Syllabus

Course Information

Course Number: PHYS 206
Course Title: Newtonian Mechanics for Engineering and Science

Sections: 501 - 506
Lecture Time: MWF 9:20 – 10:10 am, MPHY 203
Recitation Time: 501 W 11:00 am – 12:20 pm MPHY 334; 502 M 12:30 – 1:50 pm MPHY 335; 503 M 5:00 – 6:20 pm MPHY 335; 504 T 9:30 – 10:50 am MPHY 336; 505 R 3:30 – 4:50 pm MPHY 336; 506 F 11:00 am – 12:20 pm MPHY 334
Credit Hours: 3
Course Website: http://people.tamu.edu/~etanya/P218/P206.htm

Instructor Details

Instructor: Dr. Tatiana Erukhimova
Office: MPHY 308
Phone: (979)8455644
E-Mail: etanya@tamu.edu
Office Hours: MW 2:00 – 3:30 pm by Zoom (https://tamu.zoom.us/j/97646895784?pwd=WDZiU1NTczhFTmY3c1ptVmdJUHByZz09) or by appointment
There will be weekly help sessions. Please check CANVAS for updates.

Course Description

Calculus-based introductory Newtonian mechanics; laws of physical motion for solution of science and engineering problems.

Course Prerequisites

Grade of C or better in MATH 151 or MATH 171, or equivalent; also taught at Galveston and Qatar campuses.

Special Course Designation

CORE

Course Learning Outcomes

Students will be able to

1. Define, derive and calculate the kinematic relationships between position, velocity, and acceleration in one and two dimensions for linear and rotational motion.
2. Define, apply, analyze and evaluate Newton's three laws of motion using free-body diagrams for constant and time dependent forces.

3. Define, apply, analyze and evaluate the Work-Energy Theorem for position dependent forces, evaluate which forces are conservative thus leading to analysis of a potential energy function and applying Conservation of Mechanical Energy if appropriate.
4. Define and evaluate linear momentum as well as analyze and apply the Conservation of Linear Momentum when appropriate to model events like collisions, explosions, and more.
5. Define, apply, analyze and evaluate rotational motion using torque and angular momentum for point objects and rigid objects, while understanding and evaluating scenarios when angular momentum is conserved.
6. Define, apply, analyze and evaluate harmonic motion involving springs, pendulums and other devices.

Weekly Learning Outcomes

Week 1. Kinematics in One Dimension
- a. Derive equations of motion for a given acceleration by integration
- b. Derive kinematic equations for constant acceleration
- c. Apply the equations for one-dimensional motion

Week 2. Vectors and Two-Dimensional Motion
- a. Calculate the resultant of a number of vectors
- b. Express any vector in terms of components and unit vectors
- c. Derive the two-dimensional equations of motion for arbitrary time dependent acceleration
- d. Apply kinematic equations in two dimensions, e.g., projectile motion

Week 3. Newton's Laws
- a. Identify the forces acting on a system and their origins
- b. Describe Newton's laws
- c. Analyze friction and elastic forces

Week 4. Applications of the Second Law
- a. Isolate a body and draw a free body diagram
- b. Apply Newton's Laws to simple systems
- c. Analyze more complicated systems including pulleys and strings

Week 5. Work and the Work Energy Theorem
- a. Calculate the line integral for simple forces and paths
- b. Derive the Work Energy Theorem for constant forces
- c. Derive the Work Energy Theorem in general
- d. Solve various problems, e.g., springs, using the Work Energy Theorem

Week 6. Potential Energy Functions
- a. Calculate work for various forces for different paths
- b. Determine whether or not a potential energy function exists for particular forces
- c. Determine the potential energy functions (U) for conservative forces

Week 7. Conservation of Energy
- a. Obtain the law of Conservation of Energy
- b. Determine whether this law is applicable in given situations
- c. Solve Conservation of Energy problems
- d. Determine system behavior given graphical representation of U

Week 8. Conservation of Momentum
- a. Calculate the position, velocity and acceleration of the center of mass of a system of particles
- b. Relate external forces to center of mass motion

c. Determine whether Conservation of Momentum applies to a system
d. Solve general collision or explosion problems
e. Apply Conservation of Momentum when only approximately valid

Week 9. Polar Coordinates

a. Derive the expressions for the components of the velocity and acceleration in polar coordinates
b. Identify angular velocity and acceleration
c. Derive kinematic relations for given, time dependent angular accelerations

Week 10. Circular Motion

a. Express Newton's Second Law in terms of polar components
b. Apply the law to circular motion with special emphasis on the correct free body diagram
c. Determine period and frequency for circular motion
d. Relate rotational motion to translation for non-slipping motion

Week 11. Torque and Angular Momentum

a. Calculate torque and angular momentum for given forces and linear momentum
b. Relate torque and angular momentum
c. Ascertain whether angular momentum is conserved for a point particle and solve simple Conservation of Momentum problems

