ME420/520 Renewable & Sustainable Energy Systems
Spring 2024

ME420/520 is an advance undergraduate/introductory-graduate course that intends to review technical aspects of renewable & sustainable energy systems, such as thermal, solar, wind and nuclear plants, and to provide technical competence in analysis of energy systems. Thermodynamic analysis of various power cycles such as Rankine, Brayton, Otto, Diesel and refrigeration will be reviewed at the beginning of the course. Then, technical analysis of wind and solar power systems, and lastly, the nuclear energy is reviewed. Throughout the course impacts of these technologies are reviewed. Subject to in-class progress, energy storage and distribution technologies will be analyzed as well. Students must be familiar with thermodynamics (ENS202 or ENS207) and thermal-fluid sciences (ME307 and ME309) at undergraduate level; some basics will be reviewed but will not be extensive.

TEXTBOOKS:

Fundamentals of Renewable Energy Processes, 3e, Aldo Vieira da Rosa, Academic Press, 2013 (should be available in Homer, and on reserve in the library).

Sustainable Energy — without the Hot Air, David JC MacKay, 2010 (available via free download from http://www.withouthotair.com/).

REFERENCES:

Renewable and Efficient Electric Power Systems, Gilbert M. Masters, Wiley, 2003.

Principles of Sustainable Energy Systems, 2e, Frank Kreith, CRC Press, 2014.

Fundamentals of Engineering Thermodynamics, 8e, Moran, Shapiro, Boetner & Bailey, Wiley.

Fundamentals of Heat & Mass Transfer, 7e, Frank P. Incropera and David P. Dewitt, Wiley, 2011.

GRADING:

IMPORTANT NOTE: ***Grading methods and weights are subject to change according to the progress in regulations about online vs hybrid lectures.***

Midterms (2): 25%

Final: 30%

SUCourse quizzes: 5%

Take-home assignments: 15%

Note: take-home assignments are subject to the same conditions as the exams, plagiarism will be subject to disciplinary action and NAgrade conditions. If a take-home assignment is considered as plagiarism, it will be treated as not turned in. You may discuss the solution strategy with your friends and use online resources available for similar problems. In order to avoid plagiarism: **you must ensure to answer the problems with your own explanations and in your own words.**

Attendance is compulsory. Less than 70% in-class attendance will result in a letter-grade-down, and less than 50% in-class attendance will result in NA grade. NA grade will be also given if two of the exams (midterms & final) are missed without an official report.

TENTATIVE SCHEDULE

Week 1-2: Introduction, utilization of energy, energy resources, environmental impact, global energy flow, renewable and nuclear capacity.

Week 2-6: Thermodynamic fundamentals, first and second laws, ideal Carnot cycle, gas power systems (Otto, Diesel, Brayton and Stirling cycles), steam power systems (Rankine cycle) refrigeration and heat pump cycles. (1st midterm)

Week 7-9: Solar energy utilization, solar collectors, photovoltaics

Week 10-11: Wind energy fundamentals (2nd midterm)
Week 12-13: Nuclear fission, radiation & fusion
Week 14: Fuel cells & batteries