Battery Technologies and Markets:
Addressing the Growing Demand for Electrical Energy Storage

Chemical Engineering 198, Section 002 (CCN: 10849)
Spring 2010

Lectures: Tue/Thurs 12:30-2:00 — 6 Evans Hall
Office hours: Tue/Thurs 2:00-3:00 — 303 Gilman Hall

Website: battery.berkeley.edu

Course facilitators:

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Course description

This course will focus on the fundamentals of electrochemical energy storage as they relate to the operation and design of various battery technologies. A survey of specific chemistries and their advantages and disadvantages will also be covered. Integrating traditional science and engineering with practical issues such as cost analysis and policy considerations will provide a broader picture of the engineering and development of modern battery storage systems.

The course is designed for graduate and upper-level undergraduate students with limited experience in electrochemistry. A technical background is encouraged, but not necessary.

Course format: two one-hour lectures/week, homework and final project. Grades are offered on a pass/no-pass basis only.

Course learning objectives

After taking this course, students should

a) understand the basic physical concepts involved in electrochemical energy storage

b) be able to critically evaluate the utility and viability of technological claims in popular and scientific literature

Textbooks and resources

The main text is available through the library website:

Linden, D, ed. Handbook of Batteries. McGraw-Hill, Inc., New York, 2001.

Optional recommended texts include:

Bard, A. and L.R. Faulkner. Electrochemical Methods. John Wiley & Sons, New York, 2001.

Newman, J. and Thomas-Alyea, K. Electrochemical Systems. Wiley-Interscience, Hoboken, NJ,
2004.

There will also be a number of resources (e.g., articles and web links) posted on the course website, including some excerpts from Prentice, Geoffrey. Electrochemical Engineering Principles, Englewood Cliffs, N.J.: Prentice Hall, c1991.

Evaluation procedures

Final course grades will be based on the following deliverables:

• Homework (50%): 3 assignments to be distributed in class

• Class Project (50%): Students will independently read and critique a series of articles from scholarly and/or popular literature. More details on the project will be provided in class.

• Attendance and participation in lectures and discussion sections

Class schedule

week	Date	Topic	reading due	assignments due
1	Jan 21	Introduction and perspectives on batteries		
2	Jan 26 Jan 28	Fundamentals of electrochemistry Thermodynamics of Electrochemical Cells	Linden, chapter 1 Linden, chapter 2.1, 2.2	
3	Feb 2 Feb 4	Transport in Electrochemical Cells Electrode processes	Prentice chapter 2 Linden, chapter 2.3, 2.4	Homework 1
4	Feb 9 Feb 11	Voltage drops in batteries Electrochemical measurements		Homework 2
5	Feb 16 Feb 18	Performance metrics I Performance metrics II	Linden Chapter 3	
6	Feb 23 Feb 25	Lithium-ion batteries I Lithium-ion batteries II		
7	Mar 2 Mar 4	Lead-acid batteries NiMH and NiCd batteries		Homework 3
8	Mar 11 Mar 9	Guest lecture: CalCARS Metal/air batteries		
9	Mar 16 Mar 18	Primary batteries: alkaline and SOCl2 No class (tentative)		
10	Mar 30 Apr 1	Guest lecture: Tesla Motors Flow-through batteries		
11	Apr 6 Apr 8	Battery performance and selection criteria Battery industry and markets		
12	Apr 13 Apr 15	Batteries for transportation Guest lecture- fuel cells		
13	Apr 20 Apr 22	Batteries and public policy Guest lecture- medical batteries		
14	Apr 27 Apr 29	Instructors on travel- no class, or guest lecture TBA Instructors on travel- no class, or guest lecture TBA		
15	May 4 May 6	Student presentations Student presentations		Final project