PHY-201: MECHANICS AND WAVE MOTION

Effective Term
Fall 2026

BOT Approval Date
11/13/2025

Discipline
PHY - Physics
Course Number
201

Course Title
Mechanics and Wave Motion

Short Title
Mechanics and Wave Motion

Credit Status (CB 04)
D - Credit - Degree applicable

Units

Lecture Units
3.00

Lab Units
1.00

Total Units
4.00

Hours

Lecture Contact Hours
48-54
Out of Class Hours Lecture
96-108

Lab Contact Hours
48-54
Out of Class Hours Lab
0.00

Total Contact Hours
96 - 108

Total Out of Class Hours
96 - 108

Total Student Learning Hours
192 - 216

Is this an existing Extensive Lab?
Yes

Distance Education
Yes

Distance Education

Distance Education Type
Hybrid Only

What will be done in face-to-face meetings
Laboratory experiments will take place during the face-to-face meetings. Exams can also be done during face-to-face meetings.

Are you using publisher content?
No

Regular Substantive Interaction
Instructor-to-student, student-to-student, and student-to-content contact shall be distributed in a manner that will ensure regular substantive interaction (RSI) is maintained not only weekly but also for the duration of the course. Instructor interactions should be equivalent in time, quality and consistency to the engagement students would receive in a face-to-face course—for example, through announcements, discussion participation, personalized feedback, video messages, or other instructional communications. Instructors are expected to be responsive to student inquiries within a 24-72 hour time frame excluding holidays. RSI will be maintained through a variety of methods: • Orientation - Students must be oriented to the online and face-to-face portions at the start of the course. • Announcements - Announcements using the course management system must be posted at least weekly to keep students current on course events, due dates, materials, etc. • Discussion Forums - Content-related discussion forums within the designated CMS will include appropriate instructor participation and will be initiated and maintained, with timely feedback provided. Instructors are required to monitor the discussions and related activities to provide guidance and direction. Open-ended discussion boards may be used to further learning and interaction. • MSJC Communication – Instructor will use MSJC-administered communication tools (such as email or the designated CMS communication tools) to regularly communicate with and provide ease of access to students. • Timely Feedback - Timely feedback on student work will be provided by the instructor, which may include comments and/or rubrics, within the Grades area of the designated CMS. • Scheduled Meetings – Hybrid and synchronous courses will meet at regularly scheduled times. ADA Compliance - All course interactions and content must be designed with accessibility in mind and meet ADA requirements.

C-ID (Admin Only)
C-ID PHYS 205

Catalog Description
This course is a calculus-based introduction to classical mechanics of solids and fluids. The main topics covered are kinematics, Newtonian mechanics including translational and rotational statics and dynamics, universal gravitation, work, energy, momentum, fluid statics, dynamics, and oscillations. Experiments in the laboratory examine the basic laws of the mechanics of solids and fluids. Objectives include the use of common measuring instruments, the principles of data taking and analysis, and the writing of scientific reports.

Requisites

Prerequisite(s)

Prerequisite(s) (must be taken before)
MATH-C2210 (with a grade of C or better).

Codes

TOP Code (CB 03)
1902.00 - Physics, General

CIP Code
40.0801 - Physics, General.

Repeatability Code
No

Grading Option
Letter grade OR P/NP

Minimum Qualifications

Minimum Qualifications	And/Or
Physics/Astronomy (Masters Required)	End

GE Information

Check GE Types Requested
AA/AS A - Natural and Physical Sciences

Cal-GETC Areas

Approved Cal-GETC Area
AREA-5A

Approved Second Cal-GETC Area
AREA-5C

Learning Objectives

Learning Objectives

Learning Objective
1. Analyze motion in one- and two-dimensional situations with the use of vectors
2. Differentiate between Newton's laws of motion and apply them to solving problems involving force
3. Compare and contrast kinetic and potential energies and argue how they are related to work
4. Analyze the role of impulse in causing a change in momentum and its roles in conservation of momentum and analyzing collisions
5. Analyze rotational equilibrium and dynamics; and the role of Newton's law of gravity in assessing the motion of extended objects
6. Differentiate between the properties of solid matter and fluids including their static and dynamic behaviors
7. Appraise simple harmonic motion and wave behavior including sound waves
8. Collect precise measurements using simple instruments including but not limited to meter sticks, timers, scales and calipers
9. Operate computer based data acquisition systems
10. Analyze and interpret laboratory data using calculator and computer based analytic and graphing applications as needed
11. Compose clear and comprehensive laboratory reports
12. Review some of the contributions that members from underrepresented groups have made to the physical sciences.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. Students will analyze physical situations to identify which principles apply.
2. Students will derive the specific equations that describe the problem.
3. Students will solve the problem correctly using the appropriate values and units.

