

BBE 4733/BBE 5733 RENEWABLE ENERGY TECHNOLOGIES

3-credit Undergraduate/Graduate Course
Will have guest lectures by faculty with different expertise

Class time: 11:25 AM -12:40 PM, Tu, Th.
Classroom: 106 BioAgEng Bldg., St. Paul Campus
Leading Instructor: Dr. Roger Ruan, Professor, Department of Bioproducts and Biosystems Engineering
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Teaching Assistant: Dr. Bo Zhang, Research Associate, Department of Bioproducts and Biosystems Engineering
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Course Summary and Objective:

This course provides fundamentals to the current and emerging technologies for renewable energy production and uses. Issues regarding national energy security and environmental, economic and societal impacts of renewable energy will also be addressed. Students will learn the basic principals of various renewable energy technologies, such as solar thermal energy, solar photovoltaics, biomass energy, wind energy, hydroelectricity, tidal power, and geothermal energy, and basic characteristics of renewable resources, key methods for efficient production and use of renewable energy, current and probable future developments in renewable energy technologies, and impact of renewable energy on sustainable development.

References:

Renewable Energy, by Godfrey Boyle
Energy Systems and Sustainability, by Godfrey Boyle
Renewable Energy Policy, by Paul Komor
Wind Energy Basics: A Guide to Small and Micro Wind Systems (Real Goods Solar Living Book), by Paul Gipe
Renewable Energy, by Bent Sorensen
Renewable Energy Resources – Basic Principles and Applications, by G. N. Tiwari and M. K. Ghosal
Biomass for Renewable Energy, Fuels and Chemicals by D. Klass
Fundamentals of Renewable Energy Processes, by A. V. Da Rosa
Renewable Energy Resources, by J. Twidell and T. Weir
Energy in the 21st Century, by John Fanchi

Others: Handouts.

Homework and Grading Policy

Components	Weighting Percentages (%)
Homework and classroom activities	30
Term project report	15
Midterm Exam I	10
Midterm Exam II	10
Midterm Exam III	10
Final Exam	25
Total	100

Grades are based on curve. Students registered for graduate credit (BBE 5733) will be given additional problems on the exams, and in addition they will be required to perform a substantial quantitative analysis in the term paper report..

Homework problems are due one week after assignment. Late homework will be accepted with a penalty of 10 percent per day after the due date (excluding weekends) up to 50%.

Final term project report should be a team (3-4 people) or individual effort showing the ability to complete a basic project from start to finish.

Term Project

Each team is required to prepare a term project report on a selected topic related to renewable energy technology. The term project report should be double spaced, word-processed and fifteen pages maximum excluding figures, tables, and reference listing. Each student or team should consult with the instructor and decide on a topic no later than the end of the fifth week of class. The progress report (proposal) is due the first day after the spring break. The complete term report is due on the last day of class. Late submission will not be accepted.

For report preparation, each team is expected to read a substantial amount of related literature, digest the materials, and then write the report. Each team will also give a final presentation to the class during the last week of class. The paper will be graded for content, appearance, and classroom presentation.

Literature Review

Each team should obtain a few journal articles related to the chosen project. The articles should develop the justification or history of the problem or contribute to part of the analysis or solution of the problem. The Journal of Biotechnology, Renewable Energy, Biotechnology Progress, Journal of Applied Microbiology, Journal of Biotechnology and

Bioengineering, Biotechnology Techniques, Transactions of ASABE, and Applied Engineering in Agriculture are excellent sources.

The best place to search for literature is from scientific abstracts such as Applied Science Abstracts, BIOSIS Reviews, COMPENDEX (engineering index), and AGRICOLA, which are all part of the university library system (indexes and databases).

One progress report (proposal) due the first class after the spring break and it should include:

- The topic picked
- General layout of the project including a brief description, brief literature review, and preliminary flowchart
- Statement of progress up to date
- Gantt chart schedule for time assessment

Final complete project report is due on the last day of this class.

Tentative Lecture Outlines

1	Jan. 22.	Introduction
2	Jan. 24.	Fundamental Principles of Energy and Related Processes (Biological)
3	Jan. 29.	Fundamental Principles of Energy and Related Processes (Biological)
4	Jan. 31.	Fundamental Principles of Energy and Related Processes (Fluid dynamics)
5	Feb. 5.	Fundamental Principles of Energy and Related Processes (Fluid Dynamics & Heat Transfer)
6	Feb. 7.	Fundamental Principles of Energy and Related Processes (Heat Transfer)
7	Feb. 12.	Fermentation and biogas production
8	Feb. 14.	Fermentation and hydrogen production
9	Feb. 19.	Ethanol and biodiesel production
10	Feb. 21.	Exam I
11	Feb. 26.	Ethanol and biodiesel production
12	Feb. 28.	Biomass refining, thermochemical conversion
13	Mar. 4.	Fundamentals of Power Generation and Thermodynamic Efficiency
14	Mar. 6.	Fundamentals of Power Generation and Thermodynamic Efficiency
15	Mar. 11.	Renewable Syngas
16	Mar. 13.	Renewable Hydrogen
17	Mar. 17-21.	Spring Break
18	Mar. 25.	Exam II
19	Mar. 27.	Solar Energy and Photovoltaic Energy

20	Apr. 1.	Solar Energy, Photovoltaic Energy and Fuel Cell Technology
21	Apr. 3.	Biological Fuel Cell
22	Apr. 8.	Wind Power Generation
23	Apr. 10.	Wind to hydrogen and ammonia
24	Apr. 15.	Hydropower and Oceanic (Tidal and Wave) energy
25	Apr. 17.	Geothermal energy
26	Apr. 22.	Nuclear energy
27	Apr. 24.	Exam III
28	Apr. 29.	Environmental systems analysis and Life Cycle Assessment
29	May 1.	Economic Assessment of Renewable Energy Technologies
30	May 6.	Economic Assessment of Renewable Energy Technologies
31	May 8.	Final Project Presentation