Week 12. Conservation of Angular Momentum

a. Determine the relationship between torque and angular momentum for a system of particles, i.e., an extended body.
b. Calculate the moment of inertia for a symmetric body
c. Calculate the angular momentum of a symmetric body about the symmetry axis
d. Apply Conservation of Angular Momentum for extended systems
e. Apply the relationship between external torque and angular momentum for problems such as those with real pulleys

Week 13. Harmonic Motion

a. Derive the differential equation for systems with linear restoring forces
b. Solve the equations and analyze the motion, including energy considerations
c. Derive the differential equation when damping and forcing are present
d. Analyze the existence of resonances in such systems

Week 14. Frames of Reference

a. Derive the Galilean transformation equations for position, velocity and acceleration
b. Analyze the relationship between inertial and non-inertial frames and the origin of fictitious forces such as the centrifugal force

Textbook and/or Resource Materials

- "Don't Panic: Volume I", by William H. Bassichis, 7th Edition
- We will use clickers (REEF app) for various kinds of assessment: pop quizzes, homework quizzes, in class discussion, etc.
- Supplemental Materials (previous years exams, problem solving videos): https://classroom.physics.tamu.edu/

Grading Policy

- Mid-term exams 55%, Final exam 38%, Lecture quizzes 5%, and Recitation quizzes 2%
- Scale: 90-100 A, 80-89 B, 60-79 C, 45-59 D, <45 F. Grades may be curved upward.

- If your grade on the Final Exam is higher than your lowest grade on one of the three exams during the semester, the grade on the Final will replace that one lowest exam grade in computing the course grade (it will only replace one grade in case of two exams having the same lowest grade). The Final Exam grade cannot be used to replace an exam that has been missed without a University excused absence.

Late Work Policy

- The missed exam without a University excused absence will count as a zero when computing your final grade.

Course Schedule

Mid-term Exam Dates: Feb. 23, Mar. 23 and Apr. 27. Time: 7:30 – 8:30 pm

Week	Topic	Learning Objectives
Jan. 17	Calculus, One Dimensional (1D) Motion	Find derivatives and integrals of simple functions. Obtain algebraic equations for kinematic variable by integration
Jan.24	1D problems, Vectors, 2D Motion	Solve 1D problems. Become expert in unit vectors and components. 2D equations of motion. 2D problems.
Jan. 31	Newton's Laws	Learn Newton's three laws. Become familiar with certain forces. Analyze simple systems,
Feb. 7	Friction, Second Law problems. Gravitational force.	Study the friction force. Consider systems with friction. More complex systems.
Feb. 14	Work. The Work Energy Theorem.	Master the precise definition of work. Prove and apply the Work Energy Theorem.
Feb. 21	EXAM I, Feb.23 Potential Energy Functions	Ability to determine whether or not a force is conservative.
Feb. 28	Conservation of Energy	Applications of Conservation of Energy.
Mar. 7	Center of Mass, Conservation of Momentum, Collisions	Calculate Center of Mass, Apply Second Law to system of particles. Analyze elastic and inelastic collisions

Mar. 14	Spring Break	
Mar. 21	EXAM II, Mar.23 Polar coordinates	Derive the components of velocity in terms of unit vectors in polar coordinates
Mar. 28	Polar coordinates, Newton's Law in polar coordinates, circular motion	Derive the components of acceleration in terms of the unit vectors in polar coordinates. Apply Newton's Law in polar coordinates
Apr. 4	Torque and Angular Momentum	Learn definition of torque and angular momentum. Use polar coordinates to obtain useful expressions for these quantities
Apr. 11	Conservation of Angular Momentum, Applications	Derive the law of Conservation of Angular Momentum. Solve problems using the law.
Apr. 18	Harmonic Motion, Simple, Damped and Forced Resonance	Apply Newton's Law with restoring force. Solve resulting differential equation. Analyze sinusoidal motion
Apr. 25	EXAM III, Apr.27 Frames of Reference	Be able to transform kinematic variables from one coordinate system to another. Inertial systems.
May 2	Review	
May 6	FINAL EXAM	8:00-10:00 am

- It is your responsibility to determine what material is being covered each class and the dates of all exams
- Team work is encouraged outside of class but not on exams
- You should expect a quiz each class
- No calculators or notes are permitted on exams
- You should come to lecture having read about the topic and tried problems
- You should come to recitation with questions on problems

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Resources in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu. Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, you will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in proper self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.

Statement regarding vaccines and face covering

To help protect Aggieland and stop the spread of COVID-19, Texas A&M University urges students to be vaccinated and to wear masks in classrooms and all other academic facilities on campus, including labs. Doing so exemplifies the Aggie Core Values of respect, leadership, integrity, and selfless service by putting community concerns above individual preferences. COVID-19 vaccines and masking — regardless of vaccination status — have been shown to be safe and effective at reducing spread to others, infection, hospitalization, and death.