

# TAM 470 / CSE 450: COMPUTATIONAL MECHANICS

Fall 2023

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<b>Instructor:</b>	Brian Mercer	<b>Time:</b>	MWF 1:00pm – 1:50pm
<b>Email:</b>	<a href="mailto:bmercerc@illinois.edu">bmercerc@illinois.edu</a>	<b>Place:</b>	4039 Campus Instructional Facility

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## Course Pages:

1. [Canvas](#) - Syllabus and other course information; lectures notes; gradebook; etc.
2. [PrairieLearn](#) - Auto-graded coding homework problems are hosted here
3. [Gradescope](#) - Written homework submission

**Office Hours:** Instructor and TA office hours will be posted to the Canvas course page.

**Teaching Assistant:** Pavan Ravi, [pavanr2@illinois.edu](mailto:pavanr2@illinois.edu).

**Required text:** Parviz Moin, *Engineering Numerical Analysis*, Cambridge University Press, 2nd ed., 2010. Available on reserve at the Grainger Engineering Library.

**Prerequisites:** CS 101; MATH 285 or MATH 286 or MATH 441

**Course topics:** Items 1–5 correspond to Chapters 1–5 of the Moin textbook; the extent of the coverage of Item 6 will be subject to availability in the course schedule. Applications to problems in solid mechanics, fluid mechanics, dynamics, and heat transfer will be discussed.

1. Polynomial and cubic spline interpolation
2. Numerical differentiation via finite differences and Padé schemes; error analysis
3. Numerical integration; Romberg integration; Richardson extrapolation; error analysis
4. Numerical solution of ODEs; Runge-Kutta methods, multi-step methods, backwards difference methods; error and stability analysis
5. Numerical solution of both steady-state and time-dependent PDEs; semi-discretization, stability analysis, implicit methods
6. Weighted residual methods; finite element methods; finite volume methods

**Final Grade Calculation:** Homework (50%), Projects (30%), Final Exam (20%). The total score  $s$  corresponds to the final letter grade as follows:

$97\% \leq s \leq 100\%$	A+	$93\% \leq s < 97\%$	A	$90\% \leq s < 93\%$	A-
$87\% \leq s < 90\%$	B+	$83\% \leq s < 87\%$	B	$80\% \leq s < 83\%$	B-
$77\% \leq s < 80\%$	C+	$73\% \leq s < 77\%$	C	$70\% \leq s < 73\%$	C-
$67\% \leq s < 70\%$	D+	$63\% \leq s < 67\%$	D	$60\% \leq s < 63\%$	D-
$s < 60\%$	F				

**Homework:** A homework assignment may involve questions requiring written analysis and solutions submitted to Gradescope, auto-graded coding problems on PrairieLearn, or both. You must complete the PrairieLearn problems and upload your work to Gradescope in a PDF format by the specified due date to receive full credit for the assignment. The schedule of homework due dates will be maintained on the Canvas course page. Dates are subject to change as the semester progresses. **In this course, you are allowed to discuss homework assignments with other students, form study groups, etc, but all submitted work and code must be your own.** All homework assignments are weighed equally in the final course grade calculation.

**Projects:** Two projects will be assigned in this course. The project requirements and due dates will be maintained on the Canvas course page. Unlike Homework assignments, Projects should be treated like a take-home exam, and **students are not permitted to work together or discuss their work on Projects; these must be fully individual efforts.** The two projects will be given equal weighting in the final course grade calculation.

**Homework and Project late submission policy:** Late Homework and Project submissions will be penalized 10% per day, up to 2 days (48 hours) late. After 48 hours beyond the original due date have passed, the assignment will receive a zero. Please carefully review the rules below regarding extension requests for Homeworks and Projects:

1. All extension/make-up work requests must be received **in advance of the due date** or they will not be considered.
2. Every student gets **one** no-questions-asked (NQA) 48 hour extension on a homework assignment. You must email the instructor **and** TA to indicate you are using your NQA extension request for the given assignment. As the name implies, there is no need to explain your situation or provide documentation. No penalty will be assessed if the assignment is turned in within the 48 hour extension window. All NQA requests must be received before the due date, and cannot be applied retroactively to an assignment that has already been turned in late.
3. Besides the NQA extension request, you may request a homework deadline extension for the following situations, and must also provide a letter from the Office of the Dean of students:
  - Illness for 3 or more days
  - Personal crisis (e.g., car accident, required court appearance, death of a close relative).
  - Required attendance at an official UIUC activity (e.g., varsity athletics, band concert).
  - For more extreme situations that involve an extended absence for more than a few days, please contact the instructor as soon as possible so we can discuss how to proceed.

4. Note that regardless of documentation provided, the final decision to grant an extension always lies with the instructor.

**Final Exam:** The final exam for this course will be a written comprehensive exam. Per the Office of the Registrar, the final exam for this course is scheduled for **Wednesday December 13, 7pm – 10pm**. A conflict/alternate exam will only be considered if arranged well in advance for an excusable absence situation per the university student code, or due to an unforeseeable emergency.

**4 credit-hour students:** Those who are enrolled for 4 credit hours may be assigned extra problems on the Homework sets or have extra requirements on the Projects. These extra portions will be clearly marked on each Homework/Project and must be completed in their entirety to able to earn full credit on the assignment.

**Class attendance and participation:** Class time will consist of a mixture of lectures, coding demonstrations and in-class activities (solving example problems, group/classroom discussions, etc.). Regular attendance and participation in class activities is expected. Occasionally, you may need to bring a laptop to class to be able to fully participate.

**Software:** Homework and Projects involving coding must be completed using Python. It is recommended that you install Python on your personal computer to be able to complete the assignments for the course. [Anaconda](#) is recommended for the easiest installation, as it is packaged with all the libraries and software you will need for this course. More experienced Python users may wish to download Python at <https://www.python.org/downloads>. In this case, you will be responsible for setting up your own development environment and installing required libraries like `numpy`, `scipy`, etc. Alternatively, Python is available through campus computing resources:

- You can access python on campus via EWS labs, see <https://engrit.illinois.edu/ews> for locations and availability.
- See <https://answers.uillinois.edu/illinois.engineering/81693> for instructions on remote access to EWS machines.

**DRES Accommodations:** If you have DRES accommodations you must send your letter to the instructor at the beginning of the semester. You must also give advance notice for each assessment/deadline for which you'd like to use the accommodations. DRES accommodations for exams must be requested at least one week in advance of the exam to ensure the logistics can be put in place to meet your needs.

**Academic integrity:** Every student is expected to review and abide by the university's [Academic Integrity Policy](#) as outlined in the Student Code. It is your responsibility to read this policy to avoid any misunderstanding. Ignorance is not an excuse. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

**Policies related to COVID-19:** Please adhere to the latest [University policies regarding COVID-19](#).