The Cooper Union for the Advancement of Science and Art
Albert Nerken School of Engineering

ME200: Dynamics: Fall 2025

Instructor: Prof. Michelle H. Rosen
41 CS Room 715
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Course Times: Monday 2:00-3:50pm, Wednesday 4:00pm-4:50pm
41CS 506 (workshops may move to 802/803 after the conclusion of lecture)

Office Hours: Monday 11:30-12:30, Wednesday 2:00-3:00pm, Thursday
Or by appointment: Book time with Michelle Rosen: 30 minutes meeting

TA: Antonio Velez, Antonio.velez@cooper.edu

Course Overview

Course Description: This course introduces the general principles of kinematics (the description of motion) and kinetics (the relationship between motion and the forces that cause it) that are necessary to understand, design, and analyze the motion of engineering systems. Topics include Newton's laws of motion; two- and three-dimensional kinematics and kinetics of particles and rigid bodies; relative motion; work and energy relations; impulse and momentum relations; introduction to vibrations. Laboratory modules focus on numerical solutions of equations of motion. 3 credits. Prerequisites: ME 102.

Course purpose: This course is designed to introduce the principles underlying the dynamics of particles and rigid bodies. It prepares you to formulate and solve engineering problems in rigid body dynamics.

Learning objectives: By the end of this course, you should be able to do the following:

- ***Laws of Motion***. Apply Newton's laws of motion, energy methods, and impulse/momentum methods to particles and rigid bodies to obtain equations of motion. Choose the appropriate method for a given problem.
- ***Mechanisms.*** Analyze the mechanics of links, gears, gyroscopes, rolling wheels and other mechanisms.
- ***Computation.*** Use dedicated software (MATLAB, Python) to solve equations of motion.
- ***Teamwork.*** Work effectively in problem-solving teams.

Course topics

- Kinematics of particles in two and three dimensions
- Kinetics of particles in two and three dimensions
- Work/Energy methods and Impulse/Momentum methods of particles
- Centers of Mass, Moments of Inertia of rigid bodies
- Kinematics of rigid bodies in two and three dimensions
- Kinetics of rigid bodies in two and three dimensions
- Work/Energy methods and Impulse/Momentum methods of rigid bodies

Text: ***Vector Mechanics for Engineers: Statics and Dynamics***, by F.P. Beer, E.R. Johnston and D. Mazurek, McGraw-Hill, 12th ed. ISBN: 978-1-259-63809-1. This combined Statics and Dynamics eBook are available, but only the Dynamics portion will be used in this course.

Supplemental references are listed below and may be referred to during the course. Be aware that they may use different notations and conventions, but the technical material is the same!

- R.C. Hibbeler, *Engineering Mechanics: Dynamics*. Pearson. Available at Amazon
- N.J. Kasdin and D. A. Paley. *Engineering dynamics: a comprehensive introduction*. Princeton University Press. Available at Knovel (Elsevier).
- O.M. O'Reilly. *Engineering Dynamics: A Primer*. Springer. Available at SpringerLink.
- M. Potter, E. Nelson, C. Best, and W. G.McLean, *Schaum's Outline of Engineering Mechanics Dynamics*. McGraw Hill. Available at McGraw Hill or Amazon
- A. Ruina and R. Pratap. *Introduction to Statics and Dynamics*. Free at website.

Course Structure and Policies

Course Structure: The weekly structure of the course consists of a two-hour block on Mondays (with one hour as lecture and the other hour as workshop) and a one-hour lecture block on Wednesdays. The lecture periods are focused on the development of a working knowledge of course theory and problem solving. The workshop period is designed as an introduction to experimental and numerical analysis or as a group problem-solving session. Workshops are designed to be completed in class with minimal time required outside. However, you may need to spend some time if you are not able to complete the tasks during the workshop period.

Reading Schedule: A reading schedule is listed with the course schedule at the end of this document. Lectures are designed to supplement the reading. Therefore, not all required topics will be directly addressed during the limited lecture time. Reading the required sections also develops your technical reading skills.

