ENS 207 - Introduction to Energy Systems
Fall 2024

Course Instructor

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Office Hours: TBA

Course Assistants

TBA

Course Schedule

Tuesday : 16:40 - 17:30 @ Room: FENS G015
Wednesday : 15:40 - 17:30 @ Room: FENS L030

Recitations:
Thursday : 17:40 - 19:30 @ Room: **FASS G006**

References

[Moran] *Principles of Engineering Thermodynamics*, M.J. Moran, H.N. Shapiro, D.D. Boetner, M.B. Bailey, 8th Edition, Wiley, 2014. **(Main Reference)**

[Cengel] *Fundamentals of Thermal-Fluid Sciences*, Y.A. Cengel, R.H. Turner, J. Cimbala, McGraw-Hill.

[Incropera] *Fundamentals of Heat and Mass Transfer*, T.L. Bergman, A.S. Levine, F.P. Incropera, D.P. DeWitt, Wiley, 2011.

[MacKay] *Sustainable Energy-without the hot air*, David JC MacKay, 2009.
(Free e-book available on the web)

Course Description

This course is concerned with the generation of power and utilization of energy for the benefits of the society in industry, transportation and domestic use. The scope of this course includes fundamental principles and analysis of energy systems. Students will learn to use the fundamental principles that are used in the analysis of energy systems. Particular topics include but not limited or exclusive to: conservation of mass and energy, control volumes and control surfaces, the second law of thermodynamics, entropy, efficiency analysis of heat engines, refrigeration cycles.

Course Objectives

The main objective of this course is to teach students to use basic laws, rules and principles used in the analysis of energy conversion systems, such as heat engines, solar collectors and nuclear reactors, and to obtain the energy conversion efficiency for various cycles. Students must be able to derive simple mathematical formulas from the conservation laws and use in the analysis of energy conversion systems. From a general point of view, the course aims to teach students to relate fundamental laws and mathematical expressions that correspond to these laws in the analysis of energy conversion systems and components.

Tentative Schedule

Week 1: Course introduction, energy systems, climate change
Week 2: Thermodynamic view of systems, introductory concepts and definitions, energy and first law of thermodynamics [Moran Ch.1, Ch.2.1,2.2]
Week 3: Internal energy, heat, heat transfer modes, closed system energy balance [Moran Ch.2.4,2.5]
Week 4: Introduction to thermodynamic cycles: power, refrigeration and heat pump cycles, cycle energy balance; phase change; evaluating properties [Moran 2.6, 3.1-3.5]
Week 5: Applying energy balance with properties, ideal gas model [Moran 3.6, 3.8.1]
Week 6: Ideal gas model (Cont'd), MT1 (tentative, exact day and time will be announced)
Week 7: Control volume analysis: steady and transient conservation of mass, steady conservation of energy, analysis of energy system components (nozzles, diffusers, turbines, pumps and compressors, heat exchangers) [Moran Ch.4]
Week 8: Direction of spontaneous processes, reversible and irreversible processes, second law statements, entropy transfer, application of the 2nd law to cycles, Carnot efficiency limits for cycles [Moran Ch.5]
Week 9: Entropy as a property of system, isentropic processes, isentropic efficiencies turbines

and pumps. [Moran Ch.6]
Week 10: Modeling and analysis of vapor power systems, ideal Rankine cycle. [Moran 8.1-2]
Week 11: Vapor power systems continued: Superheating and reheating, regenerative cycles, feedwater heaters [Moran 8.3-4], MT2 (tentative, exact day and time will be announced)
Week 12: Gas Power Systems: Internal Combustion Engines, Gas Turbine Power Plants [Moran Ch 9.1-9.3,9.5,9.6]
Week 13: Analysis and modeling of refrigeration and heat pump cycles [Moran 10.1,10.2,10.5,10.6]
Week 14: Alternative energy conversion systems: Fuel Cells [Moran 13.4]; Energy storage systems: Batteries

Tentative Grading Policy

Grading policy is tentative for now and will be finalized during the first week of classes. Some small changes in the following items might occur.

Quizzes (10%), Homework(10%), Midterm 1 (25%), Midterm 2 (25%) , Final (30%)

- Quizzes with short questions (10 min max, usually less than 5 min) will be given throughout the semester. The quizzes will be unannounced and there might be more than one quiz per class. You must be present in the lecture for at least 40 minutes otherwise your quiz will be void. Best 80% of the quizzes will be counted towards your final grade.
- Tentative Midterm dates are provided in the schedule above. Exact dates and contents will be announced. Midterms can be scheduled to be held during recitation hours. Final exam will be scheduled by Student Resources.
- Homework will be written assignments consisting of mostly numerical problems.
- One make-up examination, covering the whole course material, will be given after the final exam date for the students who missed a midterm and/or final examination **due to a valid excuse approved by the Health Services or University**. (It is your responsibility to get approval from University Health Services. Please make sure you learn the details about the procedures.)
- No make-up will be given for quizzes.
- Attendance will be taken in classes and recitations. Attendance and active participation in lectures may affect the final grade, especially for borderline cases. Participation will be evaluated based on the in-class performance of students in lectures and recitations. Passive participation (especially sleeping in class, playing with phone or computer, doing other class work, etc) will not count towards participation credit even if you are present in class and sign the attendance sheet.
- **No extra homework/exam/project/etc. will be given to increase your grade at the end of the semester.**

Class Policies

- Lectures will be physical in class.
- Powerpoint slides will be used in lectures. Problems will be solved during classes. Students are encouraged to take their own notes during classes.
- We are all responsible for creating a safe and inclusive classroom experience for everyone in the class.

Recitations

- Recitations will be physical in class.
- Midterm exams might be held during recitation hours. In addition, through the semester there might be weeks where we use recitation hours for make-up classes. Therefore, you should be careful about any time conflicts during recitation hours.
- For 3-4 times throughout the semester, we will hold mandatory recitation sessions (i.e. attendance will be mandatory), where you will actively solve problems yourself and they will count towards your homework or quiz grade.
- In the remaining recitation sessions, you will be solving problems with TAs. Attendance to these sessions are not mandatory. But attending all sessions are **strongly recommended** since they prepare you towards the exams. Attendance will be taken and active participation in recitations will help you increase your participation credit for borderline cases.

SUCourse

- All announcements will be made through SUCourse, students are responsible from following the announcements.

Disclaimer

- Time conflict requests can be accepted for one hour only (both for lectures and recitations). Students who are registered to the course with time-conflict override accept the responsibility of any inconvenience that might occur due to missed content and/or quizzes. Exams will not be re-scheduled and no make-up will be available for missed quizzes/content. To get approval for time conflict, you need to send an e-mail stating you are aware of these facts and you accept the responsibility.

Academic Integrity

- Students are expected to be familiar with and comply with Sabanci University Academic Integrity Statement. Any form of academic dishonesty (plagiarism, copying/using other people's work, attending classes/exams on behalf of other people, etc) will be penalized with a failing grade (i.e., zero points) for the related assignment, quiz, or exam and **disciplinary actions will be taken**.