CONCEPTS OF PHYSICS

Phys 100 Fall 2021

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Office Hours: M 11:00am – 12noon, T 11:00am – 12noon, W 10:00am - 11:00am, R 2:00 - 3:00pm, F 2:00 - 3:00pm

Class Meetings: MWF 9:00am – 9:50am, Houston 138

Course Website: http://www.coloradomesa.edu/~dacollin/teaching/2021Fall/Phys100/index.html

Required Text: Art Hobson, *Physics: Concepts and Connections,* 5th ed, Pearson Prentice Hall (2010).

Prerequisites: Curiosity about the natural world!

Overview

Physics investigates the natural world and endeavors to provide an organized systematic description of the observed phenomena. Surprisingly, a vast range of natural phenomena can be described by applying a small collection of fundamental principles. For example, the same basic rules govern the motion of the moon around the earth or objects falling toward the surface of the earth.

This course will introduce you to some of the most profound concepts of physics. Some of the implications these, such as the fact that heat only flows freely from hot to cold objects, may seem obvious to you. Others, such as the apparent ability of a microscopic object to explore two divergent trajectories through space simultaneously, may confound your sensibilities. This course will also introduce you to the workings and tools of any scientific discipline: measurements, interpretation of data, hypotheses and theories.

The course covers the following topics:

1. Understanding the physical world via scientific inquiry: examples from planetary motion and the atomic world.
2. Classical physics: "clockwork" description of the physical world.
3. Energy and entropy: the driving rules for the physical world.
4. Quantum theory: the modern description of the physical world.
5. Nuclear physics: the workings of the atomic nucleus.

Prerequisites

This course does not assume any prior knowledge of physics. From time to time it will be necessary to use minimal mathematics to state and elaborate on physical concepts. It will be assumed that you are able to add, subtract, multiply and divide numbers and understand the concepts of raising a number to a power and taking a square root.

Assignments

An undergraduate student should expect to spend on this course a minimum of two hours outside the classroom for every hour in the classroom. The outside hours may vary depending on the number of credit hours or type of course. More details are available from the faculty member or department office and in CMU's Curriculum Policies and Procedures Manual.

1. **Homework:** There will be a homework assignment due approximately every week. This will be due by 5pm on the date indicated on the assignment. It is in your best interests to work by yourself on the homework problems but collaboration is acceptable. You can discuss the broad outlines of problem solutions with your colleagues but must write your final solutions independently. You are also encouraged to consult me for help with homework problems.

Exams and Quizzes

1. **Class Tests:** There will be two tests during class on the following days:

   Test 1: 27 September 2021
   Test 2: 1 November 2021
   Test 3: 29 November 2021

   Exams will be closed book and closed notes although you will be able to bring a formula sheet. Calculators will be allowed.

2. **Final Exam:** There will be a final exam at **8:00 am on Wednesday 15 December 2021**. The final will last one hour and 50 minutes and be comprehensive and closed book. Calculators will be allowed but electronic devices that can communicate with other devices are not allowed.

Grades

Individual assignments and exams will be graded using suitable scales. In general, to get full credit (100%) for a problem your solution must be correct and well justified. Partial credit will be given for incomplete or partly correct solutions. No credit (0%) will be given for problems not attempted, assignments not turned in or quizzes and exams missed without good reason.

The numerical grades for each component will be totaled and a final numerical grade will be computed according to the following distribution.

Homework	30%
Tests	45%
Final Exam	25%

The following final numerical scores will guarantee letter grades:

90%	A
80%	B
70%	C
60%	D

Policies

1. **Helpful Resources:** The Tutorial Learning Center (TLC) is a *free* academic service for all CMU students. Tutors are available in Houston Hall 113 on a walk-in basis for many courses. More information is available at www.coloradomesa.edu/tutoring or 248-1392.

   In coordination with Educational Access Services, reasonable accommodations will be provided for qualified students with disabilities. Students must register with the EAS office to receive assistance. Please meet with the instructor the first week of class for information and/or contact Educational Access Services, directly by phone at 248-1801, or in person in Houston Hall, Suite 108.

2. **Withdrawals:** There are several ways to drop this course. The deadline for dropping without penalty is **7 September 2021.** Please consult the CMU academic calendar and catalog for more details about adding and dropping courses.

3. **Attendance:** Attendance policies are described in the CMU catalog. You are expected to attend all the class meetings. In case of illness or other emergencies you must be able to produce the appropriate documentation. There are other circumstances under which you can be excused but you must discuss these with me in advance. If you miss a class or lab for a valid reason, turn in any assignments due before the start of the next class. Assignments turned in beyond your return to class will not be accepted.

   If there is an unavoidable conflict with one of the class exams or the final exam, please discuss it with me as soon as possible. In general I will assume that the final exam will have priority, since you know the dates of the exam.

