ABEN 456/656 Biobased Energy

3 credits
Tu/Th 9:30-10:45 AM in ABEN 201
Prerequisites: Junior standing in a science or engineering field or by permission of instructor

Instructor:

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Office Hours: Tuesday and Thursday after class (10:45 to 11:45 AM) or by appointment. Drop-ins are acceptable at other times but instructor availability cannot always be guaranteed. Students are also welcome to call or send questions via e-mail.

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).

Objectives (with Accreditation Board for Engineering & Technology evaluation criteria):
At the end of the course students should be able to:

- Explain the economic, environmental, and political importance of biobased fuels (ABET-4)
- Explain options and challenges for biomass production, harvest, transportation and storage (ABET - 4)
- Explain the advantages, limitations, and individual steps involved in producing: biobased electricity, thermochemical conversion fuels, corn ethanol, cellulosic ethanol, biodiesel, and biogas. (ABET – 4, 7)

Additional objectives:

- Students should think critically about what is read or heard in the media and/or scientific literature regarding biobased energy and related issues (ABET- 4, 7)

Course Format: We will incorporate two education philosophies: learner centered and case-based learning, which focuses on the learner identifying objectives, the use of case studies, and learning groups. The goal of these learning approaches is to not merely have your professor (me) constantly lecturing while you passively sit and later attempt to memorize. These learning approaches emphasize comprehension, application, analysis, synthesis, and evaluation. Education research shows these approaches increase retention of knowledge and build valuable skills. *My role as your professor in these processes is to set up learning situations for you to capitalize on to increase your knowledge of Biobased Energy and improve skills critical for a successful career.*

Each student will be assigned to a small group of students in the class. Small groups will be used for in-class discussions and small group assignments. These groups will change periodically during the semester.

ASSIGNMENTS DESCRIPTIONS

Formative Assessment

Pre-Class Assignments:

We do not have a textbook for this course; however, we do have lots of reading materials from the web and/or handouts. For most weeks, I will put a reading assignment on blackboard. It is expected that you read them before each class. Classes will involve discussions of these reading materials especially in groups.

In-Class activities:

Students must be present in class to participate in these activities. Students with excused absences can make up these activities and when possible should arrange ahead of time. These activities are typically completed in groups. Grading will be done via accuracy/completion depending on the activity.

Summative Assessments:

Summative Evaluation material will be taken from the assigned content, pre-class assignments, in class activities, exams – in other words EVERYTHING. Grading will be assessed by demonstration of the following: knowledge, application, and communication. <u>There are no makeups on summative evaluations unless PREVIOUS arrangements are made with instructor</u>.

Grading:

	Undergraduate Students - 456	Graduate Students - 656
HW Assignments* and Quizzes♦:	10%	10%
Pre-Assignments and In-Class Activities	10%	10%
Exam #1:	20%	20%
Exam #2:	20%	20%
Final Exam:	25%	20%
Group Project†:	15%	10%
Review Paper¶:		10%

*Assignments should be uploaded on Blackboard in the following format:
LastName_Assignment#.docx
Late Assignments: Contact instructor in advance to *request* an extension.
Otherwise: After deadline, ½ credit (maximum); After 24 hours, no credit
The lowest HW grade will be dropped.

♦ At least 4 unannounced class quizzes will be given during the semester.

† Students will work in groups of two/three students in energy related topics (confirm choice with instructor by Jan 30).

¶ Each graduate student will carry out a thorough review of a topic of interest (confirm topic with instructor by Feb 4).

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%), but this scale *may* be adjusted down if deemed appropriate by instructors.
A = Excellent; clearly communicated and demonstrated understanding of materials
B = Fine; met basic course requirements but did not excel
C = Fair; Lacking in demonstration or communication of course material
D/F = Poor; Did not complete assignments, did not show improvement or seek help, did not demonstrate basic understanding

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.

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.

Philosophy of the Community of Truth (Learning Community):

The following is an excerpt from *The Courage to Teach* by Parker J. Palmer:
A community of truth is a community that forms around seeking the truth; "truth is an eternal conversation about things that matter, conducted with passion and discipline."

- We invite *diversity* into our community not because it is politically correct but because diverse viewpoints are demanded by the manifold mysteries of great things.
- We embrace *ambiguity* not because we are confused or indecisive but because we understand the inadequacy of our concepts to embrace the vastness of great things.
- We welcome *creative conflict* not because we are angry or hostile but because conflict is required to correct our biases and prejudices about the nature of great things.
- We practice *honesty* not only because we owe it to one another but because to lie about what we have seen would be to betray the truth of great things.
- We experience *humility* not because we have fought and lost but because humility is the only lens through which great things can be seen—and once we have seen them, humility is the only posture possible.
- We become *free* men and women through education not because we have privileged information but because tyranny in any form can be overcome only by invoking the grace of great things.

