Biomass Energy Conversion Technology

ChE478 (93624)/ChE578 (93626)

School for Engineering of Matter, Transport and Energy, Arizona State University
(3 Credits, Time: MW 3:05 PM - 4:20 PM, Location: Tempe GWC 535, Fall 2020)

Instructor

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Office Hour: MW 2:00 PM -3:00 PM, Office Location: Engineering Research Center 279

Course Description

This course presents an introduction to the fundamentals and applications of biomass conversion process technologies. A brief review on fundamentals of engineering thermodynamics, chemistry of plant materials and reaction kinetics will be given. Biomass feedstocks for biofuels and chemicals production will be covered. The main focus of this course will be surveying the state-of-the-art technologies for cost-effective biomass conversion to biofuels including liquid fuels (bioethanol, and biodiesel) and gaseous fuels (methane, hydrogen and synthesis gas). Both biological and thermochemical processes for the conversion of biomass to biofuels and chemicals will be considered. Applications of biofuels in transportation, energy production in power plants and fuel cells, and economics, environmental impact, and policy issues relevant to biofuels will also be covered. The course will be of value to engineering students and students from other colleges (Arts & Science, Agriculture and Business) who are interested in the technologies of the developing field of biofuels, as well as engineers, managers and policymakers.

Pre-requisites

General chemistry, restricted to majors or with instructor's approval.

Textbook

1. Sergio C. Capareda, Introduction to Biomass Energy Conversions, CRC Press, ISBN: 978-1-4665-1333-4 (2013). (Required)
2. Robert C. Brown, Biorenewable Resources: Engineering New Products from Agriculture. Wiley-Blackwell Publishing (2014) (Recommended)
3. Richar A. Dunlap, Sustainable Energy, Cengage Learning (2015) (Recommended)

Course Objectives

The main objective of this course is for students to get familiar with biomass production, conversion to fuels and chemicals and applications of biofuels and chemicals produced from biomass. The specific objectives are:

- Understand basic concepts about biomass derived energy;
- Apply engineering thermodynamics, organic chemistry, chemistry of plant materials and reaction kinetics to biomass production and conversion;
- Be able to do the basic engineering calculations related to biofuel production;
- Apply biomass derived energy in different applications.

Topics

- Energy Survey
- Energy Basics
- Fossil Fuels

- Renewable Energy Resources
- Energy Conservation Processes
- Biomass Resources and Products
- Bioenergy Production
- Bioethanol Production
- Biodiesel Production
- Biogas Production
- Thermochemical Processes: Pyrolysis
- Thermochemical Processes: Gasification
- Thermochemical Processes: Hydrothermal Liquefaction
- Environmental Impact of Bioeconomy
- Economics of Biorenewable Resources
- Biorenewable Policy

Grading

There will be five quizzes, two exams, one term paper and a final presentation. The guidelines for term paper and presentation will be provided.

Quiz		10%		
Term Paper		20%		
Presentation		10%		
Exam-1:		30%		
Exam-2		30%		
A: 90-100%;	B: 80-89%;	C: 70-79%;	D: 60-69%;	F: <60% (ChE578)
A: 85-100%;	B: 78-84%;	C: 70-77%;	D: 60-69%;	F: <60% (ChE478)

Class Policies

- ASU Sync

  This course uses Sync. ASU Sync is a technology-enhanced approach designed to meet the dynamic needs of the class. During Sync classes, students learn remotely through live class lectures, discussions, study groups and/or tutoring. You can find out more information about ASU Sync for students here, https://provost.asu.edu/sync/students and https://www.asu.edu/about/fall-2020.

  To access live sessions of this class go to myASU and click the Attend via Sync button next to this class on your schedule.

  You will attend some class sessions in-person and be remote for other sessions to ensure we keep the room occupancy below 50%.

  If you cannot physically be on campus due to travel restrictions or personal health concerns, you will be able to attend your classes via ASU Sync or through iCourses during the fall semester. If you will not be on-campus for the fall semester, you are expected to contact your professors to make accommodations.

- Course Access

  Your ASU courses can be accessed by both my.asu.edu and myasucourses.asu.edu; bookmark both in the event that one site is down.

- Technology Requirements
  ASU Sync classes can be live streamed anywhere with the proper technology. We encourage you to use a PC or Apple laptop or desktop equipped with a built-in or standalone webcam. You will need an internet connection that can effectively stream live broadcasts. It is recommended that your internet download speed is at least 5.0 mbps. You can use this tool to test your current connection.

  We do not recommend the use of iPads or Chromebooks for ASU Sync as these devices do not work for class exams that may be proctored remotely.

  If you are not able to personally finance the equipment you need to attend class via ASU Sync, ASU has a laptop and WiFi hotspot checkout program available through ASU Library.

  Who is eligible?
  Any currently enrolled ASU student is eligible to checkout a laptop. The current availability of laptops can be found here.

  Borrowing and returning laptop rules

  Laptops are lent on a first-come, first-serve basis, and cannot be reserved in advance. They can be returned at any time, but will be due at the conclusion of the fall 2020 semester.

