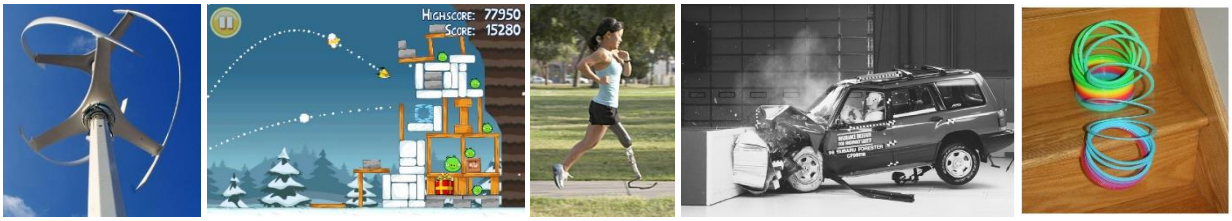
Stevens Institute of Technology
Department of Mechanical Engineering

ME 225: Dynamics

Spring 2025

Welcome to your Dynamics class!



Dynamics is the **study of motion**. We use dynamics to predict the trajectories of flying projectiles and orbiting planets. Dynamics is used to design mechanisms, which can include anything from small toys to heavy machinery. We also use dynamics to analyze human movement in locomotion, sports, or rehabilitation. Dynamics is also used in creating realistic animated movies and video games.

Course Objectives:

We will start by studying **particle** dynamics first, then move on to **rigid body** dynamics.

- You will be able to describe how a particle is moving using **kinematics** (position, velocity, and acceleration as functions of time).
- You will be able to relate a particle's motion to the causes of its motion in a variety of ways (particle **kinetics**): by applying Newton's 2nd law, the principle of work-energy, or the principle of impulse-momentum.
- You will be able to extend your knowledge of particle dynamics to rigid body dynamics, and identify the added considerations involved in going from a point mass (particle can only translate) to a mass with volume (rigid body can translate and rotate).

KINEMATICS
(Describing Motion)

Position, Velocity, Acceleration	Reference Frames (XY, NT, Polar)

KINETICS
(Effects of Forces on Motion)

Force & Acceleration	Work & Energy	Impulse & Momentum

Extra Guidance:

Have a question? Start a discussion on Canvas! You can also come to my office hours, or feel free to email me about any questions or concerns. Please include the course number (**ME 225**) in the email subject line.

ME 225: Dynamics

Instructor:	Teaching Assistant / Peer Leader:
Prof. Maxine Fontaine Department of Mechanical Engineering *Email:* maxine.fontaine@stevens.edu *Office:* Carnegie 209 *Office Hours:* Mon/Wed 1-3, or by appointment	Zitao Tang (ztang14@stevens.edu) Jagger Langhorn (jlangho1@stevens.edu) Class Meetings: **Section B** MWF 10-10:50 am (GN 103)

Course Description:

Particle kinematics and kinetics, systems of particles, work-energy, impulse and momentum, rigid-body kinematics, relative motion, Coriolis acceleration, rigid-body kinetics, direct and oblique impact, eccentric impact. *Prerequisites:* MA 126 or MA 124, PEP 112, and E 126 or ENGR 211

Learning Outcomes:

1. You are able to perform a kinematic analysis of a particle in rectilinear and curvilinear motion.
2. You are able to apply the equations of motion to solve kinetic problems involving a particle or system of particles.
3. You are able to apply the principle of work and energy to solve kinetic problems involving a particle or system of particles.
4. You are able to apply the principle of impulse and momentum to solve kinetic problems involving a particle or system of particles.
5. You are able to perform a kinematic analysis of a rigid body or a system of rigid bodies (e.g. linkage)
6. You are able to apply the equations of motion to solve kinetic problems involving rigid bodies.
7. You are able to apply the principle of work and energy to solve kinetic problems involving rigid bodies.
8. You are able to apply the principle of impulse and momentum to solve kinetic problems involving rigid bodies.

