GRAND VALLEY STATE UNIVERSITY
SEYMOUR AND ESTHER PADNOS COLLEGE OF ENGINEERING AND COMPUTING

SCHOOL OF ENGINEERING

Winter 2014 Course Syllabus

Course Title: Materials for Energy Storage
Course Number: EGR 413/513
Prerequisites: EGR 250 or EGR 257 or by permit
Faculty Information:

Instructor	L. M. Corneal, Ph.D., P.E.
Office Location	Room 243, Kennedy Hall of Engineering, Grand Rapids Campus
E-Mail	corneall@gvsu.edu
Phone	(616) 331-6502

Office Hours:

Tues. 2-3 p.m.
Wed. 2:30-4:30 p.m.
Fri. 10-11 a.m.
or by appointment

Class Meeting Times:

Wednesdays 6:00 – 8:45 p.m. 350 Kennedy Hall of Engineering

Catalog Description:

Study of the materials for advanced energy storage. Topics include: Electrochemical reactions, anode and cathode materials, electrolyte materials, electrochemical testing of materials, typical responses of common materials, and life testing. In addition, tradeoffs in material performance are discussed. There will be in-class activities.

Course Objectives:

At the completion of this course, a student should be able to:

- Explain the various components of a battery and the electrochemical reactions that occur within a battery
- Describe the material characteristics of battery components
- Evaluate the tradeoffs in material performance
- Describe the testing methods and typical responses of common materials

Additional objectives for graduate students:

- Explain capacity fade mechanisms and identify methods to increase the service life of a battery

Grading:

Homework assignments	30%
Presentations	15%
Attendance and participation	5%
Term paper	10%
Quizzes	15%
Final Exam	25 %

Graduate students will have an additional homework assignment/presentation.

Grading Scale:

93 and above	A	78	C+
90	A-	73	C
88	B+	70	C-
83	B	68	D+
80	B-	63	D
		Below 63	F

Textbook:

Huggins, R.A., Advanced Batteries – Materials Science Aspects, Springer Science+Business Media, LLC, New York, NY, 2009.

References:

Linden, D. and Reddy, T.B., Handbook of Batteries, 3rd Edition, McGraw-Hill, Inc., New York, NY, 2001.

Nazri, G.-A. and Pistoia, G. (Eds.), Lithium Batteries: Science and Technology, Springer Science+Business Media, LLC, New York, NY, 2003.

Drop Date:

The last day to drop this course for a "W" grade is Friday, March 7 at 5:00 p.m.

Attendance:

Attendance is mandatory. You must arrive at class on time and prepared for the day's work.

Participation:

Participation is very important in the learning process. Participation consists of completing assignments, being attentive in class, and asking and responding to questions.

Homework:

Homework exercises will be assigned throughout the semester. All homework exercises must be submitted at the beginning of the class period at which they are due. Late submissions will not be accepted except under extenuating circumstances. All submissions must be solely the work of the student submitting them unless otherwise specified in the assignment. You must show all work in detail in order to receive full credit for homework.

E-mail Policy:

I will reply to emails as promptly as possible, but please wait at least 24 hours before sending me a reminder email. Professionalism in all email correspondences is expected.

Academic Honesty:

All students are expected to adhere to the academic honesty standards of the Grand Valley State University Student Code. Students in this course are also expected to adhere to the academic honesty standards of the Engineering Honor Code for the School of Engineering.

Copyright:

Copying, displaying and distributing copyrighted works, may infringe the owner's copyright. Grand Valley State University's Interim Policy on Copyright provides information about whether your use of a copyrighted work is a fair use or requires permission. Any use of computer or duplicating facilities by students, faculty or staff for infringing on the use of copyrighted works is subject to appropriate disciplinary action as well as those civil remedies and criminal penalties provided by federal law.

Additional information on proper use of copyrighted material may be found at the university's library website, www.gvsu.edu/library/.

Special Needs:

If there is any student in this class who has special needs because of learning, physical or other disability, please contact me and Disability Support Services (DSS) at 616-331-2490.

Tentative Schedule:

Week 1 – January 8	Introduction to the course and review of the syllabus Electrical and chemistry refresher
Week 2 – January 15	Introduction to batteries
Week 3 – January 22	Battery manufacturing processes Electrochemical reactions
Week 4 – January 29	Reaction mechanisms and important practical parameters Binary and ternary phase diagrams for electrode materials
Week 5 – February 5	Cathode materials
Week 6 – February 12	Cathode materials continued
Week 7 – February 19	Anode materials
Week 8 – February 26	Electrolyte materials and solid electrolyte interphase (SEI)
Week 9 – March 5	Spring Break – no class
Week 10 – March 12	Electrochemical testing and typical response of common materials Material characterization techniques
Week 10 – March 19	Life testing and capacity fade mechanisms
Week 11 – March 26	Recent advances in battery technology Other advanced energy storage methods
Week 12 – April 2	Tour of Johnson Controls battery manufacturing facility
Week 13 – April 9	Applications of battery technologies
Week 14 – April 16	Final project presentations Course evaluations
Week 15 – April 23	Final Exam 6:00 p.m. – 7:50 p.m. 350 Kennedy Hall of Engineering