North Dakota State University
Department of Mechanical Engineering
ME 481/681 – Energy Conversion
(3 credit)
Syllabus (tentative)/subject to change or modification
2024 Spring Semester
TTH 11 – 11:50 AM
EHYL 220

Instructor: Dr. Jordi Estevadeordal
Office: Dolve 102B
Phone: (701) 231 9223; Email: jordi.estevadeordal@ndsu.edu
Office Hours: Tu and Th 12:30 PM – 2 PM

Teaching Assistant: Nafis Saad Resan, nafis.resan@ndsu.edu

Course Prerequisites: ME 351 (Thermodynamics) and Enrollment to Professional Program

Course Catalog Description:
Foundations of the engineering of energy conversion. Introduction to electrical power generating systems and their major components. Concepts and designs in thermodynamic cycles for engineering applications.

Course Objective:
Provide students with a firm understanding of the fundamentals of energy conversion, thermodynamic cycle designs and their engineering applications. Students will become familiar with and be able to identify issues involved with the power generation using various sources of energy. They will be able to evaluate technologies in terms of fuels, wastes, efficiency, and environmental implications. They will be able to evaluate components, systems, and overall processes for strategies to obtain desired objectives. Students will be able to compare competing technologies from (simplified) economic, environmental, and waste issues.

Textbook: None required; the following are suggested for reference: "ENERGY CONVERSION - THE EBOOK" by Kenneth C. Weston; "Fundamentals of Thermodynamics," by C. Borgnakke and R. E. Sonntag, Wiley, 8th ed., 2013 and "Fundamentals of Engineering Thermodynamics," by M. J. Moran et al., Wiley, 9th ed., 2018.

Anticipated Course Outcomes and Affected Program Outcomes:
The anticipated course outcomes are listed below along with the affected NDSU ME program outcomes.
A list of NDSU ME program objectives and outcomes (1-7) are listed at the end of the syllabus. A student achieving a passing grade in this course will be able to do energy conversion analyses and calculations as it is typical for a mechanical engineer. Upon completion of ME 481/681:

1. Students will be able to apply concepts, terminology, and equations of thermodynamics to solve energy cycles engineering problems. (1, 6, 7)
2. Students will be able to identify, formulate, and solve fundamental energy conversion engineering problems. (1, 6, 7)

3. Students will be able to analyze energy systems and create and validate models based on engineering and mathematical principles that correctly represent such systems and reflect current industry practices. (1, 2, 6, 7)
4. Students will understand the strategies and uses of components and systems in coal fired steam power plants. (1, 2, 4)
5. Students will understand the strategies and uses of components and systems in gas and combined cycle power plants. (1, 2, 4)
6. Students will understand the implications of secondary existing technologies – wind, hydro. (1, 2, 4, 7)
7. Students will be able to identify energy system components and processes to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. (2, 4, 7)
8. Students will have an understanding of the trade-offs associated with choosing one energy strategy over others and its place in the global energy supply. (2, 4, 7)
9. Students will have an understanding of professional and ethical responsibility. (2, 4, 5)
10. Students will be able to use the broad education necessary to understand the impact on engineering solutions in a global, economic, environmental, and societal context. (2, 4, 7)

Assessment:

Your level of success in attaining the anticipated course outcomes will be assessed during the semester by homework (HW) assignments, quizzes, exams, class participation, projects/field trip reports, and final examination. The format of your solutions in homework assignments and the exams should be in acceptable engineering form.

(a) Homework (HW) Assignments, Class participation:

Homework assignments will be posted in Blackboard with instructions. Homework assignments will be due typically in a week after assignment in blackboard. Late papers will not be accepted without a valid excuse. Problems should be completed in acceptable engineering form including the given assumptions, the questions statements, and the drawings labeled (if applicable) of the system being considered or will not be graded.

Blackboard will be used for assignment submission (and grading) for all students. You will need to submit your work electronically via the provided Blackboard assignment links. For full grade note:

i. Method of submission is electronically online via Blackboard.
ii. Each assignment has to be submitted as a single file including all questions/answers.

If you are sick, do not come to class or campus. Instead notify the course instructors as soon as practical, so that accommodations can be made. Class participation by attendance and interactive participation will be counted towards the total homework grade.

(b) Quizzes and Exams:

During the semester there will be quizzes and/or 50-minute exams. Information and instructions will be provided on Blackboard one week before tests. The two-hour final exam will be given on the date and time specified by the University Finals Schedule.

Students who fall ill or need to quarantine, or who know they will be missing an exam for a valid reason (e.g. family emergency) are encouraged to notify the instructor by phone or e-mail prior to the exam, if at all possible. Students missing the exam without a valid excuse will receive a grade of zero for that exam.

(c) Project/Field Trip:
A project or/and field trips related report/presentations will count towards final grade according to the Table below.

(d) Design Project – Graduate Students (ME681):
Graduate students will be required to work on an open-ended design project based on the student research and/or literature survey in one of the energy conversion techniques. This project will involve the application of concepts learned in the class.

