Technical Elective: Materials for Energy Generation & Storage
Syllabus for 2022 Fall

Instructor: Dr. Yingjie Wu (Office: 4-226; Email: yingjie.wu@scupi.cn)

Lecture: Monday, 1:50 pm - 4:25 pm, Room 4-204
Office hours: Monday, 9:15 am – 11:55 am, Room 4-226
TA: Guodong Niu (Email: 2018223010033@stu.scu.edu.cn)
QQ Group: 731845389

Course Description:

Energy balance, efficiency, sustainability, and so on, are some of many facets of energy challenges covered in current research. However, there has not been a course that directly covers a spectrum of materials issues in the context of energy conversion, harvesting and storage. Addressing one of the most pressing problems of our time, this course illuminates the roles and performance requirements of materials in energy and demonstrates why energy materials are as critical and far-reaching as energy itself. Each section of the course starts out by explaining the role of a specific energy process in today's energy landscape, followed by explanation of the fundamental energy conversion, harvesting, and storage processes. The content of this course includes: the availability, accessibility, and affordability of different energy sources; energy production processes involving material uses and performance requirements in fossil, nuclear, solar, bio, wind, hydrothermal, geothermal, and ocean energy systems; issues of materials science in energy conversion systems; issues of energy harvesting, and storage (including hydrogen storage) and materials needs.

Course Objectives:

The objective of this course is to provide an overview of the important renewable energy resources and the modern technologies to harness and store them. After taking this course, students are expected to develop a solid scientific and technological understanding of new alternative energy technologies. This course will give an overview on harnessing renewable energy resources and storing collected energy. In each topic, issues relevant to basic principles and technological barriers limiting the use of non-fossil energy will be discussed.

Applicable ABET Outcomes:

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
3. An ability to identify, formulate, and solve engineering problems
4. An ability to communicate effectively
5. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Textbook:

Lu, Kathy. *Materials in Energy Conversion, Harvesting, and Storage*. Hoboken, New Jersey: Wiley, 2014. Print.

Content of the class (tentative):

Week	Date	Topics (Lecture)	Reading assignment	Due
2 M	9/5/22	Energy Resources, Greenhouse Gases and Materials	Chapter 1	
3 M	9/12/22	Fossil Energy and Materials	Chapter 2	
4 M	9/19/22	Nuclear Energy Conversion and Materials	Chapter 3	
5 M	9/26/22	Wind Energy Conversion and Materials	Chapter 6	
6 M	10/3/22	Hydro, Geothermal, Ocean Energy and Materials	Chpater 7	
7 M	10/10/22	Bioenergy Conversion and Materials	Chapter 5	
8 M	10/17/22	Midterm Review		**Submit term paper outline and abstract**
9 M	10/24/22	Solar Energy and Materials I	Chpater 4	
10 M	10/31/22	Solar Energy and Materials II	Chapter 4	
11 M	11/7/22	Fuel Cells and Materials	Chapter 8	
12 M	11/14/22	Mechanoelectric Energy Harvesting and Materials	Chapter 9	
13 M	11/21/22	Thermoelectric Energy Conversion and Materials	Chapter 10	
14 M	11/28/22	Energy Storage and Materials	Chapter 11	**Submit term paper final draft**
15 M	12/5/22	Hydrogen Storage and Materials	Chapter 12	**Submit term paper presentation slides**
16 M	12/12/22	**Term Paper Presentation I**		
17 M	12/19/22	**Term Paper Presentation II**		

Grading Policies:

Requirements	**Corresponding Percentages**
Homework (5)	25%
Term Paper	35%
Term Paper Presentation	25%
Quiz	10%
Participation	5%

Grading Scale:

100% ≥ A ≥ 90%; 90% > A− ≥ 85%; 85% > B+ ≥ 80%; 80% > B ≥ 76%; 76% > B− ≥ 73%; 73% > C+ ≥ 70%; 70% > C ≥ 66%; 66% > C− ≥ 63%; 63% > D ≥ 60%; 60% > F.

Homework:

There will be about five homework assignments that will be submitted on Blackboard either as Word document or as pdf before the start of the class (1:50 pm) on the due day. If you are unable to attend a class, you may attach a note to your homework and submit it in advance. ***If homework is submitted late, you would lose 10% per day. You may receive no credit if homework is not submitted within a week from the due day.***

Term Paper:

A term paper on a certain type of material for energy conversion, harvesting, storage and use should be completed by groups (each group must consist of no more than **THREE** students). The term paper will be submitted on Blackboard either as Word document or as pdf. The document needs to be submitted to Blackboard ***before the start of the class (1:50 pm) on the due day (Nov. 28th)***. The requirements of the term paper are listed below.

Requirements for the Term Paper

The paper must have a title page, main content, and references. The paper should be single-column, 1-inch margins, 11-point size, single-spaced, and 9-10 pages, excluding the title page, references, and well-marked appendices.

To facilitate the grading of your paper, please follow the suggested organization listed below.

The title page should include:

- The title of the paper
- Name, email address, and student ID
- Course name, and instructor's name
- A maximum 350-word abstract
- Three to five keywords

The main content should include:

- Introduction
    - (2 points) Discuss the background
    - (3 points) Summarize the research area of this material and explain why this material has been studied.
    - (3 points) Summarize the development of this material.
    - (3 points) Summarize the advantages and issues of this material.
- Content details
    - (6 points) Present the working theory and practical application of this material.
    - (3 points) Present the perspective of this material.
- Conclusions
    - (3 points) Summarize the conclusions of this material.
- References

- (2 points) List all the citations referenced in your paper. You will lose 5 points for each dangling reference (i.e., the reference not cited in the main text).

Term Paper Presentation:

Each group needs to give a 15-min presentation in the last class. The slides need to be submitted to Blackboard the ***before the start of the class (1:50 pm) on the due day (Dec. 5th)*** as a zip or rar file. Timing, presentation, style, and content will be considered for the grade.

Participation:

Participation through presence but also answering questions, asking questions, contributing to activities is very important to improve active learning for each student. Therefore, your participation will be graded during each lecture starting with the second week.