

# MECH 105: Mechanical Engineering Problem Solving

- **Instructor:** Dr. B (or Dr. Bechara if you want to formal about it. Thats cool.)
- **Email:** samuel.bechara@colostate.edu If you need to contact me, please email me from your official CSU email address at samuel.bechara@colostate.edu. Please do not use your personal email address.
- **Office:** A105
- **Lecture Time:** MWF 12:00 - 12:50
- **Lecture Location:** Behavioral Sciences A101

## Teaching Assistants

- **GTA:** Joshua Christopher
  - **Email:** joshua.christopher@colostate.edu

## Required Materials

Required Text: Applied Numerical Methods with MATLAB for Engineers and Scientists (4th Edition). *ISBN: 978-0-07-339796-2*

- It is *required* to get access to McGraw hill connect. There will be reading and homework assigned through the McGraw Hill Connect online platform. If you go to the CSU bookstore, they can help you with the different e-text, book, and connect options.
- Please see the mech105InclusiveAccessInstructions.docx file under the Course Info module in canvas for more details.

## Read the syllabus!

A syllabus is a contract between you and your professors. I will hold you to it, and to be fair to your classmates, I will not allow *any* exceptions. If you feel that any of the policies are unfair please let me know and I will consider changing the policy. However, it is always up to me to change the policy. I will only entertain potential changes to policy in the first week of class. After that, it is assumed that you have read the syllabus in it's entirety and accept all of the stipulations within.

Before you email me a question, check and **read the syllabus!**

## Office Hours

Office hours are the time that is reserved for you just to swing by and ask anything. Both myself, the TA's and LA's will hold office hours. Emails can get very annoying so please consider swinging by my office hours as opposed to emailing if you have questions / concerns.

Person	Day	Hours	Location
Dr. B	Tues	1-2pm	Engineering A105
Dr. B	Wed	10-11am	Engineering A105
Joshua Christopher (GTF)	Wed and Thurs	2-3pm	Engineering A103V
Abbie Maben (LA)	Mon and Wed	1-2pm	Titan Classroom
Courtney Doherty (LA)	Thurs	9-11am	Titan Classroom
Courtney Doherty (LA)	Fri	1-3pm	Titan Classroom
Alden Tennison (LA)	Tues and Thurs	3-5pm	Academic Village C146

## If you want to meet with Dr.B

If you need to meet with me outside of my office hour times (and can't get your questions answered by MESA, tutoring, TA's, etc) then just drop me an email with your availability in the next 48 hours and briefly explain

why you need to meet. **Please do not just swing by my office outside of office hours.** I leave my door open but I am usually busy working on things and it is unlikely I will appreciate being interrupted. Sometimes I will not be able to meet you the same day, but I will try my best to meet you within two.

## Course Objectives / Learning Outcomes

- Become more comfortable with engineering analysis and problem solving.
- Learn how to approach and solve various types of mechanical engineering analysis and design problems (and, in so doing, learn about various areas of mechanical engineering).
- Learn the theory, application, and limitations of various numerical methods for:
  - finding roots of equations
  - solving sets of linear and nonlinear equations
  - solving optimization problems
  - curve fitting
  - differentiation and integration
  - solving differential equations
- Gain an understanding of and appreciation for the importance of engineering analysis and numerical methods.
- Become proficient with various software analysis tools, especially MATLAB.
- Learn the basics of programming including logic, iteration, loops, and functions.
- Become more comfortable with vector and matrix notation and operations.
- Get excited about various mechanical engineering areas through case studies and special topics.

In addition to learning the material, my goal is that you also learn:

- How to think algorithmically
- Why I think it is stupid to say things like: “I hate math”, “I hate MATLAB”, or “I hate coding” (oxford commas for LIFE)
- How to take responsibility for your education and what the difference is between *learning* and *teaching*.
- How to use a CLI and why you should.
- How to use GNU/Linux and why you should.
- How to write pretty files like this using markdown, latex, and pandoc. (If we have time).
- How to use Git and version control software to control your programming life.

## MATLAB and the Virtual Classroom

We are going to be using MATLAB throughout this semester to solve problems. Please familiarize yourself with how to access MATLAB as a CSU student. There are a ton of different options.