Textbook:

Engineering Mechanics: Dynamics, 15th ed. / R.C. Hibbeler / Pearson-Prentice Hall, 2021
ISBN-13: 978-0134814988

Class Format:

Our class will be (mostly) run as a "flipped classroom". In a traditional classroom, class time is used to deliver content through lectures, and exercises/problems are completed outside of class as homework. In a flipped classroom, you will review the lecture slides BEFORE the next class as homework, so we are able to spend our class time together completing exercises/problems as in-class activities.

Course Assessment:

- Reading Quizzes 5%
- Class Activities 15%
- Research Project 20%
- Exams 60% (4 exams @ 15% each)

Class Activities:

You are expected to review the lecture notes before class in order to complete the in-class activities. **Please bring your computer to class**, so you may refer the lecture notes and use any course software needed complete the activities. Please let me know if you will be unable to attend class.

In-class assignments should be completed individually, unless otherwise specified. You are encouraged to work together and learn together, but copied work is unacceptable.

- Think of the class activities as a set of study problems that will help prepare you for the exams. Many of these problems are actually old exam problems from previous years. Make the effort to really understand the concepts behind the computations – be sure to ask a lot of questions!
- Class activities will be graded largely on completion (rather than accuracy) to give you the space to make mistakes and learn from them. These assignments should be viewed as a learning opportunity to help assess your strengths and weaknesses in understanding of the course topics.
- Scan and upload your work as a single PDF to the appropriate Canvas assignment. Be sure your scanned copy is legible (i.e. not blurry, with good contrast). You can use a scanner or a phone scanner app (e.g. CamScanner, Adobe Scan, Microsoft Lens).

Research Project:

A research project will be assigned during the second half of the course. You will choose and analyze a real-life application that involves dynamics. A short final presentation (recorded) will be submitted at the end of the semester. Further project details will be discussed in class.

Exams:

Exams will be held during class, as noted on the schedule. Make-up quizzes will only be given for medical reasons or prior arrangement with the instructor.

- You are expected to do your own individual work. Exams are closed notes, but you may bring an equation sheet which will be submitted with your exam. Rules for the equation sheet:
    - One sheet (front and back) allowed for each exam
    - Two sheets (front and back) allowed for the final exam
    - Must be hand-written
    - Equations and diagrams only – **No solved problems!**

- Be sure to show your work clearly for all problems. This includes drawing complete and clear free-body diagrams when applicable. A grader should be able to reasonably follow your work from line to line. Points may be deducted if it is unclear how you arrived at a correct answer.

Late Policy:

Assignments should be submitted by the due date, as posted on Canvas. Late assignments will be subject to a late penalty of -10% per day. Extensions may be granted for students who cannot complete the assignment on time due to circumstances beyond their control.

Course Schedule:

A tentative course schedule is posted on Canvas. Students will be notified of any changes.

Grading Scale:

The following grading scale will be applied in this course:

90-100% : A, 87-89% : A-, 83-86% : B+, 80-82% : B, 77-79% : B-, etc.

A small curve may be applied at the discretion of the instructor.

Academic Integrity:

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at https://web.stevens.edu/honor.

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at https://web.stevens.edu/honor.

Learning Accommodations:

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/student-diversity-and-inclusion/disability-services. If you have any questions please contact the Office of Disability Services at disabilityservices@stevens.edu or by phone: 201.216.3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

Inclusivity:

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your pronouns and/or name, please inform the instructor of the necessary changes.

Religious Holidays

Stevens is a diverse community that is committed to providing equitable educational opportunities and supporting students of all ethnicities and belief systems. Religious observance is an essential reflection of that rich diversity. Students will not be subject to any grade penalties for missing a class, examination, or any other course requirement due to religious observance. In addition, students will not be asked to choose between religious observance and academic work. Therefore, students should inform the instructor at the beginning of the semester if a requirement for this course conflicts with religious observance so that accommodations can be made for students to observe religious practices and complete the requirements for the course.

Mental Health Resources:

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments can be made by phone (201-216-5177), online at https://stevensportal.pointnclick.com/confirm.aspx, or in person on the 2nd Floor of the Student Wellness Center.

Emergency Information:

In the event of an urgent or emergent concern about your own safety or the safety of someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year-round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students

dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is not urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.