Grading:

Quizzes	20%
Final Exam	20%
Homework	20%
Workshops	15%
Project	15%
Participation/Attendance	10%

a. There will be two **Quizzes** during the semester. They will weigh **20%** of your overall grade (10% each).
b. The **Final Exam** covers all Chapters and weighs **20%** of your overall term grade.
c. **Homework** on-time completion and selected solution grading will weigh **20%** of the overall grade. Once per semester, you may submit homework up to two days late with no questions asked. See the **Homework Policies** section below for more information on how to use this option and for formatting.

   i. **Office Hour Attendance** is required at least once during the first three weeks of the semester and counts as one homework grade. You can just stop by to chat if you don't have any questions about the material.
   ii. Other miscellaneous assignments (such as the **Introductory Surveys**) will be counted in this category

d. **Workshop** assignments will weigh **15%.** Each week, you will complete a one-hour workshop in class and submit a completed report/document/presentation as indicated. Experimental components can be completed entirely in the one-hour session, but analysis and assignment completion may extend beyond the given time.
e. A final **Project** will weigh **15%** of the overall grade. Details will be provided.
f. **Attendance and Participation** weighs **10%** of the overall grade. Attend the class meetings, take careful notes, and ask questions. Participate fully and professionally in classes and workshops.
g. The **final grade** follows the established policy of: A ≥ 90%; B ≥ 80%; C ≥ 70%; D ≥ 60%, and a lower grade will require the student to retake the course. Note that the cutoff numbers may shift lower (i.e. an A > 87%) at the discretion of the instructor and to the benefit of all students but will never shift higher. Class participation/Instructor Prerogative (IP) will be considered if final grade is borderline.

Attendance: Students are expected to attend all workshops and class sections unless ill, quarantined, or observing a religious holiday. If you must be absent, please be responsible and communicate with Prof. Rosen in advance.

Online Resources and communication: Homework assignments, solutions and administrative material will be posted on the TEAMS channel in the ME200 TEAMS channel. Communication will be through Teams or email.

If you need to reach Prof. Rosen or the TA, please send an email or Teams message. Please know that we may not reply immediately, especially outside of working hours. Allow us one working day to reply after which you can send a polite follow-up (sometimes things do get lost!). Please be mindful of your language and how you communicate. Teams messages can be informal but should still be respectful.

Homework Policy: Homework assigned will generally be due at the beginning of the Wednesday class period (unless otherwise noted). A PowerPoint with assigned problems will be posted. You may work directly on these slides or on your own paper (with relevant problem information and graphics represented). A copy of your solutions will be submitted either via Teams or a hard copy (your choice) and **ONE** problem (selected by the professor) from each homework set will be graded. *One problem will be graded, but submission of the full assignment is required.*

It is ultimately your responsibility to check the homework solutions which will be posted after they are due. You are encouraged to work with your peers on homework but you must turn in your own work that reflects your understanding of the material.

Homework Grading: Grading of one homework problem will be done with a 5/4/R/N grading strategy:
5: Solution is correct, complete, and formatted correctly
4: Solution is mostly correct, mostly complete, and formatted
R: Resubmit (feedback provided)
N: No attempt or little attempt, no resubmission allowed.

Failure to submit a valid attempt at the full homework set will result in an N. You will have one week to resubmit after the grade is returned. Don't wait until the end of the semester to resubmit – it's much better to keep up while it's fresh in your mind!

Homework Formatting: To make things as clear as possible (and to help you sort through your own thoughts), you must use the following guidelines. Failure to follow the formatting instructions will result in a resubmission or a grade penalty.

- *Basic format:* All pages should be submitted (for a multiple page submission), with your name on each page. Keep each problem self-contained and make sure it is clear which problem corresponds to the work. Your writing should be legible and easy to follow. Illegible work or work that is difficult to follow will not be accepted.
- *Problem statement and definition:*
    - Restate the question (not word for word). You should use "given" and "find" or any other notation that clearly distills the problem to its relevant parts and variables. This does not need to be as a paragraph or words! It will help you organize your thoughts (and remember what you're solving for!)
    - Include any relevant diagrams. You should be able to look back on your submissions at the end of the semester (or several years from now!) and understand the problem you were trying to solve.
    - Clearly list all assumptions made.
- *Diagrams:* Free body diagrams must be included when necessary. Axes, coordinates, and dimensions must be clearly labeled. All variables should be defined.
- *Algebraic solution:* An algebraic solution should be given whenever possible. Show as much algebra is needed to explain your thought process – you do not need to include every minor algebraic step.
- *Numerical answer:* If the problem requires it, provide a numerical answer and include accurate units. Be clear about what numbers you substituted for each variable (including units). Make sure that your answer makes sense! This is where you could use your computational software to solve, but make sure that you've shown what numbers you've plugged in for each variable.
- *Time:* Please list the amount of time that you've spent on the homework assignment. This helps the instructors understand how long each assignment takes and adjust accordingly. This may vary based on the topic!

Late Policy: Once per semester, you may submit homework up to two days late with no questions asked. To use this, email Prof. Rosen *before* the start of the class when it is due. Outside of this, no late submission of assignments will be accepted without prior permission. Additional extensions will be considered on a case-by-case basis. Consideration must be requested *before* the start of the class when it is due. Communication is key!

