ME 4315: Energy Systems Analysis & Design

Syllabus

COURSE INFORMATION

Course Number: ME 4315
Term: Fall 2026
Syllabus Revision Date: April 2026

CATALOG DESCRIPTION

Integrated concepts, laws, and methodologies from thermal sciences are used to analyze, model, and design energy systems and to predict system performance for fixed designs.

PRIMARY COURSE TOPICS

- Context for Energy Systems broadly
- Methodologies for the Assessment, Analysis & Design of Energy Systems
- Consideration of various Energy Sources, Conversion Technologies, and Metrics
- Thermodynamics, including in Depth Analysis of Thermal Cycles
    - Power Cycles
    - Heating/Cooling Cycles
- Fluid Mechanics (e.g., piping networks, Bernoulli's equation, friction/loss, pumps)
- Heat Transfer (e.g., principal modes, energy balance, heat exchangers, modeling)
- Economic and Environmental Impacts
- Other Integrated Energy Systems Modeling and Approaches

SYNOPSIS

The design of thermal-fluid and energy systems will be taught using an integrated approach that treats thermodynamics, fluid mechanics, and heat transfer as parts of one interconnected area. Knowledge of Thermodynamics, Fluid Mechanics, and Heat Transfer is assumed. Insights into the analysis and design of real-life energy systems are often best revealed when these aspects are considered simultaneously. The course leverages underlying fundamentals but emphasizes practical examples and leverages team problem solving and collaboration. Experience and feedback indicate that the course can provide an excellent foundation for a career in the thermal energy systems arena and/or advanced academic/research pursuits.

SCHEDULE

***Lectures*:**

Tuesday, Thursday 11:00 AM - 12:15 PM. Location TBD

Several of these days will be for project discussions, team meetings, or guest lectures. One field trip is proposed if time and logistics permit. Office hours will be by appointment at mutually convenient times discussed and agreed upon in class.

The class will be taught in person. Some lecture material will become available online. The course is structured to be relatively interactive. We will prioritize discussions and conversations between the students and instructor. The course will emphasize projects and applications, but will also convey underlying theory and fundamental principles.

INSTRUCTOR

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PRE-REQUISITES

Thermodynamics (ME3322), Fluid Mechanics (ME3340) and Heat Transfer (ME3345).

ASSESSMENT

Homework	20%
Projects	35%
▪ #1 (Likely: Complex Power Cycle)	
▪ #2 (Likely: Open Topic)	
Mid-Term Exam	15%
Final Exam	25%
Participation & Peer Evaluation	5%

TEXTBOOK AND RESOURCES

While, no textbook will be prescribed for this course, References in Thermodynamics, Fluid Mechanics, and Heat Transfer will be essential resources. For example, a few highly recommended books are listed below. In addition, Engineering Equation Solver (EES) is an iterative solving software package that includes valuable data libraries of working fluids and material properties. EES can be accessed by ME4315 via GT V-Lab. Other customized software and codes may be introduced as appropriate.

- Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. B. (2020). *Principles of Engineering Thermodynamics* (9th ed.). Wiley. ISBN: 978-1119792827.
- Incropera, F. P., DeWitt, D. P., Bergman, T. L., & Lavine, A. S. (2017). *Fundamentals of Heat and Mass Transfer* (8th ed.). Wiley. ISBN: 978-1119320425.
- Munson, B. R., Okiishi, T. H., Huebsch, W. W., & Rothmayer, A. P. (2018). *Fundamentals of Fluid Mechanics* (8th ed.). Wiley. ISBN: 978-1119405376.

HOMEWORK

To be assigned approximately weekly during the first half of the course, and generally due on Canvas class the following week.

Late Homework Policy. A 20% deduction will be made on submissions one class after the due date, no submissions accepted beyond this. Discussion of grades received on homework and mid-term exams will be entertained up to two days after receipt of grades.

PROJECTS

Two comprehensive projects will be assigned throughout the semester. The projects will focus on a core renewable energy topic, but the integration of concepts will build. The purpose of the projects is to expose students to applications of energy systems and to equip them to analyze, model, design and compare systems to baselines. The projects may incorporate real-world examples, datasets, and technologies that are established in the field. Projects may be conducted in groups of various sizes, depending on the particular project, scope and stage during the semester.

