

Plants and Innovative Technologies for Bioenergy

11:776:410 (3 credits)
Fall Semester (odd years)
Hybrid format

CONTACT INFORMATION

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COURSE DESCRIPTION

This course will introduce the topic of sustainable biomass and sustainable bioenergy and discuss various renewable energy pathways for numerous end products from biomass. Agronomic and bioenergy traits will be discussed for each biomass source. Conversion technologies of different biomass sources will also be discussed for production of various end products.

COURSE WEBSITE, RESOURCES, AND MATERIALS

- Course website: Sakai
- Supplemental materials posted to Sakai. **Note:** Use of lecture and handout material provided on Sakai for Plants and Innovative Technologies for Bioenergy is for the sole use of registered students for educational purposes only. Other than a single copy, materials may not be reproduced or used otherwise without the written consent of both instructors.

PREREQUISITES

11:776:242 Plant Science

COURSE LEARNING GOALS

(Link to Plant Biology Undergraduate Program Goals: <http://plantbiology.rutgers.edu/undergrad/plantbiology/>)

1. Identify and discuss issues associated with biomass/biofuels use, primarily in the U.S (addresses program goal 2)
2. Describe the biochemistry and production characteristics of biomass crops suitable for sustainable bioenergy (biopower, bioheat, biofuels, and bio-based products) and mitigating climate change (addresses program goal 1)

3. Examine and discuss innovative biomass conversion technologies suitable for potential energy from plant-based agriculture and other sustainable biomass (addresses program goals 1 and 2)

ASSIGNMENTS/RESPONSIBILITIES AND ASSESSMENT

Grading: Grades will be determined based on six topic quizzes (60% of grade), in-class participation and online discussion (30%), and a final project (10%) on relevant bioenergy topics. Three of the six quizzes will be administered in class and the remaining three quizzes will be administered on-line.

In-Class Quizzes: 30%
 Online Quizzes: 30%
 In-Class Participation: 10%
 On-line Discussion: 20%
 Final project: 10%

Scale: 90-100 = A; 80-89 = B; 70-79 = C; 60-69 = D

Learning goals assessment: Specific questions on quizzes will be used to assess student knowledge of all course learning goals. Student grasp of bioenergy issues in context (course learning goal 3) will be assessed during class discussions and final project. The percentage score on these assessments will determine the level of mastery: >90% outstanding; 80-89% good; 70-70% satisfactory; <69% unsatisfactory.

PARTICIPATION GRADE AND ABSENCE POLICY

This course is a hybrid course and therefore it is expected that students view the entire lecture for each class online as per the schedule and participate fully in on-line discussions. Students unable to attend in-class lectures may contact the instructor via e-mail prior to the missed class or may use the University absence reporting website (<https://sims.rutgers.edu/ssra/>) to indicate the date and reason for the absence. An e-mail is automatically sent to the instructor.

COURSE SCHEDULE

LECTURE
<p>Lecture Topic 1: Introduction (Bonos and Guran)</p> <ul style="list-style-type: none"> • Introduction, course syllabus. What is sustainable biomass? • Biomass to bioenergy and bio-based products conversion pathways (thermochemical, biochemical, and chemical) • US energy portfolio biomass inventories (USDOE Billion Ton Report) • NJAES biomass assessment
<p>Lecture Topic 1-A (online): Concepts and Pathways (Guran)</p> <ul style="list-style-type: none"> • Biorefinery concepts • Biochemical/chemical conversion pathways • Thermochemical conversion pathways

LECTURE

Lecture Topic 2: First Generation Biomass Species (Food-to-Fuel Pathway) (Bonos)

- Sugar and starch crops
- Lipid forming crops

Lecture Topic 2-A (online): Biomass Conversion Technologies Biomass (Guran)

- Biochemical/Chemical Conversion Pathways-1
 - Direct fermentation for ethanol production (for sugar and starch crops)
 - Transesterification for biodiesel production (for lipid crops)

Lecture Topic 3: Second Generation Biomass Species (Bonos)

- Herbaceous plants
- Fast growing woody crops (purpose-grown energy crops)

Lecture Topic 3-A (online): Conversion of Second Generation Biomass (Guran)

- Biochemical/chemical conversion pathways-2
 - Fermentation via Hydrolysis
- Thermochemical conversion pathways
 - Combustion
 - Gasification
 - Pyrolysis
 - Hydrothermal liquefaction

Lecture Topic 4: Third Generation Biomass Species (Guest Speaker)

- Algae (microalgae and macroalgae)

Lecture Topic 4-A (online): Third Generation Biomass Conversion to Fuels (Guran)

Lecture Topic 5: Duckweed (Guest Speaker, Eric Lam)

Lecture Topic 6: Breeding Plants (Bonos)

- Traditional plant breeding biotechnology
- Biotechnology

Lecture Topic 6-A (online): Biobased Materials 1 (Guran)

- Bioplastics

Lecture Topic 7: Harvesting Storage, Quality Analysis (Bonos)

Lecture Topic 7-A (online): Biobased Materials 2 (Guran)

- Chemical industry intermediaries

Lecture Topic 8: Residue (Waste) Biomass (Guran)

- Agricultural residues
- Forestry residues
- Animal manure
- Organic component of residential, commercial, institutional; and industrial waste

LECTURE
Lecture Topic 8-A (online): Current State of Organic waste (Guran)
Lecture Topic 9: Visit to WM Edison Core Facility (Bonos and Guran)
Lecture Topic 9-A (online): New Approaches for Food Waste Reutilization (Guran) <ul style="list-style-type: none"> Anaerobic digestion
Lecture Topic 10: Circular Carbon Economy (Guest Speaker, Hochman)
Lecture Topic 10-A (online): Current Biofuels Policies (Guran) <ul style="list-style-type: none"> National State International

FINAL EXAM DATE AND TIME

There is no final exam for this course.

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.