As of 2018, CSU now provides MATLAB licenses to students **FOR FREE**. This is huge and you should take advantage of it. A MATLAB license costs about \$500 so download it on your personal computer and learn how to use it!

Click here to go to the CSU MATLAB Portal and download your copy.

Whatever you decide to try, it is **your responsibility** to figure out how to access MATLAB to complete your homework and assignments. There are computer labs, virtual labs, and other options in addition to the student license of MATLAB.

## A Note on Canvas

I am going to contact the class using canvas. I will periodically send out announcements using canvas and it is your responsibility to check for announcements. I recommend allowing canvas to send you notifications. I will post homework, solutions, and you will also have the discussion posts on canvas. It is your responsibility to become familiar with Canvas.

## Academic Dishonesty and Class Conduct

It is your responsibility to make sure you are familiar with the CSU Academic Dishonesty Policy. You can find it by clicking [here](#). I take cheating in any form *very seriously* and will punish offenders.

**Any breach of the academic integrity policy will result in an automatic F grade for the course.** Exceptions to this policy are at the discretion of the instructor.

When it comes to class conduct, you should always refer to your professors as either Professor [Last Name], or Dr. [Last Name] unless they tell you differently. This applies to emails, phone calls, or any other professional communication. Respect and professionalism should always be your default. Furthermore, when dealing with the TA's I expect you to treat them the same way you treat your professors.

Relevant PhD Comic

### A Note on Showing Up Late

Personally, I don't understand showing up to class late. You (or someone) is paying a small fortune for you to attend classes and learning from your professors in class is a huge part of the learning process. Even though I don't understand it, doesn't mean it might not happen to you. A couple of things about showing up late:

- You can not make up material that you miss in class for *any* reason. So don't ask.
- If you can't help it and you are going to be late, please enter the classroom as quietly and respectfully as possible. Don't enter through the front doors, with your headphones on, and then ask people to stand up so you can get to the middle row (yes that has happened in my class before). **If you are late do not interrupt the class.** Try and enter the class through a back entrance and be quiet and respectful of your classmates that are trying to learn.

### A Note on Technology

I know it isn't a requirement to have a laptop as a student at CSU and that as a student you have access to great computer labs. However, having a laptop for this class would be a significant advantage as you could bring it into office hours and the TA's or myself can help you with your algorithms. If you do not currently have a laptop, I highly recommend getting a refurbished old thinkpad or CSU surplus laptop that will last you faithfully for the next 4 or 5 years. You do not need a \$2600 Macbook Pro with all the bells and whistles to write algorithms or code.

## In Class Participation

As mentioned before, you are paying (or someone is) a lot of money to attend CSU. Why? To learn stuff! Class attendance is an important part of the learning experience but **you** have to do the learning. I am not going to take attendance, but at random times throughout the semester, I will use the `random-student-gui` to call on students. Your performance when called on will determine your participation score in the course.

The classroom is a learning environment in which everyone is respected and everyone gets the opportunity to learn. I will expect it to be treated as such. When you come to class, you should be ready, willing, able to learn, and to help your classmates to learn. *I expect you to be engaged and working when we are in class.* For example, I don't have a cellphone or laptop policy because you are adults and both of those tools have legitimate educational utility. However, if you are playing raid legends or browsing reddit in class, I will get upset because you are not only wasting your time, but it is distracting to your classmates.

### `random-student-gui`

To show off how awesome MATLAB is, I have created a very simple program that tracks participation of students by generating a random number using `rStudent = randi(length(names))`

- `names` is a vertical array containing the entire roster of the class
- `rStudent` is an integer that corresponds to the row that the student occupies in the `names` array

- You can see for yourself and you should! Feel free to clone and hack the program. And no, I won't use your custom version that puts your row in the `blacklist` array. However, if you have a legitimate idea to improve the program, I would be happy to show you how to clone the repository, create a branch, and try out your enhancement. <https://github.com/sbechara/random-student-gui>

I use `random-student-gui` to make sure that you are working on the Super Awesome Custom Problems and other in class assignments. I will use it often throughout the semester.

A couple of last notes on the `random-student` caller.

- If you are not called on at any point during the semester, you will receive full credit.
- If you are in a large class (e.g. greater than 100) it is possible that you will be only called on once. If you miss that one call, *you will receive a 0 grade on all participation points*. This is non-negotiable and this rule will be strictly adhered to.
- The **only** exception that I will allow is for university sanctioned absences. If you are called on and have a university sanctioned absence, I will “skip” you and you will not get a 0 score for that call.

