



ME 345: Modeling and Simulation

Department of Mechanical Engineering

Spring 2025

Canvas Page: <https://sit.instructure.com/courses/77659>

Instructor: Professor Chaitanya Krishna Vallabh

Contact Info: cvallabh@stevens.edu; 201-216-5051; Office: EAS Annex 202

Prof. Vallabh Office Hours: Fridays 4-5pm (in-person or Zoom link in Canvas); others by appointment

Prerequisite(s): ME 225 (Dynamics), ME 234 or E 234 (Thermodynamics), MA 221 or MA 281 (Differential Equations)

Corequisite(s): must also be enrolled in an ME 345 Lab Section for the semester

Cross-listed with: N/A

COURSE DESCRIPTION

This course uses Solidworks, CREO, ANSYS, Matlab/Simulink, and other software to model discrete and continuous systems of interest in mechanical engineering. Students taking this class will be able to represent systems, processes, and products using appropriate modeling strategies, analyze and visualize the simulation results, and design systems based on these models and simulations. The focus of the class is on the development of general modeling and simulation techniques that are discipline and software independent.

STUDENT LEARNING OUTCOMES

After successful completion of this course, students will be able to...

Student Outcome 1: (Complex Engineering Problems) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

- 1.1: You are able to apply the Finite Element Method to assess the stress, strain, and deformation within a complex component or assembly.
- 1.2: You are able to apply CAE simulation tools to evaluate, redesign and optimize a given complex mechanical system.

Student Outcome 2: (Design) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

- 2.1: You are able to apply various CAE packages to: (i) evaluate the performance of the system, (iii) modify the system within the CAE environment to meet design targets, and (iv) assess the impact of design changes on the system performance.

Student Outcome 3: (Communication) an ability to communicate effectively with a range of audiences

- 3.1: You are able to: (i) write a clear and concise technical memo summarizing the results of a CAE simulation and (ii) appropriately support the technical conclusions drawn from the simulation

Student Outcome 6: (Experimentation & Data) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

- 6.1: You are able to critically interpret, analyze, and evaluate the results of a CAE model simulation.
- 6.2: You are able to critically evaluate FEM model results via comparison to simplified analytical solutions.

Student Outcome 7: (Acquire New Knowledge) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

- 7.1: You are able to independently find and utilize external resources to enhance your computer programming efficiency.
- 7.2: You are able to utilize software tutorials and other self-study materials to learn how to apply new engineering software tools

COURSE FORMAT AND STRUCTURE

This course is on campus. To access the course, please visit <https://sit.instructure.com/courses/77659>. For more information about course access or support, contact the Stevens Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

Course Logistics

ME IT Support: For issues with accessing or downloading the software used in the ME 345 course, please contact the ME System Administrators at mesysadmin@stevens.edu for assistance.

Lab Tutorials: The computer labs are designed to require students to THINK and EXPLORE as they progress through the tutorials. The lab assistant(s) are there to assist with thoughtful questions and issues; they are not there to hold your hand through the tutorial. Students abusing the assistance of the TAs will have points deducted from their lab grade; students assisting classmates with questions on the lab will be awarded extra credit for the lab. The policy for late lab submissions is described in the course Lab CANVAS shell.

Group Case Studies: Group Case Studies will be completed in groups of 4-5 students. You cannot sign up to work with the same student for more than one Case Study. Each member of the group is equally responsible for each problem in the Case Study. Groups will be asked to complete and submit a Group Member Contribution tracker outlining each student's contribution to the Case Study analysis and report as part of the submission. In addition, students will have an opportunity to complete a confidential, online 360 Group Member Evaluation to rate the cooperation, collaboration, and contribution of each member of the group.

Cumulative Final Exam: The cumulative final exam will be open book/notes/materials and held online during the Final Exam period. You may not use Chegg or other online resources during the exam. You may not collaborate with another individual or share any notes during the exam.

Common materials and assessments: There are two sections of this course being taught in Spring 2023. The material covered and the assessments used in the sections will be identical (i.e. the instructors consider this one single course), and a common grading scheme will be used throughout the semester. Likewise, the 6 lab sections cover the same material and have the same requirements. Each lab will be populated by students in each of the lecture sections. For group Case Studies, you may choose (or you may be assigned if you do not choose) students from any of the lab or lecture sections.

Online posting of assessment materials: Assessment materials, including Case Studies and exam questions, MAY NOT be distributed or uploaded in any manner, or at any time, to an external online resource such as Chegg. To do so is a violation of the Stevens Honor Code.

Instructor's Online Hours

I check emails regularly and try to respond as soon as I can (generally within 48 hours). When emailing us, please place in the subject line the course number/section and the topic of the email (i.e., ME 345 – Case Study 1 Question). This will help me tremendously in locating and responding to your emails more quickly.

Online Etiquette Guidelines

Your instructors and fellow students wish to foster a safe online learning environment. No matter how different or controversial they may be perceived, all opinions and experiences must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea, but you cannot attack an individual. Our differences, some of which are outlined in the University's inclusion statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambiance. Please read the Netiquette rules for this course:

- Do not dominate any discussion. Allow other students to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language as it could lead to misinterpretation.
- Keep an "open-mind" and be willing to express even your minority opinion.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.