Problem Solving and Time Management: A grasp of engineering subject matter is generally solidified through problem solving. Therefore, expect to spend a large percentage of your time outside of class working out problems. It is generally advised to work a few hours most days of the week rather than all at once. A given problem does not necessarily need to be solved in a single sitting, so a good strategy is to use an iterative approach in which you work on a problem until you are stuck, then leave it alone. *Do not refer to posted solutions!* Your brain will subconsciously work on it, and then when you return to the problem you may experience that "AHA!" moment next time you look at it. Regular homework problems are provided, but you may also want to use the unassigned textbook problems for additional practice.

As a rule of thumb, you should expect to spend 3 hours per credit hour, outside of class time, for any engineering college course. This means expect to spend 9 hours per week on reading, homework, office hours, discussions, and preparation for exams. Note time spent on your homework assignments and let the instructor know if the course takes significantly more outside time.

Collaboration Policy and Academic Integrity: *(adapted from Harvard University, EngSci51 Syllabus)* The fundamental principle of academic integrity is that one must fairly represent the source of the intellectual content of the work one submits for credit. Students are expected to adhere to this policy as subsequently explained. As professionals, we must always strive to uphold standards of honesty and integrity. ASME, the Mechanical Engineering professional society, has adopted a code of ethics in order to define our commitments. Academic dishonesty is a severe violation of our core values. Students caught plagiarizing or otherwise cheating on any assignment will be reported to the Dean's Office as outlined in the academic standards section of the Cooper Union catalog.

What is the policy on examinations? The examinations in this class are to represent individual work. You may not receive any help from other students or any other individuals.

What about home assignments? Can we work together? We encourage students to work together in this class to understand the homework assignments and to learn in general. There is much to be gained in sharing the learning process. However, the final submission should represent your own expression of the final response to the assignment and not a copy of someone else's expression thereof, whether directly from a person or as recorded on paper (e.g. a book) or electronically (e.g. on a website). Furthermore, you must fairly represent the authorship of the intellectual content of the work you submit for credit by acknowledging the contribution of sources (e.g., books, websites) you consult in the process of completing assignments. **In addition, at the end of each assignment on which you collaborated with other students, you must cite the students and the interaction.** The purpose of this is to acknowledge their contribution to your work.
Some examples follow:

1. You discuss concepts, approaches and methods, which could be applied to a home assignment before starting your write-up. This process is encouraged. You are not required to make a written acknowledgment of this type of interaction.
2. After working an assignment independently, you compare responses with another student which confirms your results and response. You should acknowledge that the other

student's write-up was used to check your own. No credit will be lost if the response is correct, the acknowledgment is made, and no direct copying of the other response is involved.

3. After working an assignment independently, you compare responses with another student which alerts you to an error in your own work which you then correct. You should state at the end of your submission that you corrected your error on the basis of checking responses with the other student. No credit will be lost if the response is correct, the acknowledgment is made, and no direct copying of the other response is involved.
4. You and another student work through an assignment together exchanging ideas as the effort progresses. You both should state at the end of your individual submissions that you worked jointly. No credit will be lost if the responses are correct, the acknowledgment is made, and the assignment write-up is independent.
5. You copy all or part of an assignment write-up from a reference such as a textbook or past solution (this is in contrast to referring to such a reference and developing the solution yourself). You must cite the reference. Partial credit will be given, since there is some educational value in reading and understanding the solution.
6. You copy verbatim all or part of a write-up from another student. You must cite the person by name. Very little partial credit will be given.
7. **Verbatim copying of any material which you submit for credit without reference to the source is considered to be academically dishonest.**

What about AI Tools? The increasing capability of artificial intelligence or machine learning tools (such as ChatGPT) has raised questions about their permissibility for completing course assignments. You are doing yourself a disservice by using these tools if you are using them in place of your own thinking, writing, or coding. Be especially careful as AI "hallucination" may simply make up information or sources, and it will generally not give you the right answer in this course (we've checked!). **Students are strongly discouraged but are not prohibited from using these tools. As with any source, they must be cited**. For example, text generated using ChatGPT should include a citation such as: "ChatGPT. (YYYY, Month DD of query). "Text of your query." Generated using OpenAI. https://chat.openai.com/" You must include the FULL transcript of your conversation with the AI Engine as an appendix to the assignment. Material generated using other tools should follow a similar citation convention. Failure to properly cite these tools constitutes academic dishonesty.

