RUTGERS
School of Environmental and Biological Sciences

**COURSE SYLLABUS**

**COURSE INFORMATION:**

**"Introduction to Bioenergy Technologies",** 3 credits, Online Class

**Pre-requisites: none**

**CONTACT INFORMATION:**

**Instructor(s): Serpil Guran**
**Office Location: 1200 Florence-Columbus Road, Bordentown, NJ 08505**
**Office Hours: By arrangement, potentially via skype (varies with semester)**
**Phone: 609-499-3600 x4225**
**Email: guran@aesop.rutgers.edu**

**COURSE MATERIALS:**
No textbook is required. Instructor will provide weekly power points on the subject of the week plus latest literature for references as PDF files.

**COURSE DESCRIPTION:**
"**Introduction to Bioenergy Technologies**" provides an introductory understanding to biomass, 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, "**Clean Energy Innovation Center and Business Incubator**" and potential group projects at the Center based on the students' preference.

**LEARNING OBJECTIVES:**
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:

- Identify potential biomass feedstocks including energy crops;
- Have an understanding of the existing and emerging biomass to energy technologies;
- Have an understanding of LCA and applications;
- Develop a critical thinking about sustainability & resilience; and
- Determine potential solutions for energy needs and problems by incorporating the bioenergy technologies being explored.

**CLASS FORMAT AND GRADED ASSIGNMENTS:**
Online courses work best as reading and discussion seminars. Each week, your instructor will assign readings or other materials, some drawn from the two textbooks and others posted on eCollege. Students will be required to submit a one-page paper each week, typically in response to a question from the instructor. These one-pagers will not be shared with other students, thus enabling the instructor to evaluate individual performance. After the one-pagers 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 will be administered throughout the semester. 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.

**SOFTWARE PLATFORM:**
eCollege

**OTHER INFORMATION:**
Students will be responsible for adhering to the academic integrity policies found at **http://academicintegrity.rutgers.edu.**

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.

**TOPICS AND READINGS BY WEEK:**

**Week 1: January 20** **Bioenergy Concepts- Introduction**
- Systems thinking
- Biopower, bioheat
- Biofuels, advanced liquid fuels, drop-in fuels
- Biobased products

**Week 2: January 27** **Biomass Feedstocks I- Harvested Feedstocks**
- Feedstocks for first generation biofuels
- Feedstocks for second generation Biofuels
- Feedstocks for third generation feedstocks

**Week 3- February 3** **Biomass Feedstocks II- Residue Feedstocks**
- Agricultural waste
- Forestry waste
- Farm waste
- Organic components of residential, commercial, institutional and industrial waste

**Week 4- February 10** **Biomass Conversion Technologies I- Biorefinery Concept**
- Understanding biorefinery concept
- Biorefineries & end products

Quiz

**Week 5- February 17** **Biomass Conversion Technologies II- Biochemical Conversion I**
- Hydrolysis, enzyme & acid hyrolysis
- Fermentation

**Week 6- February 24** **Biomass Conversion Technologies II- Biochemical Conversion II**
- Anaerobic digestion
- Trans-esterification

**Week 7- March 3** **Biomass Conversion Technologies III- Thermochemical Conversion I**
- Combustion
- Gasification

**Week 8- March 10** **Biomass Conversion Technologies III-Thermochemical Conversion II**
- Pyrolysis
- Other thermochemical conversion technologies
- Scaling up emerging technologies

MIDTERM EXAM DUE March 14 Midnight submission

SPRING RECESS - No Class this week

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| **Week 9- March 24** | **Sustainability & Resilience**<br>- Understanding sustainability<br>- Environmental sustainability<br>- Bioenergy & sustainability |
| **Week 10- March 31** | **Bioenergy & Environment, Criteria Pollutants, Carbon Footprint**<br>- Emissions of biomass to power generation applications<br>- Emissions from biofuels, ILUC issues |
| **Week 11- April 7** | **Life Cycle Analysis I**<br>- General understanding of LCA<br>- Cradle-to-grave, field to wheels concepts<br>- Goal and scope determination, defining LCA boundaries |
| **Week 12- April 14** | **Life Cycle Analysis II**<br>- Life Cycle Inventory<br>- Life Cycle Assessment |
| **Week 13- April 21** | **Advanced low-carbon fuels from waste** |
| **Week 14- April 28** | **Advanced low-carbon fuels –Case study ( term final project is due)** |

**GRADING:**

The four course components will contribute to your semester grade as follows:

- One-page papers 30%
- Quality and regularity of online discussion 20%
- Exams (2) 20%
- Final project 30%

Your final grade is determined using the following scale:

**A:** 88% and above
**B+:** 84-87.9%
**B:** 76-83.9%
**C+:** 72-75.9%
**C:** 64-71.9%
**D:** 52-63.9%
**F:** below 52%