ME 470/670 Renewable Energy Technology
3 Credits
Fall 2023

Instructor:

Prof. Adam Gladen

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Office:
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Text:

No textbook is required. However there are a number of recommended textbooks. The three textbooks that will be primarily used are:

- "Fundamentals and Applications of Renewable Energy". Mehmet Kanoglu, Yunus Cengel, John Cimbala. Publisher: McGraw Hill
  - This is a general textbook. It gives a broad overview of the various technologies such as wind and solar, but not as in depth as what we will cover in this course. We will use it primarily as a starting point for solar and wind and the main contact for hydropower and geothermal.
- "Solar Engineering of Thermal Process", 4th edition, John Duffie, William Beckman, Publisher: Wiley*
  - This a detailed textbook on solar energy, particularly solar thermal. It provides the most detailed discussion on solar resources and analyzing solar thermal systems. It also provides some information on solar photovoltaic and wind energy.
- "Wind Energy Explained: Theory, Design and Application," 2nd ed. J.F. Manwell, J.G. McGowan, A.L. Rogers, Publisher: Wiley.
  - This is a detailed textbook on wind energy. It provides the most detail on wind related aspects. It will be a primary source when we get to wind energy
- "Solar Energy – Technologies and Project Delivery for Buildings" Andy Walker, Publisher: Wiley
  - This is solar energy textbook that cover solar resources, solar thermal, and solar PV. It provides a level of detail between Kanoglu et al. text and Duffie and Beckman.

*Note: the 5th edition of this book is titled: "Solar Engineering of Thermal Processes, Photovoltaics, and Wind, 5th ed."

Additional reference textbooks will be mentioned and referenced when appropriate.

Course Location and Times

Class Times

Day(s)	Time	Location

Mon., Wed., Fri.	*9:00 – 9:50 am*	*AG Hill 326*

Final Exam

Wednesday, Dec. 13th at 10:30am --- Location: AG Hill 326

https://www.ndsu.edu/onestop/final-exam-schedule

Health and Safety Expectations

Currently (as of August 16th), NDSU does not require masks campus wide but allows faculty members discretion to require masks in their individual classes. And while masks are not required on campus, individuals should feel free to continue to wear a mask based on their individual circumstances.

Consistent with ND Department of Health, it is expected that people who are infected or close contacts who are unvaccinated will avoid campus during their five-day isolation. Fee testing kits can be picked up at the NDSU Bookstore, Library or Student Health Services.

I expect you to follow the CDC guidelines (https://www.cdc.gov/coronavirus/2019-ncov/your-health/isolation.html) in regards to isolation and quarantining, and mask-wearing post isolation.

Changes in these policies may occur depending on infection rates, and changes to CDC and NDSU recommendations/guidelines.

Attendance

According to NDSU Policy 333 (www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes (in-person) is expected when it is safe to do so in accordance with NDSU guidance regarding COVID-19. 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. Attendance will be taken for labs.

In-person attendance is expected, however, with the changing conditions of COVID-19, this may change. If so, you will be updated accordingly.

Do not come to class if you are sick, have been exposed to individuals who tested positive for COVID-19, and/or have been notified to self-quarantine due to exposure. **If you are unable to attend class for health reason, please contact me so that we can arrange alternatives for you.**

Communication

The primary methods by which course-related information will be communications during class, postings to the Blackboard page, and your NDSU email address. Check the Blackboard page regularly as it will be strongly relied upon.

Course Description and Prerequisites

Introduction to renewable energy technology, solar thermal energy systems, solar photovoltaic systems, wind turbines; biomass; bio-fuels; urban waste to energy from pyrolysis plants; hydrogen energy and fuel cells.

Prerequisites: ME 350 or 351, and admission to professional program

Course Outcomes

1. To provide an overview of environmental friendly renewable energy sources. (1)
2. To identify available solar technologies and predict the available solar energy for any given locations; design a simple hot water heating system and a basic photovoltaic system. (1,2)
3. To have in depth understanding of the modern wind energy technology and have abroad appreciation of how it is applied in practice. (1)

4. To have basic knowledge on the development of other non-conventional energy conversion technology such as biomass and urban waste. (2,7)
5. To provide a broad knowledge on the hydrogen production technology and operation of a fuel cell as well as the prospects of fuel cell systems. (2,7)
6. The team project should help the student develop the skill of lifelong learning. (2,3,5,7)

Grading

ME 470 Grade Weight Breakdown

Homework	20%
Project	20%
Exam 1	20%
Exam 2	20%
Final	20%

ME 670 Grade Weight Breakdown

Homework	15%
Project/Presentation	25%
Exam 1	20%
Exam 2	20%
Final	20%

Final Course Grades Scale

The final course grade will be assigned per the following absolute scale:

$A \geq 90\%$
$90 > B \geq 80\%$
$80 > C \geq 70\%$
$70 > D \geq 60\%$
$F < 60\%$

The final grade will be calculated use a weighted average. Note, the overall homework grade is calculated based on total points earned divided by possible points. The *lowest individual homework grade will be dropped* when calculating the homework score.

Regrades:

With the exception of arithmetic errors, all requests for re-grading of a problem must be submitting in writing. Please write a short note detailing the perceived mistake and why your solution merits points back. *Requests for regrades must be submitted to Dr. Gladen within a week of receiving the graded material*.

Assessments

Homework:

Reading and homework assignments will be given during class lecture and posted to Blackboard. In general, homework problems will be due one week from the assignment date. Homework must be in acceptable engineering form including labeled drawings of the system being considered. An overview of proper engineering homework format is provided on Blackboard). The examples worked in class are also in the proper format.

Experience has shown that working through problems on one's own is the best way to learn this material, and it will help your performance on the exams. As such, each student is expected to do their own

work and must turn in their own homework set. Working in groups, as well as discussions with other students and the instructor/TA are encouraged, but the problem set that you hand in should be your own work. To be fair to all students, *late homework will not be accepted*. Additionally, if a wrong problem is submitted, that problem will receive a zero. The *lowest individual homework grade will be dropped* when calculating the overall homework grade.

Project

Students will be required to work on an open-ended project related to renewable energy and write a report. Undergraduate students will work on the project as a part of a team. Graduate students will work independently. Additionally, graduate students will have to develop a presentation that they will present to the class. Details on the project requirements will be provided nearer to when the project is assigned.

Exams:

There will be two tests and a final. The tentative schedule** is as follows. It could change:

- *Exam 1 – Week 6: 9/29/2023*
- *Exam 2 – Week 11: 11/1/2022*
- *Final Exam – Finals Week:*
    - *12/13/2022 at 10:30am*

  The final exam will be comprehensive but weighted to the material presented after Exam 2

**This schedule is subject to change.

If you expect to miss an exam for an excused absence (e.g. University Sanctioned Event, Military Duties, Pregnancy or other Medical - see Policy 333), please talk with the instructor to make arrangements. Note: wanting to leave early for a vacation is not an excused absence.

Tentative Topic Schedule

Note: this schedule is subject to change.

Week	***Topics***	***Outcomes***
1 - 2	Introduction and Energy Overview	1
2 – 8	Solar Energy Overview and Solar Resources Solar Thermal – Flat Plate Photovoltaics (PV)	2
9 – 12	Wind Energy Overview and Components Wind Resources Betz limit and Turbine Efficiency Basic Aerodynamics for Turbines Overview of Siting and Control	3
13-14	Hydropower Basics Types and analysis of turbines	4
15	Geothermal	4
16	Biomass	4

Assistance

My goal is to help you learn the material and to assist you in having a positive and effective learning experience. As such, please let me know if you have any questions or concerns about the course or if there is something which may aid you in learning the material.

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.

Veterans and Student Soldiers

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.

Academic Honesty

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.

ABET Student Outcomes

To foster attainment of the educational objectives, the ME Department has developed a curriculum that insures students will achieve the following outcomes by the time of graduation:

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.