Disability Accommodations: Students with disabilities or who need special accommodations for this class are required to provide us with a letter from the Dean of Students so that arrangements can be made. Cooper Union has limited resources and extra time is required for such arrangements to be feasible. In order to receive accommodations, you must notify us in writing at least two weeks before they are needed, and you must also be registered with the Dean of Students. Students will not be afforded any special accommodations retroactively, i.e., for academic work completed prior to disclosure of the disability to us and the Dean of Students. Support services are described here.

Diversity And Inclusion Statement*: (adapted from Dr. Monica Linden, Senior Lecturer in Neuroscience at Brown University)*
We strive to create a learning environment for our students that supports a diversity of thoughts, perspectives, and experiences, and honors your identities (including race, gender, class, sexuality, religion, ability, etc.) To help accomplish this:

- If you have a name and/or set of pronouns that differ from those that appear in your official records, please let us know.
- If you feel the material presented in any way does not represent a diverse background of authors, presenters and experiences, or that we can do better to include diverse perspectives, please let us know.
- If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with us. We want to be a resource for you. We may also be able to also help point you in the direction of other resources
- We (like many people) are still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that made you feel uncomfortable, please talk to us about it.
- As a participant in course discussions, you should also strive to honor the diversity of your classmates.

If you are struggling for any reason in this course or find that you are uncomfortable or not being assessed in a way that reflects your abilities, please reach out to your instructor and/or contact the Title IX officer (resources here).

Where can I get help?

Problem	**Resources**
I'm struggling with the course material!	We are here to help you, but so are your fellow classmates. Here are some ways to get help with course material: • Ask questions during class! • Come to Office Hours (or schedule a meeting with Prof. Rosen or TA) • Form a study group to work on homework • Post a message on Teams - your classmates can help answer too! • Email or Teams Message Prof. Rosen or TA
I need an extension on an assignment.	Please simply ask! We will be considerate of circumstances – we'd prefer you to take an extra day or two than not look at the assignment at all. However, it is in your best interest to keep up with the work as well as you can, as the material is cumulative in this course. Communication is key!
I'm struggling with my mental health	These are really hard times and your mental health is very important. You are a person first and a student later. Remember this and remember to take care of yourself. The Counseling and Mental Health Services (https://cooper.edu/students/student-affairs/health/counseling) is a great resource. If there's anything we can do for you as a teaching staff, don't hesitate to let your professor know.
There's something else...	Please contact us. We're happy to point you in the direction of resources that can help you if we can't. We can't help if you don't communicate, so don't hesitate to reach out!

Course Schedule

Quiz/Exam Schedule: Quizzes: Oct. 15, Nov. 19, Final Exam – due Dec. 15

Reading and Quiz Schedule (subject to change): Fall 2025
The reading schedule will be followed as closely as possible. Material developed in lectures will not necessarily follow the same schedule. It is advised that you complete an initial reading (perhaps with incomplete comprehension) prior to class that week. Then iterate between working on assigned problems and re-reading appropriate sections.

Reading assignments will generally align with the start of lecture on Mondays and homework assignments due at the start of class on Wednesday.

Wk.	Date (Mon.)	Topic	Reading (12th ed)	HW	Workshop (Monday)	QUIZ
1	9/1	**NO CLASS MONDAY** Kinematics of Particles	Ch 11			-
2	9/8	Kinematics of Particles	Ch 12	1	Bouncing Ball	
3	9/15	Kinetics of Particles	Ch 13.1, 2	2	Relative Motion 1	
4	9/22	Work and Energy	Ch 13.3, 4	3	Relative Motion 2	
5	9/29	Impulse and Momentum	Ch 14	4	Problem Solving Session	
6	10/6	Rigid Body Introduction	Ch 5.4 & Ch 9.5	5	Bouncing Ball Revisited	
7	10/13	Rigid Body Kinematics: velocity	Ch 15.1-4		Problem Solving Session	Quiz 1
8	10/20	Rigid Body Kinematics: acceleration	Ch 15.5-7	6	Plendulum Part 1	
9	10/27	2D Rigid Body Kinetics	Ch 16	7	Plendulum Part 2	
10	11/3	2D Rigid Body Kinetics	Ch 17.1	8	Problem Solving Session	
11	11/10	2D Rigid Body Energy Methods	Ch 17.2, 3	9	Spools	
12	11/17	2D Rigid Body Momentum Methods	Ch 18.1		Project, Pics2FBD	Quiz 2
13	11/24	3D Rigid Body Kinematics **NO CLASS WEDNESDAY**	Ch 18.2, 3	10	Project	
14	12/1	3D Rigid Body: Kinetics		11	Project	
15	12/8	3D Rigid Body: Energy and Momentum			Project	
16	12/15	FINAL EXAM due Monday Project Presentations Wednesday				