Academic Integrity
All work in this course must be completed in a manner consistent with: 1) NDSU University Senate Policy, Section 335: Code of Academic Responsibility and Conduct www.ndsu.edu/fileadmin/policy/335.pdf and 2) the CoE Honor System
www.ndsu.edu/coe/undergraduate_students/honor_code/

Plagiarism
Plagiarism will not be tolerated in writing assignments and students will not be given any credit for assignments containing plagiarized material. Students should cite references used for all assignments. Citing a reference does not mean that it is acceptable to copy material directly. Quotation marks are needed when quoting directly and direct quotes should be used sparingly, if ever.

Attendance
According to NDSU Policy 333, attendance in classes is expected. Students are responsible for getting any information or announcements made if class absence is necessary.

Students and Military Service:
Veterans and student soldiers with special circumstances or who are activated are encouraged to notify the instructor in advance.

Students with Disabilities:
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 as soon as possible.

Use of Cell Phones, iPods, MP3 Players, and Other Electronic Devices:
All participants in this class are subject to NDSU University Senate Policy 158: Acceptable use of Electronic Communications Devices (http://www.ndsu.edu/fileadmin/policy/158.pdf).

As a courtesy to other students and the instructor, all cell phones, iPods, MP3 players, should be turned off or placed in a vibrate-only mode during class time. Initiating phone calls, text message, or other types of messages during class time -including those to friends, family, classmates, coworkers, or supervisors—is unacceptable unless there is a genuine emergency. Examples of emergencies include weather-related school closing announcements; fire, bomb, or other threats to public safety and well-being; and other incidents in which the NDSU system is or could be activated to provide broadcast messages to the NDSU community.

ABEN 456/656 (Group Project)

Students will work in a group of two in energy related topics. Projects should be well-researched and thought out using peer-reviewed journal articles (at least 5 references). Students' project grades will be based upon participation, paper submission and oral presentations (15 minutes). Students will be asked to evaluate each other's presentations. Guidelines for a written report are: 12 point font; at least 1000 words without references, figures and illustrations). The course instructor should approve the project to be presented. Confirm choice with instructor by Jan 30, 2020.

Students will submit:

Tentative Outline and Reference List **(15 pts)**:	Feb 27, 2020
Paper Submission **(50 pts)**:	April 23, 2020
Oral Presentation **(30 pts)**:	Last 3 weeks of classes
Participation and Evaluation of the Presentation **(5 pts):**	Last 3 weeks of classes

Possible project topics: (*not* in any way limited to these topics)

1. Algae to fuel
2. Analysis of Brazil's sugar ethanol industry
3. Aviation/Jetfuel biofuel
4. Biobutanol
5. Biodiesel from jatropha
6. Biodiesel from palm oil
7. Biological hydrogen production
8. Carbon capture and storage
9. Carbon credit and emission trading
10. Coal energy
11. Electric vehicle
12. Genetically modified plants for biofuel production
13. Geothermal energy
14. Green diesel
15. Hydrogen and fuel cells
16. Hydrogen storage
17. Hydrogen vehicle
18. Hydrothermal liquefaction
19. Natural gas energy
20. Nuclear energy
21. Smart grid
22. Solar energy
23. Water energy
24. Wind energy

Students are welcome and encouraged to meet with class instructor to discuss these or other topic ideas.

***Tentative* Course Calendar**

Date	Topic
1/14/2020	Class Intro and Current Energy Consumption/Resources
1/16/2020	Current Energy Consumption/Resources
1/21/2020	Peak Oil
1/23/2020	Peak Oil, Biofuels and Oil
1/28/2020	Sustainability - GHG Emissions, Other Sustainability Criteria
1/30/2020	Guest Lecture LCA (Dr. Ghasideh)
2/4/2020	Biofuel Feedstocks
2/6/2020	Biomass Feedstocks – Forestry
2/11/2020	Biomass Feedstocks – Agricultural Resources
2/13/2020	Harvest/Storage/Transportation
2/18/2020	Densification
2/20/2020	Review
2/25/2020	Exam #1 (through densification)
2/27/2020	Thermochemical – Combustion
3/3/2020	Thermochemical – Pyrolysis (bio-oil)
3/5/2020	Thermochemical – Gasification (i.e. syngas)
3/10/2020	Thermochemical – Gasification/review
3/12/2020	Cellulosic Fuels – Thermochemical Platform (Syngas Ferm.)
3/17/2020	SPRING BREAK
3/19/2020	SPRING BREAK
3/24/2020	Cellulosic Fuels – Thermochemical Platform (FTS)
3/26/2020	Review
3/31/2020	Exam #2 (Thermochemical Conversion)
4/2/2020	Sugar/Corn Ethanol
4/7/2020	Corn Ethanol/ Field trip: Thoraldsons Ethanol Plant, Casselton
4/9/2020	Cellulosic Ethanol – Sugar Platform (PT)
4/14/2020	Cellulosic Ethanol – Sugar Platform (Hydrolysis, Fermentation) (Lab)
4/16/2020	Guest Lecture: Dave Ripplinger (RFA, RIN)
4/21/2020	Biodiesel (Lab demonstration)
4/23/2020	Anaerobic Digestion
4/28/2020	Student Presentations
4/30/2020	Student Presentations
5/5/2020	Student Presentations
5/7/2020	Review
5/12/2020	Final Exam – same room (1 –3 PM) (cumulative w/ emphasis on last third)