University Of California, Berkeley
Department of Mechanical Engineering

ME 246: Advanced Energy Conversion Principles (3 units)

Graduate Course

Syllabus

CATALOG DESCRIPTION

This course covers the fundamental principles of energy conversion processes, followed by development of theoretical and computational tools that can be used to analyze energy conversion processes. The course also introduces the use of modern computational methods to model energy conversion performance characteristics of devices and systems. Performance features, sources of inefficiencies, and optimal design strategies are explored for a variety of applications, which may include conventional combustion based and Rankine power systems, energy systems for space applications, solar, wind, wave, thermoelectric, and geothermal energy systems.

EXPANDED DESCRIPTION

This course begins with an exploration of how physics, chemistry, thermodynamics, fluid flow, heat transfer affect the performance of energy conversion systems. Systems that have variable temperature and those that operate isothermally will be considered. Methodologies will be developed to model the thermodynamics, flow and heat transfer associated with energy conversion in system components such as pumps, compressors, piston expanders, turbines, heat exchangers and solar collectors. The course introduces the use of modern computational tools to model energy conversion processes and performance characteristics of devices and systems. Strategies for combining component models to model system performance will also be examined. The course will consider example applications selected from modern energy technologies. These may include conventional combustion heat engine and Rankine cycle power systems, heat pumps, building and vehicle energy systems, cryogenic systems, energy systems for space vehicles, and alternative/renewable energy systems such as solar, wind and geothermal energy systems. Students will complete two applications-based projects that will use theoretical tools from the thermosciences together with computational methods developed in class lectures. Projects may also include student design and fabrication of an energy conversion device or system.

COURSE PREREQUISITES

ENG 7, ME 40, ME 106, and ME 109 or their equivalents.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Fundamentals of Renewable Energy Processes, Second Edition, A.V. da Rosa, Academic Press, NY, 2009.

ADDITIONAL REFERENCES

Computer Methods for Engineering, Y. Jaluria, Taylor and Francis, 1996.
Introduction to MATLAB for Engineers, W. J. Palm, III, 3rd edition, McGraw Hill, 2010.

COURSE OBJECTIVES

This class provides students with an understanding of the thermophysical principles that govern energy conversion processes of different types, and will introduce them to modern computational methods for modeling the performance of energy conversion processes, devices and systems. This course is a capstone experience for ME students, synthesizing thermodynamics, fluid dynamics, heat transfer and computational analysis tools to facilitate engineering design analysis.

DESIRED COURSE OUTCOMES

This course will provide a foundation for design analysis of energy conversion systems encountered in a variety of applications.

TOPICS COVERED

Please see attached Course Outline.

CLASS/LABORATORY SCHEDULE

Three hours of lecture and one hour discussion per week

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

This course is an elective course in the Mechanical Engineering Professional M.Eng Program.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

The course grade will be based on homework assignments (8%), four projects (18% each) and a final exam (20%). Students in ME 246 and ME 246 will be graded separately.

REMARKS

This is a room-share course that will be taught concurrently with ME 146. ME 146 and ME 246 will share a common lecture, but project assignments for graduate students in ME 246 will be different than those for undergraduate students in ME 146. Compared to the projects assigned to undergraduates, graduate students taking ME 246 will be given project assignments that require modeling of more physically complex systems, and use of more sophisticated computational tools. Final exam questions for graduate students in ME 246 will be different than those for undergraduate students in ME 146.

PERSON(S) WHO PREPARED THIS DESCRIPTION
Professor Van Carey | April 19, 2012

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): AD NRGY CNV PRNCPLS
TIE CODE: LECS
GRADING: Letter
SEMESTER OFFERED: Fall and Spring
COURSES THAT WILL RESTRICT CREDIT: ME 146
INSTRUCTORS: Carey

DURATION OF COURSE: 14 Weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 9
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: None