E15 – Dynamics

"An introduction to the analysis of dynamic mechanical systems"

Instructor

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Office hours: Monday, 3-5 PM, 520-127

Teaching Assistants

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Class Time and Location

Tuesdays and Thursdays, 10:30 AM-11:50 AM
300-300
Fall quarter, 2025

Problem Sessions

Friday 4PM-5PM with Trishna in 550-126
Monday 6PM-7PM with Daniel in Durand 450 (except for 10/6, 11/10, in Durand 353)
Starting Friday September 26

During Problem Sessions the CA will solve more example problems to complement those seen during lecture. Questions about these examples can be discussed during office hours.

Everyone is expected to attend a problem session.

Office Hours

Friday 5PM-6PM with Trishna, problem session's location
Monday 3PM-5PM with Adrian in 520-127
Monday 7PM-8PM with Daniel, problem session's location
Tuesday 3PM-5PM with Cadence in the student atrium of 520
Tuesday 5PM-7PM with Trishna in the student atrium of 520
Tuesday 7PM-9PM with Giuse in the student atrium of 520
Wednesday 1PM-3PM with Giuse in 550-162
Wednesday 4PM-6PM with Daniel in 520-231
Wednesday 6PM-8PM with Cadence in 520-231

Starting Friday, September 26.

Review sessions will be scheduled before each exam.

Questions can be submitted at any time via Ed Discussion, which you can access from Canvas, and efforts will be made by the teaching team to answer questions promptly.

Prerequisites

ENGR 14

Textbook

"Engineering Mechanics - Dynamics"
R. C. Hibbeler
15th edition
Pearson

The 12th, 13th, and 14th editions have essentially the same content, so they are acceptable.

The instructor will post the statement of all assigned problems, and many quizzes will be online in Canvas, so the different numbering of the problems in the book should not represent an obstacle to use either edition.

Website

Canvas, http://canvas.stanford.edu
Discussions for the class will use the discussion software *Ed Discussion,* which is accessible from the Canvas sidebar.

Teaching Team Email

Please email the entire teaching team using
eng15-staff@lists.stanford.edu

Homework Assignments

Every week except on the week of the midterm exam. Due on Wednesday at midnight of California (PDT). No credit for late turn-in (unless approved by instructor). *You can count with one guaranteed approval for late homework during the quarter, normally to Friday. A second approval will be granted under reasonable circumstances.*

Homework assignments will be uploaded to Gradescope for grading.

Collaboration in assignments between students is permitted only towards discussing the statement and the solution of a problem. The solution of each homework problem is an individual task and should be written independently by each student. Failure to honor this rule will result in the homework assignment receiving zero score.

In completing a part of a homework assignment, make sure to clearly outline your thought process to the solution. This will enable us to assign you partial credit for an otherwise incorrect solution.

You are strongly encouraged to use computer software such as Maple, Matlab, Mathematica, or Octave to help you avoid tedious computation. If you use code to solve a problem, a copy of the code/file used to obtain the results should be attached.

Homework assignments need to be **NEATLY** (meaning legibly and with a clear organizational structure) presented on a clean sheet of paper or document. Your assignments need to be easy to follow and understand. We will simply disregard as not turned-in and assign a minimum grade to any assignment that does not meet these requirements. I cannot emphasize this enough.

Exams

Midterm: Wednesday, October 29, 6-10 PM, TBA
Final Exam: Thursday, December 11, 3:30-6:30 PM, TBA

The midterm is only two hours long. You choose which slot of two-consecutive hours from 6:00-10:00 PM to do it. Changes to the exam dates are highly unlikely and will be announced a minimum of 1 week in advance. Exams will be closed book/closed notes, but you may bring one handwritten, letter sized formula sheet (no photocopies or printouts) to each exam. Bring a calculator, but pre-programmed functions or programs may not be used. No internal (e.g., with other students) or external (phone, e-mail, wireless internet, semaphore, telepathy, etc.) communication is permitted during the exam. Except for documented medical or family emergencies, prior arrangement (at least 1 week) will be required to reschedule an exam for valid reasons. The final exam must be taken at the scheduled time.

Grading Policy

Your class score is obtained by weighting the scores in the following way

- Homework: 25%
- Midterm Exam: 35%
- Final: 40%

Most problems in an assignment or exam are graded in a scale from 5 to 10, with 10 being perfect and 5 being an effortless and incorrect attempt to do it, or not doing it.

The final score of an assignment or exam is obtained by simply adding up the scores for each problem. The total score of your assignments is the sum of all the scores for all assignments.

The final grade for the class is computed with both an absolute and relative (curve) scale. If you get above or equal to

- 96.0% of the maximum score you get an A+
- 93.0% of the maximum score you get an A
- 90.0% of the maximum score you get an A-
- 86.5% of the maximum score you get a B+
- 83.0% of the maximum score you get a B
- 79.5% of the maximum score you get a B-
- 77.5% of the maximum score you get a C+
- 75.0% of the maximum score you get a C
- 72.5% of the maximum score you get a C-
- 70.0% of the maximum score you get a D+
- 67.5% of the maximum score you get a D
- 65.0% of the maximum score you get a D-

If you score below 65.0% of the maximum score you get an NP.