### University Sanctioned Absences

Please note that it is *your responsibility* to keep track of your University Sanctioned absences paperwork. If at the end of the semester I give you a 0 on the random student caller and you had a legitimate excuse, you will need to provide the documentation to prove your absence was excused, even if you had already provided the documentation to me earlier in the semester. Please hold on to it until the semester is over.

### Discussion Posts

Every other week (or so) we will have an online discussion about a topic tangentially related to problem solving. Sometimes it might even just be related to what is like to be a professional engineer. The discussion will take place on canvas and is intended to be exactly that, a discussion. As such the grading is all or nothing. You get 1 point if myself or the TA determines that you participated adequately, and you will receive 0 points if we do not think you put in enough effort. *Grading is at our discretion and is not negotiable*. The discussion prompts will be posted on canvas and are intended to get you thinking about engineering ethics and are supposed to be fun. Please take them seriously and give them some thought and effort. I will not drop any of your discussion post scores.

### Homework Assignments

Homework assignments will be assigned periodically throughout the semester and will usually be due by the next class period (unless otherwise noted on the assignment). The assumption from you should be that it is due by the next class period.

**Late homework is not accepted for any reason, however I will drop your lowest homework score.** You are welcome to work with your classmates on homework but you are not allowed to access homework solutions from previous semesters. *Letting someone copy your work is considered cheating and will be dealt with as such*. I will drop your lowest homework assignment score.

There are different types of homework assignments that have slightly different requirements:

1. Algorithm Development (graded)
2. Online via McGraw Hill Connect (graded)

### Algorithm Development Question Guidelines

At various times throughout the semester I will ask that you develop an algorithm in MATLAB that performs some Numerical Method on some bit of data. You will turn these assignments in on MATLAB Grader. MATLAB Grader is an online tool for turning in MATLAB assignments. You will receive more instructions on how to sign up for MATLAB Grader in class.

The reality is that most of the algorithms I am having you work on have already been developed and are easily accessible via the internet. However, **copying an algorithm from a previous year student or off the internet defeats the whole purpose of attending the course and will be considered cheating.** Please recall that violations of the academic integrity policy result in an F for the course. The algorithm development problems are designed to improve your MATLAB coding and your algorithmic thinking, both skills which will be beneficial to you in the future. Please take them seriously and work on them honestly and earnestly. I always give an extended period of time to work on these problems so that you have adequate time to think and struggle. Remember, *struggling is an integral part of learning.*

### Online Homework via McGraw Hill Connect

Most of the time, I will assign homework assignments using the McGraw Hill connect online homework thing. I hate online homework but the reality is I assign too much to grade a huge class like this by hand. I will try my best to design my own, and pick problems, that are relevant to your other classes and the topics we are learning. These are automatically graded online.

### Exams

Three comprehensive exams will be given in class. The final will follow a similar format as the class exams and will be comprehensive. For the midterm exams, you can use one side of an 8.5"x11" piece of paper with handwritten notes to assist on the exam. If you show up to class with something else (i.e. double sided, not hand written, chisled on a slate tablet) **I will not let you use it on the exam and there are no exceptions to this rule.** The use of calculators is recommended but no cell phones or smart anything can be used. If it can connect to the internet, you can't use it. I will make an in-class announcement of any materials that can be used on the final exam. For more rules, see the examInstructions.pdf on canvas.

**No makeup exams will be accepted.** (Exceptions will be made in extenuating circumstances after conference with, substantiation, and approval of the instructor in accordance with CSU policy).

**Do not ask for exceptions to the final exam time and please plan your travel around the final exam.**

Only PE exam approved calculators will be allowed in Exams. Currently that is limited to:

- Texas Instruments: All TI-30X and TI-36X models (must have "TI-30X" or "TI-36X" in its model name)
- Hewlett Packard: The HP 33s and HP 35s models, but no others
- Casio: All fx-115 and fx-991 models (Any Casio calculator must have "fx-115" or "fx-991" in its model name.)
- **NO OTHER CALCULATORS WILL BE ALLOWED ON EXAMS** Be sure you get a PE approved calculator.

