ME 533: Energy Conversion

Spring 2020

Instructor
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Class Time: Monday/Wednesday 10:10-11:55AM

Classroom: PHO 201

Office Hours: Fridays 10-11 AM, or by appointment

Course Description:
Thermodynamic and mechanical aspects of modern energy conversion systems, including traditional systems such as steam power plants, gas turbines and internal combustion engines and refrigeration systems, and renewable systems such as solar, wind, geothermal. Combined heat and power and cogeneration are also considered, as well as economic and environmental aspects of energy conversion.

Grading:

Homework	10%
Exam 1	20%
Exam 2	25%
Project	25%
Participation	10%
Discussion Lead	10%

Homework
Homework includes in-class assignments and assigned problem sets and will count for 10% of the final grade. Homework should be turned in during class. Late homework will not be accepted.

Homework assignments should be presented in a professional manner. This includes clean, stapled pages; standard sized notebook or engineering paper; no rough edges; clear, logical work; labeled plots and tables.

Exams
Two exams will be given during the semester. The first will be an in-class exam and will cover material from the first half of the semester. The final exam will be a take home exam.

The final exam will be a report discussing your vision for a sustainable energy future. The report must include citations, calculations to support your vision, a discussion of how your project topic fits (or does not fit) into your vision, and the economic implications of your vision. Details on the report requirements will be given out in class.

All exams are to be done individually. Collaboration of any kind will be grounds for a zero on the exam and possible disciplinary action.

Project
The project will focus on learning about state of the art energy conversion technologies. Individuals or teams of 2 students will work together to research a topic related to a new or advanced energy conversion

technology. Teams will present their technology in class during a mock poster session for the Energy Conversion Conference held mid-semester. Grading will be based on your abstract, poster, presentation and reviews by your fellow classmates. Details on the project will be given in class.

Participation

Participation includes in-class discussions, asking questions in class, attending office hours, answering questions, and generally being present and making an effort.

Discussion Lead

Teams of 2 will chose a short reading (~5-8 pages) relevant to the topic of day and lead a discussion on the reading. The reading should come from a peer reviewed scientific journal and have been published within the last 5 years. The reading should discuss a state of the art technology, societal, environmental or economic aspect of the topic. Readings should not present a review or overview of the topic.

Readings should be selected a week before the class and 2 questions should also be assigned. The questions and a PDF of the selected reading should be emailed to Prof. Ryan one week ahead of class. Readings and questions will be posted on Blackboard.

Note: You must have different partners and topics for the project and the discussion lead.

Class Policies:

1. Academic dishonesty will not be tolerated. Students are expected to follow the BU Code of Student Responsibilities (http://www.bu.edu/dos/policies/student-responsibilities/)
2. Cell phone use during class or exams is not allowed. This includes phone calls, texting, browsing, calculator functions, etc.
3. Class begins promptly at 10:10AM. Late arrival is not permitted without prior approval.

Course Materials:

Blackboard will be used for all class communications and documents.

Readings:

Selected articles, reports, and book chapters will be assigned throughout class and are posted to Blackboard.

Reference Textbooks:

1. J.W. Tester, E.M. Drake, M.J. Driscoll, M.W. Golay, W.A. Peters, *Sustainable Energy: Choosing Among Option*, MIT Press, Second Edition, 2012.
2. K. Weston, *Energy Conversion,* EBook, http://www.personal.utulsa.edu/~kenneth-weston/.
3. A.W. Culp, *Principles of Energy Conversion*, McGraw-Hill, 1991.
4. Y.A. Cengel, M.A. Boles, *Thermodynamics*, McGraw-Hill, 2002.