Content

Course Lecture Content

1. Basic tools of Physics
    a. Units of measures
    b. Dimensional analysis
    c. Vectors and scalars
2. Kinematics

   a. Displacement
   b. Velocity
   c. Acceleration
   d. Solving Kinematics problems in 1, 2 and 3 dimensions using calculus
3. Dynamics
   a. The concept of force
   b. Inertial mass
   c. Newton's three laws of motion
   d. Static equilibrium
   e. Gravitational force and weight
   f. Solving force problems utilizing the principles of calculus
4. Work, Energy and Power at the calculus level
   a. Work done by a force
   b. Work - Energy theorem
   c. Isolated and non-isolated systems
   d. Conservative and non-conservative forces
   e. Potential energy
   f. Stability and equilibrium
5. Momentum and collisions
   a. Linear momentum and its conservation
   b. Impulse and momentum
   c. Collisions
   d. Center of mass
   e. Motion of a system of particles
   f. Solving momentum problems at the calculus level
6. Rotational Motion at a calculus level
   a. Rotational kinematics
   b. Relations between rotational and translational quantities
   c. Torque and Newton's second law
   d. Rotational kinetic energy
   e. Angular momentum and its conservation
7. Gravity and planetary orbits
   a. Newton's law of universal gravitation
   b. Kepler's laws
   c. Energy considerations in planetary and satellite motion
   d. Solving gravitational problems at a calculus level
   e. Going to space: Contribution to the space race from diverse underrepresented groups
8. Oscillatory Motion
   a. Motion of a particle attached to a spring
   b. Mathematical representation of simple harmonic motion
   c. Energy considerations in simple harmonic motion
   d. The simple pendulum
   e. The physical pendulum
   f. Damped and forced oscillations
9. Mechanical waves
   a. The wave model
   b. Reflection and transmission of waves
   c. Energy transfer in sinusoidal waves
   d. The Doppler effect
   e. The principle of superposition
   f. Interference of waves
   g. Standing waves
   h. Non-sinusoidal wave patterns
10. Fluid mechanics

a. Pressure
b. Buoyant forces and Archimedes's principle
c. Fluid dynamics
d. Continuity equation for fluids
e. Bernoulli's principle

Course Lab Content

1. Introduction to Physics Lab
   a. Significant figures
   b. Error analysis
   c. Measurements
2. Computer Based Laboratory
   a. Opening data collection programs
   b. Setting up experimental equipment and sensors
   c. Calibrating sensors
   d. Taking data
   e. Analyzing data
3. The laboratory report
   a. Importance of laboratory notebook
   b. Lab report structure
   c. Creating data tables
   d. Writing adequate conclusions
4. Labs Covering the Following Topics
   a. Kinematics: measuring motion in one and two dimensions
   b. Newton's laws of motion
   c. Work - Kinetic energy theorem
   d. Conservation of mechanical energy
   e. Impulse and change in momentum
   f. Conservation of momentum
   g. Rotational equilibrium and dynamics
   h. Static and dynamic behaviors of fluids
   i. Simple harmonic motion
   j. Wave behavior

Methods of Instruction

Method

Lab Activities

Integration

Laboratory experiments with guided instructions will be performed in person. In this experiments students will test the validity of certain physical relations such as the work-energy theorem. Students may also measure some physical constants, such as free fall acceleration near the surface of the earth, and compare their results against accepted values.

DE Adaptations for MOI

There is no DE adaptation since laboratory activities take place during the face-to-face part of the hybrid course.

Method

Lecture

Integration

Lecture time will be used to present terminology, definitions, notation, concepts, and derivations such as how to obtain the kinematic equations by integrating acceleration and velocity with respect to time.

