AE/ME 5830
Applied Computational Methods

Tuesday/Thursday 11:00 AM – 12:15 PM CST
(Online-Synchronous)

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Course Sections

There are 4 sections of this course:

-AERO_ENG 5830-101 (on-campus)
-AERO_ENG 5830-102 (distance)
-MECH_ENG 5830-101 (on-campus)
-MECH_ENG 5830-102 (distance)

Catalog Description

Detailed study of computational methods for efficient solution of selected fluids, structures, thermodynamics, and controls problems in aerospace and mechanical engineering. Besides basic numerical techniques, topics covered include gradient-based optimization and uncertainty quantification.

Course Pre-Requisites and Expectations

- Comp Sci 1570 or 1970 or 1981; Math 3304 or

Consent of the instructor

- This course will require programming for the assignments and tests
  - You are free to use the software of your choice
    - Matlab, Mathematica, C, Fortran, …
- **The objective of this course is "not" to teach you a programming language**. It will focus on the theory and the application of the various numerical methods, which will require the use of a programming language. I expect that students who take this course know and can implement a programming language.

Course Pre-Requisites and Expectations

- Note that this is a **graduate level** course.
- The HW assignments and tests will need you to write programs, which may require you to spend **more time for this course** compared to other courses.
- **Since the students who take this course are expected to know how to program** (in any language which may be Matlab, Mathematica, Python, C, Fortran, etc), no help will be provided to the students in debugging their codes by the instructor or TA.

Course Website

- Missouri S&T Canvas System
- Announcements, Zoom course recordings, slides, notes, homework etc. will all be posted to the course website on Canvas, so please check the page regularly.
- Note that I have combined all sections of the course under "AERO_ENG / MECH_ENG 5830: APPLIED COMPUTATIONAL METHODS SP2021" section so you should be able to access all the material under this section on Canvas

Course Delivery Mode

- Online-synchronous through Zoom meetings at regular class times (Tu/Th 11:00 AM-12:15 PM CST)

- Zoom Meeting Info (also posted on Canvas)

Zoom Link:

https://umsystem.zoom.us/j/94253578065?pwd=NjA3R1IjVXo4WnZVMjRsTUVDQVIEZz09

Meeting ID: 942 5357 8065

Passcode: ACM_2021

Office Hours

- Tuesday and Wednesday 4:00-5:00 PM or by appointment
  - Through Zoom Meeting

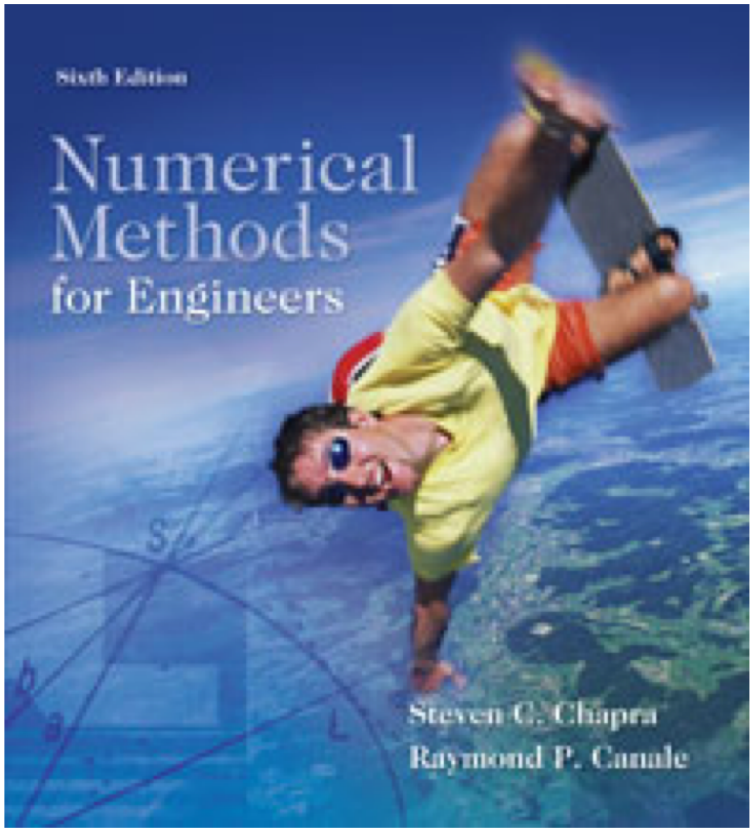
- Zoom Meeting Info for Office Hours (also posted on Canvas)

