

EMA4450

Spring 2022

Instructor: Associate Professor, Dr. Katerina E. Aifantis

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Office hours: Wednesdays 12-2pm and by appointment

Zoom room: <https://ufl.zoom.us/j/4855871400>

Textbook (optional): High Energy Density Lithium Batteries: Materials, Engineering, Applicationn by K.E. Aifantis, S.A. Hackney, R.V. Kumar, Wiley-VCH, ISBN-13: 978-3527324071

Course Description

Li-ion batteries are the most widely used energy sources for portable electronic devices, electric vehicles. Throughout this course the main quantities and reactions that characterize electrochemical cells will be described. The historical development of batteries, leading to Li-ion cells will be described and focus will be given on the components (anodes, cathodes, electrodes) of present and next-generation rechargeable Li-ion batteries. By the end of the course students will know how to use concepts from materials science, engineering and mechanics in order to develop design criteria for next generation Li-ion batteries that are to be used in portable electronic devices, electric vehicles, medical devices. In addition, Sodium-ion batteries, fuel cells, capacitors and hydrogen storage will also be covered.

Evaluation

3 Exams @ 20% each	60%
Final Exam / Project	15%
Homework / Assignments	20%
Participation	5%

Grading scale

95-100 A
90-94 A-
85-89 B+
80-84 B
77-79 B-
73-76 C+
68-72 C
66-67 C-
63-65 D+
59-62 D
0-58 E

For individuals in the gray area between two grades, performance on the homework and quizzes will be used to make the final decision.

Project

The project will be a literature review on a topic of interest of the student, with the approval of the instructor. It will consist of a 20 min power point presentation, along with a write-up of 2500 words for undergrads

Homework policy

Homework is due at the beginning of class on the due date. The homework schedule is tentatively shown within the course outline. However, since the course schedule for each topic is dependent on class progress, the due date for each homework assignment is subject to change. Any homework changes will be posted on the Canvas class website. Students are responsible for checking Canvas and university email on a regular basis. The students taking the course in the 6000 level will be given two additional homework problems to solve in each set, which require a more in-depth use of physics, chemistry and mechanics concepts.

Attendance

In light of the challenge of the pandemic, attendance is not required in the course. However, participation is expected and credit will be given. Participation will be graded based on in class or online quizzes; in some cases they may also be submitted through email. If you cannot keep up with the class for justifiable reasons (sickness, family obligations, etc.), you must inform the instructor in advance or immediately after the day of absence. If a student misses a class,

he/she is responsible for all announcements and subjects covered in that class. If in doubt, contact the instructor.

Tentative schedule for Spring 2021

(The instructor may change this schedule to accommodate class needs.)

Week 1 (Jan 5-Jan 7): Introduction to Electrochemical cells (Ch. 1, 2)

Week 2 (Jan 10-Jan 14): Quantities Characterizing Batteries (Ch. 1, 2)
Li-ion battery technology-review of current state of art

HW1 Due Jan 14

Week 3 (Jan 17-Jan 21): Li-ion battery technology

Week 4 (Jan 24-Jan 28): Electrolytes (Ch. 7)

HW2 Due Jan 28

Week 5 (Jan 31-Feb 4): Voltage Capacity Curves and Cathodes for Li-ion

Week 6 (Feb 7-Feb 11): Anode materials for Lithium ion batteries (Ch. 6)

HW3 Due Feb 11

Week 7 (Feb 14-Feb 18): Review and Exam 1

Exam 1 Feb 18

Week 8 (Feb 21-Feb 25): Applications for Li-ion Batteries (Ch. 4)

Week 9 (Feb 28-Mar 4): Fracture in Li-ion batteries

HW 4 Due Mar 4

Week 10 (Mar 7-Mar 11): Spring break

Week 11 (Mar 14-Mar 18): Review and Exam 2

Exam 2 Mar 18

Week 12 (Mar 21-Mar 25): Li-S batteries

HW 5 Due Mar 25

Week 13 (Mar 22-Mar 26): Na-ion batteries

Week 14 (Mar 28-Apr 1): Capacitors, Mg batteries

HW6 Due Apr 1

Week 15 (Apr 4-Apr 8): Review and Exam 3

April 6, Exam 3

Week 16 (Apr 12-Apr 16): Lab Demos/Project presentations

Week 17 (Apr 19-Apr 21): Project presentations

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/> (Links to an external site.). It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/> (Links to an external site.). Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/> (Links to an external site.). Summaries of course evaluation results are available to students at

<https://gatorevals.aa.ufl.edu/public-results/> (Links to an external site.).

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/> (Links to an external site.)) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator

- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html> (Links to an external site.)

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other

helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center:

<http://www.counseling.ufl.edu/cwc> (Links to an external site.), and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance (Links to an external site.)**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

COVID-19

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.

- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.
- Consistent with UF policy: "If a student is absent from classes or examinations because of illness, they should contact their instructors."
- If you contract Covid-19 during the semester, the instructor pledges to help you to the extent possible, to help you learn and manage your assignments. Letting the instructor know is step one.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/> (Links to an external site.).

Academic Resources **E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml> (Links to an external site.).

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/> (Links to an external site.).

Library Support, <http://cms.uflib.ufl.edu/ask> (Links to an external site.). Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/> (Links to an external site.).

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/> (Links to an external site.).

Student Complaints Campus: <https://care.dso.ufl.edu> (Links to an external site.).

On-Line Students Complaints:

<http://www.distance.ufl.edu/student-complaint-process> (Links to an external site.).