DE Adaptations for MOI

On-line lectures will be made available to the students in accessible format either as prerecorded videos posted in the CMS using course pages, or synchronously using video conferencing tools.

Method

Observation and Demonstration

Integration

Observation and demonstrations are used to analyze problem solving strategies in physics. This may include the instructor showing how to solve different mechanics problems with step by step instructions. Demonstrations may also consist of presenting different physical phenomena in action, such as the precession of a gyroscope.

DE Adaptations for MOI

Problem solving strategies and examples can be presented via prerecorded videos delivered with the CMS or synchronously through videoconferencing. Demonstrations can be done via embedded applets in the CMS. All material will meet accessibility requirements.

Method

Activity

Integration

In-class group or individual activities may be implemented to allow students to practice their understanding of concepts of kinematics, Newton's laws of motion and gravitational forces. Students may work on solving problems similar to the ones that they will encounter in assignments and exams. The instructor may also implement think-pair-share activities where students review physical concepts related to the motion of objects in different physical situations.

DE Adaptations for MOI

Group activities can be completed using group discussions and groups collaborations through the CMS. Synchronous group interaction can take place via accessible video conferencing tools that allow for online document sharing.

Method

Discussion

Integration

After students have read a document that highlights the contributions made from members of underrepresented groups to the American space program, a guided discussion can take place where students share their impressions from the reading, how the calculations that some of this members did are similar or different from the ones students do in their assignments, and how those examples relate to their own career aspirations.

DE Adaptations for MOI

The discussion can take place on a discussion board inside the CMS where students respond to each other and the instructor participates as well.

Methods of Evaluation

Method

Papers

Integration

Laboratory reports will be written by the students describing the experiment they performed. The report will include a description of the experiment objectives, necessary theory to analyze the collected data, necessary equipment, experimental procedure, experimental data, data and error analysis, and conclusions. Reports will be evaluated for completeness, how correct is their description of the physical theory behind the experiment, proper presentation of collected data, reproducibility of experimental procedure, correct analysis of data, proper presentation of results with error analysis. A detailed rubric and instructions will be provided through the CMS or on paper.

DE Adaptations for MOE

A detailed rubric and instructions will be provided through the CMS. Written assignments will be submitted through the CMS via document upload, using the assignment tool in the CMS. Accessibility requirements will be met. Feedback will be provided by the instructor within two weeks.

Method

Exams/Tests

Integration

Students will be evaluated on their ability to analyze various physical systems. A rubric can be used that assigns points based on the completeness of each solutions. The rubric may assign points based on the inclusion of a sketch or free body diagram, the statement, in the form of an equation, of the basic physical principle that applies to that situation, the incorporation of the information given in the problem into that equation, the correct mathematical solution, the inclusion of correct units, and a correct interpretation of the numerical result obtained as a solution. A minimum of 4 examinations will be required. Exams should contribute a minimum of the 50% of the final grade.

DE Adaptations for MOE

Tests may be assigned, submitted, and graded through the course management system (CMS). For example, a link to a third-party publisher's content may be provided or the entire test can be embedded on CMS. Feedback can be delivered using the comment section or within an accompanying rubric within two weeks. The instructions and the tests will meet accessibility requirements. Instructors may consider assign exams during the face-to-face portion of the hybrid class.

Method

Homework

Integration

Homework assignments may consists of sets of word problems involving kinematics, uniform circular motion, and fluid mechanics, among others. Students will perform similar analysis as the problems presented in the examinations. Students will be evaluated on their ability to identify the correct calculus based formula, and explain how it applies to the particular problem.

DE Adaptations for MOE

Homework may be assigned, submitted, and graded through the course management system (CMS). For example, a link to a third-party publisher's content may be provided or the entire assignment can be embedded on CMS. Feedback will be delivered within within two weeks using the comment section or within an accompanying rubric. The instructions and the assignments will meet accessibility requirements.

Method

Quizzes

Integration

Quizzes with conceptual questions covering the materials such as kinematics, Newton's laws of motion, gravitation and fluid mechanics, may be used to assess the students understanding of such topics. Quizzes will be evaluated on accuracy and completeness.

DE Adaptations for MOE

Quizzes will be assigned, submitted, and graded through the course management system (CMS). For example, a link to a third-party publisher's content may be provided or the entire quiz can be embedded on the CMS. Feedback can be delivered using the comment section or within an accompanying rubric within two weeks. The instructions and the quizzes will meet accessibility requirements.