Deliverables & Assessment. In general, each project will culminate with the submission of a project report inclusive of data, codes, parametric analysis, and other supporting documentation. Projects may require some combination of written reports and/or brief oral presentation in-class or via pre-recorded video. A scoring rubric with review criteria will be provided when projects are announced and teams assigned. More info on projects will be provided separately.

PEER EVALUATION and STUDENT PARTICIPATION

Your final grade will also include an assessment of your individual participation in group projects and your individual participation in the class overall. Your contribution to group projects will be established from formal peer evaluation responses provided by yourself and your team members. This feedback is confidential and will only be seen by the instructor. Your individual participation in the class overall will be assessed by the instructor, and will be based upon your general involvement in the class. This will take into account your participation in classroom discussions, Q&A, attentiveness during class, and preparedness during group/project meetings. Peer evaluations and student participation grades may include qualitative and quantitative metrics, and will be converted to a quantitative score toward your weighted final average.

NOTES ON ASSESSMENT

- The overall grade in the course will be based not only on the absolute percentage obtained in the course, but also on the performance of the entire class. The grading will, however, not be strictly according to a normal distribution. Minimal requirements for passing or receiving a particular grade will be maintained irrespective of the class performance. Transitions between grades will be based on potential discrete demarcations between student scores.

NOTES ON ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

- If you are a student with learning needs that require special accommodations, contact the Office of Disability Services (often referred to as ADAPTS) at (404)-385-2325 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible to set up a time to discuss your learning needs.

NOTES ON ABSENCES, ATTENDANCE AND WELLNESS

- Georgia Tech policy on excused absences for religious observances: http://www.catalog.gatech.edu/rules/4/: "Students who are absent because of participation

in a particular religious observance will be permitted to make up the work missed during their absence with no late penalty, provided the student informs the course instructor of the upcoming absence, in writing, within the first two weeks of class, and provided the student makes up the missed material within the timeframe established by the course instructor."

- GT policy on absences for medical reasons. http://www.catalog.gatech.edu/rules/4/ Students will work with the Office of VP for Student Life (Dean of Students) to have them verify that the student was ill and to determine the severity of the problem; the Dean's office will then interact with the instructor(s) if necessary. To the extent possible, requests from the Office of the Dean of Students to excuse a medical emergency or illness and allow make-up of the work missed, including homeworks, examinations, or other class assignments will be accommodated.
- Class attendance is not mandatory, but student participation is important and carries weight in student assessment. In addition, the class is conducted in a highly interactive and participatory manner and students are encouraged to participate. In this way, class attendance can contribute to the achievement of the learning objectives, to preparation for assignments, and attainment of credit toward individual student participation scores. Due to the broad and dynamic nature of the subject matter, it is possible that certain discussion material may not directly be available in any single textbook, and while ample educational resources will be shared, there is no guarantee that all lecture material will be provided online. Please be advised that certain topics and concepts may be best attained by attentive participation during lectures and classroom discussions.
- **Mental Health & Wellness:** As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, depression, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. GT offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know is experiencing any of the issues noted above, consider utilizing the confidential mental health services available on campus. I encourage you to reach out to GT CARE (www.care.gatech.edu, 404-894-3498) or the Counseling Center (www.counseling.gatech.edu, 404-894-2575) for support. An on-campus counselor or after-hours services are available to assist you.

NOTES ON ACADEMIC HONOR CODE AND ACADEMIC INTEGRITY

- Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Compliance with the Georgia Tech honor code is mandatory. Please carefully read the honor code at: https://policylibrary.gatech.edu/student-life/academic-honor-code. Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations. Allegations of scientific or scholarly

misconduct are handled in accordance with the procedures outlined by the Policy for Responding to Allegations of Scientific or Other Scholarly Misconduct.

NOTES ON STUDENT-FACULTY EXPECTATIONS

- At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See https://catalog.gatech.edu/rules/21/ for an articulation of some basic expectation that you can have of faculty and that faculty have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, we encourage you to remain committed to the ideals of Georgia Tech while in this class.

CAMPUS RESOURCES FOR STUDENTS

- Visit this page https://ctl.gatech.edu/sites/default/files/documents/campus_resources_students.pdf for a list of relevant campus resources available to Georgia Tech students.