

Advanced Mechanics II. Spring 2025

Applications of Lagrangian and Hamiltonian methods to selected problems of classical mechanics.

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Office Hours: TR 10:00am – 11:00am

Web page: <http://people.physics.tamu.edu/abanov/courses/P303/index303.php>

Texts: Recommended book: John R. Taylor, Classical Mechanics, University Science Books, Any edition.

Recommended book: L.D. Landau and E.M. Lifshitz, Mechanics, Any edition

Recommended book: V.I. Arnold, Mathematical Methods of Classical Mechanics.

Free book: Douglas Cline, [Variational Principles in Classical Mechanics](#)

Class lecture notes: http://people.tamu.edu/~abanov/courses/P303/2025_Spring/LectureNotes.pdf

Grading:	Exams:
Midterm Exam	30%
Final (comprehensive)	30%
Homework (weekly)	40%

Midterm Exam: **March 18-March 20; Take home.**
 Final exam: **May 6, Tuesday, 8:00 a.m.-10:00 a.m.**
*An exam missed without a University excused absence will count as a zero in your final grade.
 Late homework will not be accepted unless there is instructor's approval prior to the due date.
 Missed homework will count as a zero in your final grade.*

Grading scheme: 90-100 A; 75-89.99 B; 60-74.99 C; 50-59.99 D; 0-49.99 F. Grades may be curved upward. Each homework and exam is graded out of 100 points.

Prerequisites and Co-requisites: PHYS 302

Honors section only: In order to receive honors credit for a course, the course is “expected to provide increased intellectual challenge through more sophisticated material, a higher level of intellectual engagement, and more responsibility for the learning process than would typically be expected in an undergraduate course.” As such, in addition to more in-depth understanding of the material in lectures will be expected, additional Honors assignments will be required for Honors sections. These assignments will be discussed on the first day of class and details can be found on Canvas. **Exams between honors and non-honors sections will be identical.**

Course Learning Outcomes:

Conceptual knowledge to gain:

- Deeper understanding of classical mechanics and analytic tools. Understanding Scattering, Oscillations with many degrees of freedom, Rigid Body Motion, and Elasticity.
- Understand the concept of separation of scales. Understanding the universality of the analytic tools as applied to Classical Mechanics.

Upon successful completion of this course, students will be able to:

- Compute the differential scattering cross-section in different potential, find normal frequencies and normal modes of coupled oscillators, compute and analyze the motion of the rigid body, compute the stress and strain tensors in simple problems in elasticity.

Course timeline:

A rough lecture timeline for the course is given below. The detailed description of the lectures and the full lectures' content can be found in the [lecture notes](#).

Week 1	Lecture 1. Introduction. Review of Phys 302. Newtonian formulation. Lecture 2. Review of Phys 302. Energy conservation.
Week 2	Lecture 3. Review of Phys 302. Lagrangian and Hamiltonian formulations. Lecture 4. Probability density. Solid angle.
Week 3	Lecture 5. Disintegration of many particles. Lecture 6. Scattering. Scattering cross-section.
Week 4	Lecture 7. Rutherford's formula. Lecture 8. Oscillations. Many degrees of freedom.
Week 5	Lecture 9. Oscillations. Many degrees of freedom. Examples. Lecture 10. Small oscillations. General solution.
Week 6	Lecture 11. Oscillations with time-dependent parameters. Kapitza pendulum. Separation of scales. Lecture 12. Kapitza pendulum. What is going on? Horizontal case.
Week 7	Lecture 13. Foucault pendulum. Lecture 14. Foucault pendulum. General case.
Week 8	Lecture 15. Oscillations with parameters depending on time. Parametric resonance. Lecture 16. Oscillations of an infinite series of springs. Oscillations of a rope. Phonons.
Week 9	Lecture 17. Motion of a rigid body. Kinematics. Lecture 18. Rotation of a symmetric top. Euler angles.
Week 10	Lecture 19. Symmetric top in gravitational field. Lecture 20. Euler equations. Stability of asymmetric top.
Week 11	Lecture 21. Statics. Lecture 22. Strain.
Week 12	Lecture 23. Stress. Lecture 24. Work, Stress, and Strain.
Week 13	Lecture 25. Elastic Moduli. Lecture 26. Small deformation of a beam.
Week 14	Lecture 27. A rigid beam on three supports. Lecture 28. Hydrodynamics of Ideal Fluid: Mass conservation and Euler equation, Incompressible fluid, potential flow.

University Policies

This section outlines the university level policies that must be included in each course syllabus. The TAMU Faculty Senate established the wording of these 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](#)).

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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 the Disability Resources office on your campus (resources listed below) 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.

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Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu.

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, a person who is subjected to the alleged conduct 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.

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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 healthy self-care by utilizing available resources and services on your campus

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Students who need someone to talk to can contact Counseling & Psychological Services (CAPS) or 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 on the Family Educational Rights and Privacy Act (FERPA)

FERPA is a federal law designed to protect the privacy of educational records by limiting access to these records, to establish the right of students to inspect and review their educational records and to provide guidelines for the correction of inaccurate and misleading data through informal and formal hearings. Currently enrolled students wishing to withhold any or all directory information items may do so by going to [howdy.tamu.edu](#) and

clicking on the "Directory Hold Information" link in the Student Records channel on the MyRecord tab. The complete [FERPA Notice to Students](#) and the student records policy is available on the Office of the Registrar webpage.

Items that can never be identified as public information are a student's social security number, citizenship, gender, grades, GPR or class schedule. All efforts will be made in this class to protect your privacy and to ensure confidential treatment of information associated with or generated by your participation in the class.

Directory items include name, UIN, local address, permanent address, email address, local telephone number, permanent telephone number, dates of attendance, program of study (college, major, campus), classification, previous institutions attended, degrees honors and awards received, participation in officially recognized activities and sports, medical residence location and medical residence specialization.