Topics:

1. Overview of Energy Conversion
2. Environmental Impacts
3. Thermodynamics Review
4. Vapor Power Cycles
5. Gas Power Cycles
6. Cleaning up fossil fuels
7. The Electric Grid
8. Nuclear Power
9. Wind
10. Solar
11. Ocean/Wave Energy
12. Geothermal
13. Other Renewable Energy Systems
14. Direct Chemical-Electrical Conversion

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Reading Assignments

UPDATED: January 20, 2020

Readings should be done ahead of the class in which they will be discussed

Readings can be found on the Blackboard site

NOTE: This is a living document and will be updated during the semester

Lecture	Date	Day	Topic	Readings	HW Due	Student Readings
1	1/22/2020	Wednesday	Class Overview and Expectations			
2	1/27/2020	Monday	Introduction	Overview/Key Take-aways of DOE Annual Energy Overview 2019; Executive Summary of IEA World Energy Outlook 2019		Gilbert and Sovacool, "Looking the wrong way: Bias, renewable electricity, and energy modelling in the United States"
3	1/29/2020	Wednesday	Environmental Impacts	Michaelides, "Alternative Energy Sources", Chapter 2, pp.33-61		
4	2/3/2020	Monday	Fossil Fuels	U.S. Fossil Fuel Resources: Terminology, Reporting and Summary		
5	2/5/2020	Wednesday	Thermodynamics Review	Weston, "Energy Conversion", Chapter 1, pp. 4-19 (section 1.2-1.5)		
6	2/10/2020	Monday	Thermodynamics and Combustion	Basic Thermodynamics Textbook, sections on combustion, adiabatic flame T		
7	2/12/2020	Wednesday	Thermodynamics; Vapor Power Cycles	Basic Thermodynamics Textbook, sections on combustion, adiabatic flame T and cycles; Optional readings from 2 thermodynamics textbooks posted on Blackboard	HW1	
8	2/18/2020	Tuesday	VPC; Gas Power Cycles	Optional readings from 2 thermodynamics textbooks posted on Blackboard		
9	2/19/2020	Wednesday	Gas Power Cycles	Weston, "Energy Conversion", Chapter 5, Gas Turbines and Jet Engines.	Project Abstract	
10	2/24/2020	Monday	Power Cycles; Review		HW2	
11	2/26/2020	Wednesday	Midterm			
12	3/2/2020	Monday	Combined and Cogeneration Cycles	Pew Report: Cogeneration/Combined Heat and Power; El Wakil "Powerplant Technologies" Combined Cycles (pg. 341-351)		
13	3/4/2020	Wednesday	Power plant components; Carbon capture & sequestration	Leung et al, "An overview of current status of carbon dioxide capture and storage technologies"		
14	3/16/2020	Monday	Nuclear Power: History/Reactor Design	Information Library of World Nuclear Association -Read Introduction Sections and Nuclear Power Reactor Sections	Optional Draft Poster	
15	3/18/2020	Wednesday	Nuclear Power Reactor Designs/safety/disposal/future	Information Library of World Nuclear Association -Read Fuel Recycling Sections and Nuclear Waste Sections	Final Poster Uploaded to Blackboard	
16	3/23/2020	Monday	Project	***** Class will be held in ENG 245******		
17	3/25/2020	Wednesday	Nuclear			
18	3/30/2020	Monday	Nuclear; Building Efficiency	DOE Quadrennial Technology Review: Chapter 5		
19	4/1/2020	Wednesday	Wind	Wind Turbine Technology: Chapters 2-4		
20	4/6/2020	Monday	Wind; Electrochemistry	Sustainable Energy, Jefferson Tester - Chapter 17		
21	4/8/2020	Wednesday	Guest Lecture - The Grid	Guest Lecture: Peter Fox-Penner	HW3	
22	4/13/2020	Monday	Storage	An Assessment of Solar Energy Conversion Technologies and Research Opportunities		
23	4/15/2020	Wednesday	Solar	Sustainable Energy, Jefferson Tester - Chapter 11		
24	4/22/2020	Wednesday	Geothermal; Power from Water	Sustainable Energy, Jefferson Tester - Chapter 14		
25	4/27/2020	Monday	Hydropower	Sustainable Energy, Jefferson Tester - Chapter 12		
26	4/29/2020	Wednesday	Summary; Other Renewables		HW4	