### Exam Dates

Exams will likely be administered in an alternative classroom. In class and canvas announcements will be made to let you know where the exams will take place.

Exam	Date
1	14 February 2020
2	13 March 2020
3	17 April 2020
<b>Final</b>	Monday 11 May 2020 11:50am-1:50pm

### Course Evaluation

Assignments will be weighted as follows:

Category	Percentage
Participation via <b>random-student</b>	6%
Reading Assignments	16%
Discussion Posts	6%
Homework Assignments (graded)	22%
Exams	50%

And your letter grade will be calculated as follows:

Percentage	Grade
100-94	A
93-90	A-
89-87	B+
86-84	B
83-80	B-
79-75	C+
74-70	C
69-66	D
<66	F

[Click here to see the CSU Grading Policy for more details](#)

### A Few More *IMPORTANT* Notes on Evaluation, Grading, and Conduct

- Remember, no makeup exams will be accepted. (Exceptions will be made in extenuating circumstances after conference with, substantiation, and approval of the instructor in accordance with CSU policy). Yes, I am repeating this from earlier in the syllabus.
- No late homework assignments will be accepted for *any* reason. Please do not ask for exceptions.
- It is *your responsibility* to get notes from a classmate if you miss class. Do not ask the instructor or the TA for notes. You are expected to attend all classes. If you can't make it, that is your prerogative but do not expect us to do extra work for you.
- If you feel that a mistake has been made during grading, *it must be brought up no later than one week after the assignment has been returned*. If you have a grading question, please meet with the instructor and have a written explanation as to why your question was graded incorrectly. No pleas to change grades will be entertained after the week has passed.
- I will round everybody's final grade up at the end of the semester to the nearest integer using the MATLAB function `ceil()`. If you are unfamiliar with how this function works, please see the corresponding MATLAB documentation. Please note, *this is the only form of curving, rounding, extra credit that I offer*. It does not matter how close your grade is to the next grade, to ensure the integrity of the course and out of fairness to everyone **I WILL NOT ENTERTAIN PLEAS TO CHANGE GRADES FOR ANY REASON**. The only exception to this is if a grade was entered incorrectly, in that case, I will be happy to change it to the correct grade.
- I randomly call on students in class to give you an opportunity to highlight your learning. You run the chance of getting called on at any point in class to answer any question. That means **it is ok to get it wrong, but it is not ok to not put in any effort**.
- If we are working on a problem in class, and it is easy to you, you need to help your classmates that are finding it difficult. If you struggle, it's ok, but you need to find someone in class to help you. It's ok if you don't understand everything, that is the point of learning! It's not ok to not try, or to be distracting.
- Do not pack your stuff to leave class until I am finished. A lot of my lectures come down to the wire and it is uncommon for me to lose track of time. It is disrespectful to your professors and distracting to

your classmates to pack up before lecture is done.

- When I invite a guest to speak to the class I expect that you treat them with the upmost respect. Nothing will get you on my bad list faster than disrespecting a guest speaker. Understand that it reflects poorly on me when a class is disrespectful to a guest speaker. It doesn't matter how boring you think it is, I expect you to give the guest speakers your undivided attention.

## Rough Schedule

This is a tentative schedule and is one of the few parts of the syllabus that is not a contract. We may shift things around here or there but for the most part, this is how our semester will flow. I will announce your readings in class and post them on canvas:

Week	Lecture Topic	Reading Assignment
1	Introduction, Expectations	Chapter 1
2	Matlab and programming <b>Fundamentals</b>	Chapter 2, 3
3	More Matlab Review	Chapter 3
4	Errors (Taylor series, numerical differentiation)	Chapter 4
5	Roots: Bracketing and Open Methods	Chapter 5, 6
6	Roots Open Methods	Chapter 6, 7
7	Optimization, Matrix Algebra, Linear Systems	Chapter 7, 8
8	Matrix Algebra, Gauss Elimination	Chapters 8, 9
9	Review, Exam, Gauss Elimination	Chapter 9
10	Matrix Inverse	Chapter 10, 11
11	Linear Regression	Chapter 14
12	Numerical Integration	Chapter 19
13	Review Session, Exam, Numerical Integration	Chapter 19, 20
14	Numerical Differentiation Runge-Kutta Method	Chapters 21, 22
15	Case Studies and Review Session	Chapter 23