Method

Oral Presentation

Integration

Students will be asked to use the library to find resources discussing the contributions to the field of classical mechanics from member from underrepresented groups. Student will be asked to present their findings to the rest of the class. Students will be evaluated on clarity and their ability to demonstrate the impacts that those contributions made to the advancement of our knowledge of classical mechanics

DE Adaptations for MOE

Students can be asked to record a video with their presentation and post it as part of a discussion.

Assignments

Assignment Type

Writing

In-class and/or outside of class

In-class

Formative or Summative

Summative

Assignment

Solve the following sets of problems. As usual, remember to make a sketch of the situation, draw a free body diagram (if necessary), identify the physical principle(s) and equation(s) that apply to the situation described, solve for the requested quantity, substitute given values (with units) and give a final answer (with units).

1. A gymnast climbs a rope that is attached to a force sensor which measures the tension on the rope. When the gymnast climbs at constant velocity the reading on the sensor indicates a tension of 550.0 N. What is the mass of the gymnast?

2. A 24-g ball at the end of a string is swung in a vertical circle with a radius of 17 cm. When the ball is at the top of the circle the tension is measured to be 1.2 N. Find the speed of the ball at the top of the circle.

3. A small block of mass 180 g starts at rest at point A, slides down through a curved surface to point B where its speed is 7.2 m/s, then slides along a horizontal surface before coming to rest at point C. What is the work done by friction along the curved surface from point A to point B?

How assignment will be adapted in online format

The assignment will be assigned, submitted, and graded through the course management system (CMS). For example, a link to a third-party publisher's content may be provided or the entire assignment can be embedded on CMS or student may be allowed to submit a scan of their work. The feedback can be delivered using the comment section or within an accompanying rubric through the CMS within two weeks. The instructions and the assignments will meet accessibility requirements.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

With the data from the in-class experiment where you measured the velocity of a falling picket fence as a function of time you will write a lab report where you calculate the value of the free-fall acceleration.

Your report should include the following content:
Page title with the names of all the group members that worked on the experiment and lab report.

Abstract that contains a summarized what, how, and results from the lab.
Purpose and theory that explains the experiment and the needed equations.
Procedure and apparatus that describes the steps, equipment and set-up used.
Collected data and graphs that shows all the data from the lab in either table or graph form.
Calculations and error analysis that shows how the final result was calculated with its corresponding error bar.
Results and conclusions that states what was learned and how to improve the results.

How assignment will be adapted in online format

A detailed rubric and instructions will be provided through the CMS. Reports will be submitted through the CMS via document upload, using the assignment tool in the CMS. Reports will be evaluated using the rubric that outlines the expected requirements. Feedback will be provided by the instructor within two weeks. All content will meet accessibility requirements.

Assignment Type

Reading

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Now that we have learned about Newton's gravitational law we know that the equations that describe the motion of an object under the influence of the gravitational force can be used to compute the orbit of different objects traveling in space. These equations were used in the 1960s to compute the orbit of astronauts traveling to the moon and back to Earth. Given the complexity of having multiple objects (like the Earth and the moon) applying gravitational forces on a spaceship solving those equations required the use of "computers". However back in then the term computer was used to refer to a person that would compute, by hand, the solution to those complicated equations. The vast majority of the computers hired by the federal government were women, a significant number of them black women. Knowing this, use the resources at the campus library, to research examples of the contribution that some of the women made to the success of the Apollo mission. As an example of the type of reading you can look for look at the article from the Washington Post title "How World War II opened the door for one of the first black women at NASA". Be prepared to present and discuss your findings with the class.

How assignment will be adapted in online format

The assignment will be presented to the class through the CMS. Students will be asked to make a short video detailing their findings and post it in a discussion board within the CMS. Students will be required to also post response videos to some of their classmates. Accessibility requirements will be met. Feedback will be provided by the instructor within two weeks.

Course Materials

Textbooks

Serway and Jewett (2025). Physics for Scientists and Engineers. 11th Edition CENGAGE . ISBN: 9798214193151

Other Resources

Pasco Scientific. Physics Labs with Computers. PASCO Scientific , 01-01-1999.

