

Introduction to Bioenergy Technologies

11:776:112 (3 credits)
Spring Semester (yearly)
On-line Format

CONTACT INFORMATION

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Office Hours: by arrangement

COURSE DESCRIPTION

Introduction to Bioenergy Technologies provides an introductory understanding of biomass and biomass to low-carbon energy systems including biopower, bioheat, and biofuels, with a scientific examination of feedstocks, conversion technologies, and scale up for industrial production, end products, and their applications. The course will also provide entry level understanding of the concepts of sustainability, systems thinking, and Life Cycle Analysis (LCA) and incorporation of these concepts into bioenergy systems. The class will explore the potential advantages of low-carbon energy in developing a low-carbon economy and society. The class may include also a tour of the EcoComplex and the Clean Energy Innovation Center and Business Incubator, and group projects at the Center based on student preference.

COURSE WEBSITE, RESOURCES AND MATERIALS

- Course website: Canvas
- Recommended text: none
- Weekly PowerPoint presentations plus literature posted to course website as PDFs

PREREQUISITE

None

COURSE LEARNING GOALS (link to Plant Biology Undergraduate Program Goals:

<http://plantbiology.rutgers.edu/undergrad/plantbiology/>)

This course will be focused on academic achievement, acquisition of knowledge and enhancement of comprehension of information regarding biomass and bioenergy technologies and their sustainable applications. Students will practice knowledge-based critical thinking and solution offering about emerging innovative bioenergy technologies. Students completing this course will be able to:

1. Identify potential biomass feedstocks including energy crops (addresses program goal 1)
2. Describe an understanding of the existing and emerging biomass to energy technologies and the LCA and its applications (addresses program goal 2)
3. Develop a critical thinking about sustainability and resilience (addresses program goal 4)

- Determine potential solutions for energy needs and problems by incorporating the bioenergy technologies being explored (addresses program goal 4)

ASSIGNMENTS/RESPONSIBILITIES AND ASSESSMENT

Grading:

- One-page papers, quality of discussion 50%
- Quiz, mid-term examination 25%
- Final project 25%

Grades will be classified based on Rutgers approved system: A, B+, B, C+, C, D, and F.

Online courses work best as reading and discussion seminars. Each week, assigned readings or other materials will be posted to eCollege. Students will be required to submit a one-page paper each week, typically in response to a question from the instructor. These papers will not be shared with other students, thus enabling the instructor to evaluate individual performance. After these papers are submitted, the entire class will engage in an asynchronous, open, guided discussion of the readings. These discussions will be open until the following week's paper is due.

Two exams (quiz, mid-term) will be administered. Students will also be responsible for a final life cycle analysis project. Given the time constraints of a single semester, this project is not likely to require the collection of original data.

It is important that students have the tools to succeed in this course. Please see/contact the instructor *as soon as possible* with any difficulties or questions regarding the course materials. In addition, the Office of Student Affairs is available at <http://studentaffairs.rutgers.edu> for any other needs or concerns.

Learning goals assessment: Specific questions on grading mechanisms will be used to assess student knowledge of course learning goals, including demonstrated mastery of fundamental terms associated with bioenergy technologies. In addition, students will communicate critical thinking skills (learning goal 3) and ability to determine potential solutions for energy needs (learning goal 4) in graded assigned weekly papers and the final project. The percentage score on these assessments will determine the level of mastery: >90% outstanding; 80-89% good; 70-70% satisfactory; <69% unsatisfactory.

COURSE SCHEDULE

Week	Topics and readings
1	Bioenergy concepts – Introduction Systems thinking Biopower, bioheat Biofuels, advanced liquid fuels, drop-in fuels Biobased products
2	Biomass feedstocks I – Harvested feedstocks Feedstocks for first generation biofuels Feedstocks for second generation biofuels Feedstocks for third generation feedstocks
3	Biomass feedstocks II – Residue feedstocks Agricultural waste

Week	Topics and readings
	Forestry waste Farm waste Organic components of residential, commercial, institutional, and industrial waste
4	Biomass conversion technologies I – Biorefinery concept Understanding the biorefinery concept Biorefineries and end products Quiz
5	Biomass conversion technologies II – Biochemical conversion I Hydrolysis, enzyme, and acid hydrolysis Fermentation
6	Biomass conversion technologies II – Biochemical conversion II Anaerobic digestion Trans-esterification
7	Biomass conversion technologies III – Thermochemical conversion I Combustion Gasification
8	Biomass conversion technologies III – Thermochemical conversion II Pyrolysis Other thermochemical conversion technologies Scaling up emerging technologies Mid-term Exam Spring Break (no class)
9	Sustainability and resilience Understanding sustainability Environmental sustainability Bioenergy and sustainability
10	Bioenergy and environment, criteria pollutants, carbon footprint Emissions of biomass to power generation applications Emissions from biofuels, ILUC issues
11	Life Cycle Analysis I General understanding of LCA Cradle-to-grave, field-to-wheels concept Goal and scope determination, defining LCA boundaries
12	Life Cycle Analysis II Life cycle inventory Life cycle assessment
13	Advanced low-carbon fuels from waste
14	Advanced low-carbon fuels – case study Final project due
Final Exam: none	

ACCOMODATIONS FOR STUDENTS WITH DISABILITIES

Please follow the procedures outlined at <https://ods.rutgers.edu/students/registration-form>. Full policies and procedures are at <https://ods.rutgers.edu/>

ACADEMIC INTEGRITY

The university's policy on Academic Integrity is available at <http://academicintegrity.rutgers.edu/>

The principles of academic integrity require that a student:

- Properly acknowledge and cite all use of the ideas, results, or words of others.
- Properly acknowledge all contributors to a given piece of work.
- Make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of impermissible materials or impermissible collaboration.
- Obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- Treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- Uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Adherence to these principles is necessary in order to ensure that:

- Everyone is given proper credit for his or her ideas, words, results, and other scholarly accomplishments.
- All student work is fairly evaluated and no student has an inappropriate advantage over others.
- The academic and ethical development of all students is fostered.
- The reputation of the University for integrity in its teaching, research, and scholarship is maintained and enhanced.

Failure to uphold these principles of academic integrity threatens both the reputation of the University and the value of the degrees awarded to its students. Every member of the University community therefore bears a responsibility for ensuring that the highest standards of academic integrity are upheld.

STUDENT WELLNESS SERVICES

Just In Case Web App <http://codu.co/cee05e>

Access helpful mental health information and resources for yourself or a friend in a mental health crisis on your smartphone or tablet and easily contact CAPS or RUPD.

Counseling, ADAP & Psychiatric Services (CAPS)

(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901/ www.rhscaps.rutgers.edu/

CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professional within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include: individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

Violence Prevention & Victim Assistance (VPVA)

(848) 932-1181 / 3 Bartlett Street, New Brunswick, NJ 08901 / www.vpva.rutgers.edu/

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

Disability Services

(848) 445-6800 / Lucy Stone Hall, Suite A145, Livingston Campus, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854 / <https://ods.rutgers.edu/>

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: <https://ods.rutgers.edu/students/documentation-guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: <https://ods.rutgers.edu/students/registration-form>.

Scarlet Listeners

(732) 247-5555 / <http://www.scarletlisteners.com/>

Free and confidential peer counseling and referral hotline, providing a comforting and supportive safe space.