Zoom Link:

https://umsystem.zoom.us/j/98231608006

Meeting ID: 982 3160 8006

Textbook



Title: Numerical Methods for Engineers

Authors: Steven C. Chapra and Raymond P. Canale

Publisher: McGraw Hill

Edition year: 2010 (7^{th} or 6^{th} Edition)

(In addition to the textbook, instructor will extensively use his own notes/slides coming from various references and his research on each topic)

Outline

	Topic	Chapter
1.	Introduction and Root Finding	Notes, 5-8
2.	Solving System of Linear Equations	Notes, 9-12
3.	Solving System of Non-Linear Equations	Notes
4.	Gradient-Based Optimization Techniques	Notes, 13-16
5.	Interpolation & Function Approximation	Notes, 18-20
6.	Numerical Differentiation & Integration	Notes, 21-24
7.	Numerical Solution of ODE's	Notes, 25-28
8.	Intro to Uncertainty Quantification Methods	Notes

Objective of the course

- The main objective is to teach students the numerical methods that may be applied to various problems in mechanical and aerospace engineering in their career

Grading

Homework 34 %

Tests (2) 33 % each

Graduate students: A: 100 – 90 B: 89 – 80
C: 79 – 70 F: Below 70

Undergraduate students: A: 100 – 90 B: 89 –80
C: 79 – 70 D: 69 – 60 F: Below 60

Homework

- Will be assigned after each topic area
  - Typically on a 10 day or every two week basis
- No late homework will be accepted
  - Topics build on the previous material
  - It is essential that you keep up with the work
- **Start the HW early!**
- Do your own work, you will learn a lot more!
- Assignments will require programming
- You are free to use the software of your choice
  - Matlab, Mathematica, C, Fortran, …

Homework Format and Submission

- **Important:** For all homework assignments, when you are preparing the final form of your homework, for each question please first include your results such as the description of the problem, the method you use, tables, plots, discussion, and any derivations you have performed. At the end, please include the listing of the programs you use (the programs that you have written to solve the problem) as an Appendix and properly label them to reference in your results section.

- **All students** should submit a **PDF** of their homework solution electronically (i.e., post the PDF on Canvas) by the due date and time (the file name should contain the homework number and the surname of the student).

Links to Matlab and Mathematica Tutorials

- Matlab:

https://www.mathworks.com/academia/student_center/tutorials.html?s_tid=acmain_st-pop-tut_gw_bod

- Mathematica:

http://www.wolfram.com/broadcast/#Tutorials

- Some lectures for introduction to Matlab are also posted under “Files” folder on Canvas.

Academic Dishonesty

- Feel free to discuss the course material homework, and projects with others. You may give advice and guidance to a colleague but stop there.
- **Very important rule to be enforced:**
  - **Submitted homework and tests should be an individual effort. Copying from a fellow classmate (including the codes used) or other resources are not allowed. Not obeying this rule will be an honor code violation and you will receive zero credit from that question or the entire assignment and will be reported to the appropriate university department.**
- Do not allow others to copy your work
- Review http://stuco.mst.edu/honor-code/ and the page 22 of the Student Academic Regulations handbook (http://registrar.mst.edu/academicregs/index.html)

Reading Assignment

- Chapter 1
  - Mathematical Modeling and Engineering Solving
- Chapter 2
  - Programming and Software
- Chapters 3 & 4
  - Error Definitions
  - Taylor Series and Truncation Errors