Grading Policy:

The grades for this course will be determined as follows:

ME 481 (undergraduate):

HW, Class Participation	25%
Quizzes and Midterms	25%
Project/Field Trip (report/presentation)	25%
Final Exam	25%

ME 681 (graduate):

HW, Class Participation	20%
Quizzes and Midterms	20%
Project/Field Trip (report/presentation)	20%
Final Exam	20%
Design Project	20%

Final course grades will assigned according to the following scale:

A 90% or greater
B 80% to less than 90%
C 70% to less than 80%
D 60% to less than 70%
F less than 60%

Communication

- *Course assignments, calendar, announcements, etc. will be posted on Blackboard on a regular basis. You will need to login and check https://bb.ndsu.nodak.edu/ for announcements and online assignments.*
- *The primary method by which course-related information will be communicated is during class. Reminders, notification of any schedule or assignment changes will be communicated through NDSU email and posted on Blackboard announcements page. Your NDSU email address is the official route for information.*
- *Office Hours: You may meet with me in person during office hours (please remember to wear a face covering and practice social distancing), by appointment, or virtually using the Blackboard Collaborate Virtual Classroom, Zoom, or Teams. Casual email and virtual requests are welcome.*

Additional Information:
Course assignments, calendar, announcements, lab reports and presentations guidelines, etc. will be posted on Blackboard on regular basis, you will need to login and check https://blackboard.ndus.edu for announcements and online assignments.

Copyrights of Course Materials

• According to NDSU Policy 190 on Intellectual property, in this course recording the lectures for anything other than personal use is prohibited.

• All other course-related materials, including handouts, slides, homework, projects, course announcements, solutions, past exams, will be updated regularly on Blackboard for students enrolled in this class only and is subject to copyrights. Please do not spread the course materials online.

Attendance statement

According to NDSU Policy 333 (www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes is expected. Veterans and student service members with special circumstances or who are activated are encouraged to notify the instructor as soon as possible and are encouraged to provide Activation Orders.

Americans with disabilities act for students with special needs

Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the Disability Services Office (www.ndsu.edu/disabilityservices) as soon as possible.

Family Educational Rights and Privacy Act (FERPA) statement: Students personally identifiable information and educational records as they relate to this course are subject to FERPA.

Academic honesty statement

The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

Additional Resources for Students

You are encouraged to use support resources:

- *As a member of the NDSU community, resources are available for you should you need help in dealing with adverse reactions to things happening in the world today. A variety of resources are listed below:*

  For students on campus and remotely (telehealth):
  Counseling Services: 701-231-7671; https://www.ndsu.edu/counseling/
  Disability Services: 701-231-8463; https://www.ndsu.edu/disabilityservices/
  Student Health Service: 701-231-7331; https://www.ndsu.edu/studenthealthservice/
  Dean of Students Office: 701-231-7701; https://www.ndsu.edu/deanofstudents/

  In a crisis or emergency situation:

Call University Police: 701-231-8998
Call 9-1-1
Go to a Hospital Emergency Room
Go to Prairie St. Johns for a Needs Assessment: 701-476-7216 (510 4th St. S.)
Call the FirstLink Help Line: 1-800-273- TALK (8255) or 2-1-1
Call Rape and Abuse Crisis Center: 701-293-7273

ME 481/681 Tentative Course Schedule *(may change)*
2022 Spring Semester

Weeks	***Topic***
Jan 9 – Feb 9	1. Chapter 1: Introduction and Thermodynamics review (1.5 weeks)
	2. Chapter 2: Steam Cycles and Efficiencies (2 weeks)
	3. Chapter 3: Gas Cycles, Combined Cycles, and Efficiencies (1.5 weeks)
	Midterm 1 (date TBA)
Feb 12 – March 1	4. Chapter 4: Internal Combustion Engine Cycles and Efficiencies (1 week)
	5. Chapter 5: Mixtures and Humidity (1 weeks)
	6. Chapter 6: Fuels and Combustion (1 week)
	Midterm 2 (date TBA)
March 4 – March 8	*Holiday - Spring Break*
March 11 – April 5	7. Chapter 6: Nuclear Energy (2 weeks)
	8. Chapter 7: Other topics (Turbines, etc.) (2 weeks)
	Field Trip (date TBA)
April 8 – May 3	9. Chapter 9: Alternative and Renewable Energies (Fuel Cell, Geothermal, Solar, Wind, etc.) (2 week)
	10. Chapter 11: Other Topics, presentations, TBD (2 week)
May 6 – May 10	*Finals Week* *FINAL EXAM Thursday, May 12, 3:30PM-5:30PM*

Department of Mechanical Engineering North Dakota State University

Vision

To become nationally recognized and respected for excellence in engineering education, research, and service to local and regional industries.

Mission

The Department of Mechanical Engineering at NDSU will contribute to the aspirations of a land-grant university in the three primary components of education, research, and service. In support of these endeavors, the mission of the department is to:

- Educate undergraduate and graduate students in the fundamentals of the discipline, prepare graduates (BS, MS, or PhD) to effectively function in society in the field of their choice, and provide the learning skills to adapt to evolving personal and professional goals.
- Develop and maintain high quality research programs in traditional and emerging areas that build on the diverse strengths of the faculty, foster interdisciplinary collaborations, and address national and global needs.

- Serve the needs of the profession, the state of North Dakota, and regional industries to promote and enhance economic development opportunities.

Educational Objectives

In support of the mission of the ME Department, the educational objectives of the program are to produce engineering graduates who:

1) Are well educated in the fundamentals of the discipline, and possess the ability and willingness to adapt to emerging technologies through continued professional development.
2) Will contribute in a competent manner to the engineering profession in the field of their choice.
3) Demonstrate a commitment to uphold high ethical and professional standards in the practice of engineering.
4) Can effectively function in a team environment and interact with people of diverse backgrounds.
5) Understand the context in which their designs will be implemented and the corresponding impact of their activities on society.

Program Outcomes

To foster attainment of the program educational objectives, the ME Department has developed a curriculum that insures students will achieve the following outcomes (1) through (7). Attainment of these outcomes prepares graduates to enter the professional practice of engineering.

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. an ability to communicate effectively with a range of audiences

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies