

ABEN 456/656 Biobased Energy
3 credits, Spring 2024
Meets in **LADD 114** on **Tu/Th 9:30-10:45 a.m.**

Prerequisites: Junior standing in a science or engineering field or by permission of instructor

Instructors and contact information:

Name: Dr. Clairmont Clementson

Office location: LADD 104K

Contact Information: clairmont.clementson@ndsu.edu and Phone: 701-231-7277

Office Hours: Tuesdays after class (10:45 to 11:45 AM) or by appointment.

Catalog Description: Topics to be addressed include benefits and limitations of biobased energy development; resource potential; biomass production, harvest, storage, and transportation issues; and conversion technologies (e.g. combustion, pyrolysis, gasification, starch and cellulosic ethanol production, biodiesel production, and anaerobic digestion).

Course Materials:

As the subject of biobased energy is a rapidly expanding technology area, there will be no textbook for this course. Course readings will be posted on Blackboard and will come from government reports, technical literature, and other reliable internet sources. Some of these reports may be provided by the instructor. If students wish to have a paper copy of other readings, they are responsible for printing out materials themselves.

Objectives with Accreditation Board for Engineering & Technology (ABET) evaluation criteria:

At the end of the course students should be able to:

1. Explain the economic, environmental, and political importance of biobased fuels (ABET- C Outcome 4, see Table 1)
2. Explain options and challenges for biomass production, harvest, transportation and storage (ABET-A Outcome 2; ABET- C Outcome 7, see Table 1)
3. Explain the advantages, limitations, and individual steps involved in producing: biobased electricity, thermochemical conversion fuels, corn ethanol, cellulosic ethanol, biodiesel, and biogas. (ABET-A Outcome 2; ABET- C Outcome 7, see Table 1)
4. Students should be better writers (grammatical form, sentence and paragraph clarity, etc) (ABET-B Outcome 3)
5. Students should think critically about what is read or heard in the media and/or scientific literature regarding biobased energy and related issues (ABET- C Outcome 4, see Table 1)

Table 1. Program educational objectives and supporting student outcomes. *

Graduates are expected to have established themselves as practicing engineers who, within a few years of graduation:

- A Successfully address emerging engineering challenges in the design or evaluation of machine systems, processing systems, and natural resources and environmental systems affecting the production of food, feed, and other biobased products.

Technical learning outcomes include student outcomes (1), (2), and (6):

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

B Effectively use professional communication, critical thinking, and interpersonal skills as team leaders and team members.

Communicational learning outcomes include student outcomes (3) and (5):

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

C Responsibly serve the public and their employers by participating in professional development and by maintaining the highest standard of professional ethics.

Contextual learning outcomes include student outcomes (4) and (7):

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

* See https://www.ndsu.edu/aben/about/abet_accredited/ for the current ABEN program educational objectives. See <https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2021-2022/> for information on ABET student outcomes 1-7, effective as part of the "Criteria for Accrediting Engineering Programs, 2021-2022."

Grading

	Undergraduate Students - 456	Graduate Students - 656
HW Assignments* and Quizzes ^ψ :	20%	20%
Exam #1:	15%	15%
Exam #2:	15%	15%
Final Exam:	20%	15%
Discussion board ^ρ :	15%	15%
Group Project [†] :	15%	10%
Review Paper [¶] :		10%

*Assignments should be uploaded on Blackboard in the following format:

LastName_Assignment#.docx

(e.g. Luke Skywalker's submission for the 3rd HW would be: Skywalker_3.docx)

Late Assignments: Contact instructor in advance to *request* an extension.

Otherwise:

After deadline, $\frac{3}{4}$ credit (maximum) before 6 hrs. $\frac{1}{2}$ credit (maximum) before 24 hrs. After 24 hours, $\frac{1}{4}$ credit (maximum).

The lowest HW grade will be dropped at the end of the semester.

Ψ Class quizzes will be given via blackboard during the semester.

† Students will work in groups of two students in energy related topics (confirm choice with instructor by Jan 25).

¶ 4-5 graduate students will carry out a thorough review of a topic of interest (confirm topic with instructor by Jan 30).

‡ Discussion boards will be arranged. Students will be graded for participation. Students are required to provide a response to the discussion question and provide a response to at least two of their classmate's response.

Final grades will tentatively be based on a standard distribution (A= 90-100%, B=80-89.9%, C=70-79.9%, D=60-69.9%, and F <60%).

Some of the evaluation of students' work for this course will be based on writing. Communication skills (including writing) may be the most valuable skills that any student develops – no matter what her or his career goals are, students are expected to write professionally as if the assignment were to be used as a professional writing sample. Students are welcomed and *encouraged* to read and edit one another's work. Students are also encouraged to visit the Center for Writer's in the NDSU Library for additional assistance, especially for recurring difficulties. They do not serve as a last-minute editor but should be able to help with larger organization issues.

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.

Students with special requirements

Any students with disabilities who need accommodations in this course are invited to share these concerns or requests with the instructor and contact the [Center for Accessibility and Disability Resources](#) as soon as possible.

Veterans and military personnel

Veterans or military personnel with special circumstances or who are activated are encouraged to notify the instructor as early as possible and are encouraged to provide Activation Orders.

Family Educational Rights and Privacy Act (FERPA)

Your personally identifiable information and educational records as they relate to this course are subject to [FERPA](#).

Important Dates (Full NDSU dates/deadlines can be found [here](#))

Jan 1	Mon	HOLIDAY — New Year's Day (offices closed)
Jan 8	Mon	Classes begin at 4:00 p.m.
Jan 9	Tue	First full day of classes
Jan 15	Mon	HOLIDAY — Martin Luther King, Jr. Day (no classes, offices closed)
Jan 16	Tue	Last day to be added to Campus Connection Wait Lists
Jan 18	Thu	Last day to Add classes via Campus Connection
Jan 18	Thu	Last day for no-record Drop of classes @ 100% refund
Jan 18	Thu	Last day to Withdraw to Zero Credits @ 100% refund
Jan 24	Wed	Payments due for NDSU account balances
Jan 29	Mon	Last day to submit requests to Audit, Pass/Fail
Feb 19	Mon	HOLIDAY — Presidents' Day (no classes, offices closed)
Feb 19	Mon	Last day to Withdraw to Zero Credits @ 75% refund
Mar 4-8	Mon-Fri	Spring Break Week (no classes, offices open)
Mar 15	Fri	Late fee applied to unpaid account balances (11:59 p.m.)
Mar 21	Thu	Last day to Withdraw to Zero Credits @ 50% refund
Mar 29-Apr 1	Fri-Mon	HOLIDAY -- Spring Recess
Apr 5	Fri	Last day to Drop classes with 'W' record
Apr 5	Fri	Last day to Withdraw to Zero Credits for Spring
Apr 15	Mon	Late fees applied to unpaid account balances (11:59 p.m.)
Apr 29-May 3	Mon-Fri	Dead Week
May 6-10	Mon-Fri	Final Examinations
May 11	Sat	Commencement ceremony

Tentative Course Schedule

<u>Date</u>	<u>Topic</u>
1/09/2023	Class Intro and Current Energy Consumption
1/11/2023	Current Energy Consumption/Resources
1/16/2023	Peak Oil
1/18/2023	Peak Oil, Biofuels and Oil
1/23/2023	Sustainability - GHG Emissions, Other sustainability Criteria
1/25/2023	Sustainability / Biomass Feedstock
1/30/2023	Biomass Feedstocks – Forestry
2/01/2023	Biomass Feedstocks – Agricultural Resources
2/06/2023	Billion-ton Biomass Report
2/08/2023	Biomass Transportation/Densification
2/13/2023	Harvest/Storage/Transportation

2/15/2023 Guest Lecture: **Dr. Ripplinger** (Bioenergy Economics)

2/20/2023 Exam 1

2/22/2023 Thermochemical – Combustion

2/27/2023 Thermochemical – Pyrolysis (bio-oil)

2/29/2023 Thermochemical – Gasification (i.e. syngas)

3/05/2023 **SPRING BREAK**

3/07/2023 **SPRING BREAK**

3/12/2024 Cellulosic Fuels: Thermochemical Platform (FTS)

3/14/2023 Project Meeting

3/19/2023 Cellulosic Fuels: Thermochemical Platform (Syngas Ferm)

3/21/2023 Thermochemical Technology Review

3/26/2023 Exam #2

3/28/2023 Cellulosic Ethanol – Sugar Platform (Pre-treatment)

4/02/2023 Cellulosic Ethanol – Sugar Platform (Hydrolysis & Fermentation)

4/04/2023 Sugar/Corn Ethanol

4/09/2023 Anaerobic digestion

4/11/2023 Biodiesel

4/16/2023 Plant Tour: **Beet sugar Plant visit**

4/18/2023 Plant Tour: **Casselton Ethanol Plant**

4/23/2023 Student Presentation – Graduate Students

4/25/2023 Student Presentations – Undergraduate Students

4/30/2023 Student Presentations – Undergraduate Students

5/02/2023 Exam Review

5/08/2023 Final Exam – same room (8-10 am)

(Cumulative w/ emphasis on last third)