Simultaneously, at least 20% of the class will get an A- or higher, at least 40% of the class will get a B- or higher, and at least 60% of the class will get a C- or higher, as long as the minimum of 65.0% of the maximum total score is achieved.

Class Policy

Reminder: We should all abide by Stanford's honor code.

Suspected infractions will be referred to Judicial Affairs -- Please do not force us to do this.

Communication with the Instructor

The instructor will be happy to set up individual discussions upon request. Email him to schedule it.

Objectives

ENGR 15 uses the same principles of Dynamics that you have seen in Phys 41, but goes beyond and applies them to systems of particles and rigid bodies, trying to build a first foray into engineering problems. ENGR 15 also emphasizes the adoption of a systematic and orderly approach towards analyzing engineering problems, as well as towards creating simple models of complex systems that can provide a first ballpark answer to questions about the system. We call these “back-of-the-envelope” calculations.

By the end of the course you should be able to:

1. Solve problems involving the dynamics of mechanical systems formed by particles and rigid bodies moving on a plane and some three-dimensional situations, by combining Newton’s laws and linear and angular momentum and energy balance. In particular, this generally involves:

    a. Building a model for the physical system under consideration: This means observing the physical system and idealize it in a way that it retains only the relevant features needed to answer the question at hand.
    b. Decomposing the problem into separate stages for the analysis. The analysis of each one of these stages would require a different set of equations and free-body diagrams, generally resulting from a change on the kinematic constraints or balance laws.
    c. Performing a kinematic analysis of the problem, computing positions, velocities and accelerations of a mechanical system.
    d. Performing an analysis of the dynamics of each stage of the problem, identifying the balance of forces, linear momentum, angular momentum, or energy that can be useful to find the unknowns at any given stage of the analysis.
    e. Solving the equations for the unknowns sought at any given stage of the problem, and then performing a sanity check. In particular, you will be encouraged to separate the analysis and computing parts of the solution: first you should identify and write down all the equations needed for a given stage, and only then proceed to manipulate them to solve them.

2. Use vectors for the analysis of problems in dynamics, decomposing them in a convenient basis for the problem at hand, sometimes using more than one basis perhaps. For example, in writing Newton’s laws, forces and accelerations might be expressed in components in a cylindrical basis.

3. Obtain the equations of motion of simple mechanical systems with particles and rigid bodies, and use them to compute relevant kinetic quantities such as forces, velocities and accelerations.

Miscellaneous Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty. Unless the student has a temporary disability, Accommodation letters are issued for the entire academic year. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: https://oae.stanford.edu/.

Class schedule:

Wk	Mo	Tu	We	Th	Fr
1		Sep 23 1		Sep 25 2	
2		Sept 30 3	Oct 1 HW#1 due	Oct 2 4	
3		Oct 7 5	Oct 8 HW#2 due	Oct 9 6	
4		Oct 14 7	Oct 15 HW#3 due	Oct 16 8	
5		Oct 21 9	Oct 22 HW#4 due	Oct 23 10	
6		Oct 28 11	Oct 29 Midterm Exam	Oct 30 12	
7		Nov 4 Democracy Day No class	Nov 5 HW#5 due	Nov 6 13	
8		Nov 11 14	Nov 12 HW#6 due	Nov 13 15	
9		Nov 17 16	Nov 18 HW#7 due	Nov 19 17	
Thanksgiving Break					
10		Dec 2 18	Dec 3 HW#8 due	Dec 4 19	
				Dec 11 Final Exam	

Legend:

Oct 2 (date) 1 (lecture #)

Reading and Lecture Schedule

#		Date		Topic	Textbook
1	Tu	Sep	23	Presentation of the Course Rectilinear Motion	12.2
2	Th	Sep	25	Curvilinear Motion	12.4-12.7
3	Tu	Sep	30	Curvilinear Motion	12.8-12.9
4	Th	Oct	2	Relative Motion	12.10
5	Tu	Oct	7	Kinetics of a Particle	13.1-13.4
6	Th	Oct	9	Kinetics of a Particle	13.5-13.6
7	Tu	Oct	14	Work-Energy Principle	14.1-14.6
8	Th	Oct	16	Linear Impulse and Momentum Principle	15.1-15.3
9	Tu	Oct	21	Impact	15.4
10	Th	Oct	23	Angular Impulse and Momentum Principle	15.5-15.7
11	Tu	Oct	28	Planar Rigid Body Kinematics	16.1-16.4
12	Th	Oct	30	Planar Rigid Body Kinematics	16.5-16.6
	Tu	Nov	4	No Class	
13	Th	Nov	6	Planar Rigid Body Kinematics	16.7
14	Tu	Nov	11	Kinetics of a Rigid Body	17.1-17.3
15	Th	Nov	13	Kinetics of a Rigid Body	17.4-17.5
16	Tu	Nov	17	Kinetics of a Rigid Body	17.1-17.5
17	Th	Nov	19	Work and Energy for Rigid Bodies	18
18	Tu	Dec	2	Impulse-Momentum Principles for Rigid Bodies	19.1-19.2
19	Th	Dec	4	Impulse-Momentum Principles for Rigid Bodies	19.3