TENTATIVE COURSE SCHEDULE

A one-page tentative course schedule for ME 345 is posted below and also available on CANVAS and will be discussed with students during the first lecture.

Any changes to this tentative schedule will be highlighted in lecture and communicated via a CANVAS Announcement to all students in the course.

Week		Topic/Notes
1	lab	Lab 1- Reintroduction to SolidWorks tutorials (refresher)
	class	Lecture 1 - Introduction to Modeling and Simulation
2	lab	Lab 2 – Assembly in SolidWorks
	class	Lecture 2 - MATLAB programming 1
3	lab	Lab 3 – Mechanism Analysis in SolidWorks
	class	Lecture 3 - MATLABprogramming 2
4	lab	Lab 4 – Structural Analysis in SolidWorks
	class	Lecture 4 - Mechanisms 1
5	lab	Lab 5 – Structural Analysis in ANSYS
	class	Lecture 5 - Mechanisms 2
6	lab	Lab 6 – LINKAGES / Thermal and Flow Analysis in ANSYS (Part 1)
	class	Lecture 6 - Introduction to the Finite Element Method
7	lab	Lab 7 – Thermal and Flow Analysis in ANSYS (Part 2)
	class	Lecture 7 - Finite Element methods II (MATLAB)
8	lab	Lab 8 – ANSYS APDL (ANSYS Parametric Design Language)
	class	Lecture 8 - Von Mises stresses and failure theories
9	lab	Lab 9 - Optimization in SolidWorks
	class	Lecture 9 – Finite Element methods III (misc ME domains)
10	lab	Lab 10 - CREO Elements 1 - Parametric Modeling
	class	Lecture 10 - Multivariate optimization – theory and EXCEL
11	lab	Lab 11 – CREO Elements 2 - Simulation & Optimization
	class	Lecture 11 - Artificial Intelligence (AI) and Machine Learning (ML) in ME -
12	lab	Lab 12 – AI and ML in MATLAB
	class	Lecture 12 - Artificial Intelligence (AI) and Machine Learning (ML) in ME -
13	lab	Lab 13 – CREO Flow Analysis
	class	Lecture 13 – Strategic Learning / Engineering in Practice Presentations
14	lab	Lab 14 – “Choose Your Final Lab Assignment”
	class	Lecture 14 – Review and Final Exam Preparation

The review and final exam period is Thursday May 8 through Saturday May 17.

The ME 345 Final Exam will be scheduled by the Office of the Registrar during the Final Exam period.

COURSE MATERIALS

Required Textbook(s): None.

Online Material: Extensive materials will be distributed electronically via CANVAS.

Reference Texts (optional): Example of textbooks that cover lecture material include the following:

- Finite Element Analysis: Theory and Application with ANSYS (Third Edition), S. Moaveni, Pearson Education, Inc, Upper Saddle River, NJ, 2007, ISBN 013189080
- Modeling and Analysis of Dynamic Systems, 3rd. Ed. Close, Frederick, and Newell, Wiley, 2002, ISBN 0-471-39442-4

TECHNOLOGY REQUIREMENTS

Baseline technical skills

- Basic computer and web-browsing skills
- Navigating Canvas

Technology skills necessary for this specific course

- Live web conferencing using Zoom

Required Equipment

- Computer: current Mac (OS X) or PC (Windows 7+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed
- Microphone: built-in laptop or tablet mic or external microphone

Required Software

- [ME 345 CAE software covered in the lab is described here \(link here\) \(Links to an external site.\)](#)
- MATLAB
- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint

GRADING PROCEDURES

Final course grades will be based on:

Homework (Lecture) 10%

Weekly Lab Summaries 15%

Two Group Case Studies 30%

Final Case Study 20%

Cumulative Final Exam 25%

[A description of how letter grades should describe performance in a Stevens course is available on the Stevens website.](#)

Online posting of assessment materials: Assessment materials, including Case Studies and exam questions, MAY NOT be distributed or uploaded in any manner, or at any time, to an external online resource such as Chegg. To do so is a violation of the Stevens Honor Code.

Late Policies

Lecture-based material: Homework arising from the lecture portion of the class will be accepted up to one week late with a penalty of 20% of the total grade. Late Case Studies will incur a penalty of 10% for each partial 24 hour period after the submission deadline.

Lab-based materials: Each Lab Summary will be submitted through CANVAS and be due at the date/time indicated in the CANVAS assignment (generally at 7 pm pm the day of the next lab meeting for your section). Lab Summaries submitted after this time will lose 5 points per partial day late.

Academic Integrity

Undergraduate Honor System

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 <http://web.stevens.edu/honor/> (Links to an external site.)

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."

Reporting Honor System Violations

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 www.stevens.edu/honor ([Links to an external site.](#)).

EXAM CONDITIONS

The following procedures apply to quizzes and exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Conditions on the quiz or exam.

Students may use the following materials during quizzes and/or exams. Any materials that are not mentioned in the list below are not permitted.

- Materials posted on the ME 345 lecture and/or lab CANVAS pages.
- Assignments completed by the student in the context of the course.
- Personal notes taken by the student during the course.
- Calculator
- Any software programs or files explicitly requested to be used on the exam.

Students are/are not allowed to work with, talk to, or communicate with other students or individuals during quizzes and/or exams.

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: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@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

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 name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

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.

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).

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or 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.