  Rentals are limited to one laptop per student.

  Laptops are available for checkout at the following libraries on all four campuses. (Please check online for current library hours)

  Downtown Phoenix campus Library

  Polytechnic campus Library

  Tempe: Hayden and Noble Libraries

  West campus: Fletcher Library

  Return laptops to any ASU Library Information Desk (not at the drop box or other location)

  Refer to ASU Library Computer Use Policy and ASU Computer, Internet, and Electronic Communications Policy.

  Borrowers are responsible for loss, damage, and theft of the laptop while in their possession. Borrowers should verify the condition of the laptop at the time of check-out and upon check-in.

- Late Submission, Make-up Exams, & Attendance
  Late assignments will not be accepted and makeup exams will not be given, except as described by ACD 304-04 and ACD 304-02. Accommodations will be made for religious observances provided that students notify the instructor at the beginning of the semester concerning those dates. Students who expect to miss class due to officially university-sanctioned activities should inform the instructor early in the semester. Alternative arrangements will generally be made for any examinations and other graded in-class work affected by such absences. The preceding policies are based on ACD 304–04, "Accommodation for Religious Practices" and ACD 304–02, "Missed Classes Due to University-Sanctioned Activities."
- Academic Integrity & Plagiarism Policy
  All students are expected to be familiar with and to comply with the Arizona State University Academic Integrity Policy http://provost.asu.edu/academicintegrity. Cheating on exams, plagiarism of homework solutions, and any other acts which violate the academic integrity policy in this course will diminish the student's grade. All occurrences of violations of the academic integrity policy will be reported to the appropriate University authorities for further disciplinary action.
- Students with Disabilities
  Students with a documented disability who have registered with the campus Disability Resource Center should speak with the instructor after class or during office hours to arrange any necessary accommodations.
  http://www.asu.edu/aad/manuals/ssm/ssm701-02.html
  http://www.asu.edu/studentaffairs/ed/drc/
- Electronic Devices
  Cell phones, beepers, and other electronic messaging devices must be turned off during class. Also, all cell phone headsets, earpieces, and headphones must be removed prior to entering the classroom and throughout the class session. Failure to adhere to this policy will result in a deduction of one point (for each detected occurrence) from the final semester grade. A laptop computer with MATLAB and excel programs will be needed during lectures and exams.
- Policy Against Threating Behavior
  Per the Student Services Manual, SSM 104–02
  http://www.asu.edu/aad/manuals/ssm/ssm104-02.html, "Handling Disruptive, Threatening, or Violent Individuals on Campus", any student interfering with the peaceful conduct of university-related business or activities or remaining on campus grounds after a request to leave may be considered a crime. If the professor or TAs deem your behavior to interfere with the peaceful conduct of the class, you will be asked to leave the classroom.
- Sexual Discrimination
  Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you

know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.
As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish discuss any concerns confidentially and privately.

- Copyright
  Course content, including lectures, are copyrighted materials and students may not share outside the class, upload to online websites not approved by the instructor, sell, or distribute course content or notes taken during the conduct of the course (see ACD 304–06, "Commercial Note Taking Services" and ABOR Policy 5-308 F.14 for more information).
  You must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, material that is not the student's original work, unless the students first comply with all applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.
- Other Notices
  Any information in this syllabus (other than grading and absence policies) may be subject to change with reasonable advance notice.

ChE 478/ChE 578 (Biomass to Energy Conversion Technology)
Fall'2020 Tentative Schedule

Session	Date	Topics	Assignment Due Date
1	8/24	Introduction/Energy Basics	
2	8/26	Past, Present and Future World Energy Use	
3	8/31	Energy Basics: Mass Balance (1)	
4	9/2	Energy Basics: Mass Balance (2)	
5	9/7	Labor Day, No Class	
6	9/9	Energy Basics: Energy Balance	
7	9/14	Energy Basics: Adiabatic T and Heating Values	
8	9/16	Energy Basics: Chemical Reaction Equilibrium	
9	9/21	Fossil Fuels (1)	
10	9/23	Fossil Fuels (2)	
11	9/28	Renewable Energy	
12	9/30	Energy Conservation	
13	10/5	Biorenwable Resources (1)	
14	10/7	Biorenwable Resources (2)	
15	10/12	Fall Break, No Class	
16	10/14	Problem Session 1	
17	10/19	**Exam 1**	
18	10/21	Products from Biorenwable Resources	
19	10/26	Conversion of Biorenewable Resources into Heat, Power and Gases (1)	
20	10/28	Conversion of Biorenewable Resources into Heat, Power and Gases (2)	
21	11/2	Bio-ethanol Production (1)	
22	11/4	Processing of Biorenewable Resources into Natural Fibers	
23	11/9	Bio-ethanol Production (2)	
24	11/11	Veterans Day, No Class	
25	11/16	Biodiesel Production	
26	11/18	Biogas Production	
27	11/23	Term Paper Presentation (1)	Term Paper due (11/23)
28	11/25	Term Paper Presentation (2)	
29	11/30	Problem Session 2	
30	12/2	**Exam 2**	