questions about school policies and procedures regarding Title IX issues, please contact Amy Schaffer, University Compliance Officer and the FHSU Title IX Coordinator, at alschaffer@fhsu.edu or (785) 628-4175. The Compliance Officer can help connect you to campus and outside resources, discuss all of your reporting options, and assist with any concerns you may have

A "space elevator" is a contraption that would allow objects to be lifted into space without a rocket. The idea is that a satellite could circle around Earth and be tethered to the ground with a cable. If the satellite were travelling at orbital speed, then there would be no tension in the cable. However, if the satellite travels faster than orbital speed, tension in the cable will be required to keep the satellite from flying away.

The satellite would be required to stay over one location above Earth, which means it would have to be placed over the equator and circle the Earth once a day. However, the actual cable tension will depend on the length of cable used

What would the tension in the elevator cable be for a 1 ton (2000-lb) satellite placed 30,000 mi above ground?



$m = 2000\,lb = 907.18\,kg$

$L = 30000\,mi$

$R = 3959\,mi$ radius of Earth

$M = 5.972\times10^{24}\,kg$ mass of Earth

The satellite will be in uniform circular motion with a period of 1 day. For uniform circular motion, the radial acceleration must be

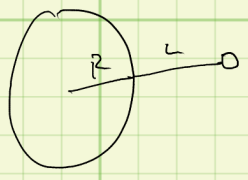
$$a_r = \frac{v^2}{r}$$

The radial force will be $F_r = ma_r$, and this force will be provided by the force of gravity from Earth and the tension in the cable.

$$F_r = F_g + F_T$$

Problem 0.1 | Phys 212 | C.D. Clark III | 2/2

The radius, r, of the circle traveled by the satellite will be



$$r = R + L$$

where R is the radius of Earth and L is the length of the cable.

Since the satellite must travel the circle once a day, its velocity will be

$$v = \frac{C}{T} = \frac{2\pi(R+L)}{T} \qquad \text{where } T = 1 \text{ day}$$

Therefore

$$F_g + F_T = F_r = m\frac{\frac{4\pi^2(R+L)^2}{T^2}}{(R+L)} = m\frac{4\pi^2}{T^2}(R+L)$$

The force of gravity on the satellite will be

$$F_g = \frac{GMm}{r^2} = \frac{GMm}{(R+L)^2} \qquad \text{where } M \text{ is the mass of Earth.}$$

We are looking for the force of tension, F_T, so

$$\frac{GMm}{(R+L)^2} + F_T = \frac{4\pi^2 m(R+L)}{T^2}$$

$$\boxed{F_T = \left(\frac{4\pi^2(R+L)}{T^2} - \frac{GM}{(R+L)^2}\right)m}$$

which gives 141 N