ENGR10 -Introduction to Engineering Analysis
Professor M. A. Cappelli
4 Units, Summer 2024-25
Syllabus

Level. The course is primarily intended for freshman with advanced placement in math and physics, and sophomores. It is not recommended to be taken by undergraduates who have already taken sophomore/junior-level courses in mechanics, thermodynamics, or fluid mechanics (such as E14, E15, E30, or ME70). During the summer, it is available to high school students who have had AP calculus and AP physics (calculus-based highly recommended). As a prerequisite, this course requires competency in differential and integral calculus. The prerequisites for Stanford undergraduates include MATH 20 and 21, as well as a calculus-based PHYSICS class (e.g., PHYSICS 40 and 41). Students can get by with PHYSICS 20 and 21 but may have to work harder associating the mathematics with the physical principles.

Objective. Analysis is the way that modern engineers use mathematics and science to figure out how to understand, design and build complex devices, machinery, structures, or interacting systems. This course provides an introduction to fundamental properties and a unified treatment of principles used in engineering analysis. The fundamental properties include mass, charge, elements, linear momentum, angular momentum, energy, and entropy, but also other properties of interest to engineers, such as money, manufactured products, and even other economic metrics. The associated fundamental principles express the conservation of the properties. The course is built around the notions of balances for these properties; getting the balances right is the most important part of any analysis, and once you have these balances, the rest is pretty easy. The balances themselves are easy once you get the hang of it, so analysis (which is crucial to high-tech design) is not only important, but also easy, creative, and fun! Sometimes, the analysis results in equations that are easily solved using algebraic tools that you would have learned in an advanced high school algebra class or in a college calculus class. Sometimes the analysis results in equations which have derivatives of the variable you seek to find (often, the engineering system property of interest, like the mass of a rocket ship, or its speed). Some of these equations are easy to solve. In most cases, however, engineers have to use computers to do so. In this class, you will be taught how to solve such "differential" equations (as they are called, because they have derivatives in them) using modern tools such as Matlab. Strap yourself in and come along for the ride - with a little work on your part you will master the governing principles behind all engineering systems and how engineers exploit them to develop an understanding as to how their constructions work.

Credit. 4 units. E10 is an approved Engineering Fundamental, which means you can use it to satisfy these requirement in any engineering major. For Stanford undergraduates, it is approved to satisfy the Ways requirement in Applied Quantitative Reasoning (AQR) and also Formal Reasoning (FR).

Instructor. Professor M. A. Cappelli, cap@stanford.edu, Building 520, Room 124, 725-2020 (Office). For the summer quarter of 24-25, I will set aside MW afternoons 4:00 am - 5:00 pm, for office hours, and I may survey the class to find another time for those who cannot attend these two opportunities. There may be days when I have a pressing meeting during these times and may have to reschedule. I will let you know in advance. I can also be available by appointment. I usually answer my email promptly unless I am preoccupied in a meeting (or sleeping!). But if it is after 8 pm, please do not expect an immediate response!

Administrative Assistant. Ms. Tasha Jackson, tashaja1@stanford.edu, Building 520, Rm. 118. This office has my mailbox too. For the summer of 24-25, it is unlikely that you will need to contact her.

Course (Teaching) Assistant. The course assistants are TBD. The course assistants will be engaged in holding office hours and tutorial sessions where you will be able to see them work sample problems. Office hours and tutorials will be posted during the first week of class.

Class Schedule. Lectures will be on Monday, Wednesday, and Friday, at 1:30 – 2:50 pm in Building 200, Rm 203.

Homework. With the exception of the first homework, which is a review of advanced high school or AP math and physics, homework will be due midnight every Thursday, submitted via Gradescope. (gradescope.com). Gradescope is coupled to Canvas (canvas.stanford.edu) the course management website), and you should already have a Gradescope account because of this. You will upload your homework solutions to Gradescope on a problem by problem basis (we will provide some instruction on this process). Gradescope is the platform that we will use to grade your homework. Homework will be graded within about a week. Homework is designed to help you learn the material and will count for 40% of the course grade so take it seriously!

Homework Format. When you do an analysis, if you do it neatly and in an organized way from the beginning, you are likely to get it right the first time and hence spend less time on it than if you do it first in a sloppy way, and then copy it over. See the methodology outlined in section 1.6 of the reader. Be sure to explain the problem briefly, and how you solved it. Don't just give a bunch of equations with no explanations; the person reading the analysis can't ask you questions, and so you need to be clear (but brief) in your explanation. The green engineering pads sold in the bookstore are widely used and recommended here. The lines on the backside make it easy to be neat and organized. A solution presented in pencil is fine, although pen is more permanent, and will be appreciated many years down the road. You should also consider preparing your problem sets on a computer, as this will be the way reports are written and presented now in Engineering practice. It takes longer but will be more accessible to you and available to you forever!

Reader. "Introduction to Engineering Analysis", by W.C. Reynolds, course reader for E10, available as a pdf file(s) on the course (Canvas) website. We will use MATLAB throughout the class. I do not ask you to purchase a reader/text, but I do ask that you purchase MATLAB. We will have workshops for MATLAB review for those who need a primer. If you have a hardship and cannot purchase MATLAB, you can use the University computing resources which offer MATLAB on-line access.

Midterm Test. Typically at the end of 4th week, outside of class (but in person). Submitted via Gradescope.

Quizzes. Typically, at the end of the 2nd and 6th week**.** Take-at-home (open everything but you cannot confer with anyone), limited time (typically 30 minutes). Submitted via Gradescope.

Final Test. This is scheduled by the University.

Course Grade. The homework is worth 40%. Quizzes (2) will be worth 5% each. The final test is worth 35%, the midterm test is worth 15%.