4. **Academic integrity:** You are expected to present your own work in assignments, exams and quizzes. Fabrication of data, plagiarism, and copying from anyone else, particularly in closed book exams, are serious violation of academic norms. CMU has extensive policies on these matters and penalties for infringement can be severe. For more details, consult the academic integrity policies in the CMU catalog.

Student Learning Outcomes (Course)

A student who has taken this course will demonstrate the ability to:

1. Apply Newton's First, Second, and Third Laws to analyze the dynamics of physical situations involving one-dimensional linear motion.
2. Apply the concepts of energy, work, and the conservation of energy to analyze the dynamics of physical situations involving linear and/or rotational motion.
3. Apply the concepts of the conservation of momentum and angular momentum to analyze the dynamics of physical situations involving linear and rotational motion.
4. Distinguish between quantities used to describe the different properties and phases of matter.
5. Distinguish between and relate concepts and quantities used to describe thermodynamic systems.

Student Learning Outcomes (Essential Learning)

This course is part of CMU's essential learning curriculum and satisfies the following essential learning outcomes:

1. Demonstrate investigative and analytical thinking skills to solve problems.
2. Select and use appropriate information in an academic project.
3. Demonstrate quantitative literacy.

Guaranteed Transfer

The Colorado Commission on Higher Education has approved PHYS 100 for inclusion in the Guaranteed Transfer (GT) Pathways program in the GTSC2 category. For transferring students, successful completion with a minimum C- grade guarantees transfer and application of credit in this GT Pathways category. For more information on the GT Pathways program, go to http://highered.colorado.gov/Academics/Transfers/gtPathways/curriculum.html.

Content Criteria

This course should provide students with the opportunity to/Students should be able to:

a) Develop foundational knowledge in specific field(s) of science.
b) Develop an understanding of the nature and process of science.
c) Demonstrate the ability to use scientific methodologies.
d) Examine quantitative approaches to study natural phenomena.

The laboratory (either a combined lecture and laboratory, or a separate laboratory tied to a science lecture course) content of a GT Pathways science course (GT-SC1): Students should be able to:

a) Perform hands-on activities with demonstration and simulation components playing a secondary role.
b) Engage in inquiry-based activities.
c) Demonstrate the ability to use the scientific method.
d) Obtain and interpret data, and communicate the results of inquiry.
e) Demonstrate proper technique and safe practices.

Student Learning Outcomes

Inquiry and Analysis Competency

Inquiry is a systematic process of exploring issues/objects/works through the collection and analysis of evidence that results in informed conclusions.

Student Learning Outcomes (SLOs): Students should be able to:

1. Select or Develop a Design Process
    a) Select or develop elements of the methodology or theoretical framework to solve problems in a given discipline.
2. Analyze or Interpret Evidence
    a) Examine evidence to identify patterns, differences, similarities, limitations, and/or implications related to the focus.

b) Utilize multiple representations to interpret the data.

3. Draw Conclusions

   a) State a conclusion based on findings.

Quantitative Literacy Competency

Competency in quantitative literacy represents a student's ability to use quantifiable information and mathematical analysis to make connections and draw conclusions. Students with strong quantitative literacy skills understand and can create sophisticated arguments supported by quantitative evidence and can clearly communicate those arguments in a variety of formats (using words, tables, graphs, mathematical equations, etc.).

Student Learning Outcomes (SLOs): Students should be able to:

1. Interpret Information

   a) Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).

2. Represent information

   a) Convert information into and between various mathematical forms (e.g., equations, graphs, diagrams, tables, words).

Schedule

The following schedule is tentative, except for the dates of the class exams.

Week	Dates	Topic
1	8/23 – 8/27	Scientific inquiry, solar system (Ch 1).
2	8/30 – 9/3	Atoms and matter, measurements and units (Ch 2).
3	9/6 – 9/11	Measurements and units, describing motion (Ch 2.4, Ch 3).
4	9/13 – 9/17	Describing motion, force and acceleration, Newton's laws (Ch 4).
5	9/20 – 9/24	Newton's laws, Newton's theory of gravitation, review (Ch 5).
6	9/27 – 10/1	**Exam I**, Energy (Ch 6).
7	10/4 – 10/8	Energy, heat energy (Ch 6 – 7).
8	10/11 – 10/13	Energy (Ch 7).
8	10/15	Fall break (no classes).
9	10/18 – 10/22	Waves (Ch 9)
10	10/25 – 10/29	Waves and Light (Ch 9), review.
11	11/1 – 11/5	**Exam II**, Quantum phenomena (Ch 12).
12	11/8 – 11/12	Quantum phenomena (Ch 12).
13	11/15 – 11/19	Quantum theory (Ch 13).
14	11/22 – 11/25	Thanksgiving (no classes).
15	11/29 – 12/3	**Exam III**, Nuclear structure (Ch 14).
16	12/6 – 12/10	Radioactivity (Ch 14), nuclear energy (Ch 15), final review.