Open Educational Resources

William Moebs, Samuel J. Ling, Jeff Sanny (2016). University Physics, Volume 1. OpenStax. ISBN-13: 978-1-947172-20-3

Class Size Information

Class Size

32

Class Size Category

G - Large lab 32

Diversity and Inclusion

Course Design and Materials: Course will incorporate diverse perspectives, authors, and examples that reflect a variety of cultures, identities, and lived experiences. Instructional materials will be reviewed regularly to ensure representation, inclusivity, and alignment with equity-minded practices across disciplines.

Inclusive Learning Environment: Instructors will establish classroom norms and policies that promote respect, civil discourse, and belonging in both online and face-to-face classes. Clear expectations for communication and engagement will support a learning space where all students feel valued and heard.

Accessible Instruction: Course content will be delivered using accessible design. Materials will follow accessibility guidelines within the CMS, including captioned media, readable document formats, and multiple means of engagement to support diverse learning.

Equitable Teaching Practices: Instructors will use transparent and grading criteria, varied assessment methods, and timely feedback to promote fairness and student success. Opportunities for revision, reflection, and multiple demonstrations of learning may be incorporated when appropriate to the discipline.

Culturally Responsive Pedagogies: Instructional strategies will encourage critical thinking about diverse perspectives and systems of power relevant to the course content. Faculty will foster opportunities for students to connect course material to real-world contexts.

Ongoing Reflection and Improvement: Faculty will engage in continuous professional development related to IDEAA principles and reflect on course practices using metacognition to identify opportunities for increased equity, inclusion, and accessibility.

Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.

The content references and discusses the contribution that members from underrepresented groups in STEM have made to our knowledge of classical mechanics. Some assignments, such as readings, research papers and discussions will center on how people of color and women have used their knowledge of classical mechanics to make impactful contributions to their communities or society at large. Examples and assigned problems will apply concepts of classical mechanics to every day situations which can reflect the experiences of students from different backgrounds.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

The content presented to the students, either through the CMS or in class, will follow Universal Design for Learning (UDL) guidelines. These guidelines ensure that, among other things, the course content provides different ways of engagement that can appeal to students from a variety backgrounds and that content is presented in different formats so that it can be accessed by students with different abilities. The course promotes an equitable learning environment by adopting the use of Open Educational Resources (OER), like an EOR textbook and an open homework platform, so that the course is accessible to students from different socioeconomic backgrounds. The course also includes a variety of formative and summative assessments so that the methods of evaluation provide students with multiple ways to demonstrate the knowledge of classical mechanics.

Interactions

Explain how the course will incorporate student-to-student interaction.

This course will incorporate student-to-student interaction by having students interact with each during in class discussions, such as comparing their thought process to determine the amount of work performed on an object that moves with constant velocity. Students will also work on groups to solve some of the problems presented as examples during class or review sessions. During laboratory experiments students will work together to set up the experimental device, perform measurements as well as collect and analyze data. Students may use discussion boards in the CMS to coordinate how to work on their laboratory reports and have all of their collected data in a single place.

Explain how the course will incorporate instructor-to-student interaction.

This course will incorporate instructor-to-student interaction by having the instructor present the material in lectures. The instructor may also join the discussion boards if questions arise about the requirements for assignments. Weekly announcements can be used to summarize the content seen in class, remind students of due dates and upcoming assignments. The instructor will provide feedback on students' performance through grading rubrics and comments in the CMS. During lab experiments the instructor will interact with students by providing guidance and clarification on how to perform the laboratory experiments.

Explain how the course will incorporate student-to-content interaction.

This course will incorporate student-to-content interaction by having the students engage with the course content from the lectures and content provided in different formats, such as video and audio, posted on the CMS. Students will also interact with the course content by working on solving problems, like calculating the terminal velocity of a skydiver.

Explain how the course will incorporate student-to-self interaction (metacognitive).

This course will incorporate student-to-self interaction by providing multiple opportunities for self-reflection on the process that each student follows to solve a particular problem. A student can for example compare the description of the motion of an object under gravitational force through the kinematic equations or through the use of the work-energy theorem. By working on solving a variety of problems on their own students will also strengthen their critical thinking skills by distinguishing the necessary and redundant variables among all the information provided in a particular word problem.

Key: 2636