ENS 207 - Introduction to Energy Systems
Fall 2020

Course Instructor

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Course Schedule

Monday : 10:40 - 12:30 @ Zoom (Online)
Wednesday : 10:40 - 11:30 @ Zoom (Online)

Recitations:
Thursday : 16:40 - 18:30 @ Zoom (Online)

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, obtain pumping power and flow rates in flow systems, determine temperatures and heat transfer rates in thermal systems with conduction and convection processes. 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

Grading Policy

Quizzes (15%), Exams (40%), Homework(20%), Final (25%)

- To pass the course, you should collect at least 40 points and you have to take the final exam.
- Pop-quizzes with short questions (around 10 min each) will be given throughout the semester. They will be at the end of the lectures and will be on material that was covered during that hour/day. There will be minimum 1 maximum 3 quizzes per week. Best 80% of the quizzes will be counted towards your final grade.
  4 short exams (around 45 min each) will be given throughout the semester. Their details will be announced. Exams can be scheduled to be held during recitation hours.
- Attendance will be taken. Attendance and active participation/interest in lectures may affect the final grade for borderline cases. You are expected to sign in to the Zoom lectures with your name and surname.
- 3 or 4 homework assignments will be given. They will be written assignments consisting of (most probably) open ended problems that require you to provide commentary and discussion in your own sentences.
- Students whose quiz/assignment/exam/final answers seem suspicious will be called to recorded oral exams with the instructor. The oral exam questions might not be limited with the content of the suspicious quiz/assignment/exam and the instructor might ask questions from a broader range of topics to evaluate student's understanding of the course material.
- One make-up examination, covering the whole course material, will be given after the final exam date for the students who missed an exam and/or final examination **due to a valid excuse approved by the faculty/university**. No make-up will be given for quizzes. If you miss an exam due to a health problem, you can take the make-up only if you have a valid report approved by the University Health Services. (It is your responsibility to get approval from University Health Services. Please make sure you learn the details about the procedures.)
- **No extra homework/exam/project/etc. will be given to increase your grade at the end of the semester.**

Online Class Policies

- Online lectures will be held via Zoom.
- Incomplete lecture slides will be shared on SUCourse, students are expected to complete them during the class.
- You are expected to sign in to the Zoom lectures with your name and surname.
- Students cannot share or post to the Web any document or recording of any of the course material with third parties.
- We are all responsible for creating a safe and inclusive classroom experience for everyone

in the class.

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. 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.
- This syllabus and course details might need to be updated throughout the semester because of the uncertainties the pandemic brings. Any modification will be announced at SUCourse and also during the class. Students are responsible from following the announcements.

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**.