

**TO:** The Faculty of the College of Engineering  
**FROM:** The Davidson School of Chemical Engineering  
**RE:** New Graduate Course, CHE 56000 Intro to Energy Storage Systems

The faculty of the Davidson School of Chemical Engineering have approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

**Course:** CHE 56000 Intro to Energy Storage Systems  
Fall/Spring, Lecture, Cr. 3  
Restrictions: May not be enrolled as the following Classifications:  
Freshman: 0 - 14 hours  
Freshman: 15 - 29 hours  
Sophomore: 30 - 44 hours  
Sophomore: 45 - 59 hours  
Junior: 60 - 74 hours  
Junior: 75 - 89 hours

**Description:**

Energy Storage Systems Laboratory course is designed to introduce fundamentals of electrochemistry and electrochemical engineering of rechargeable lithium ion batteries (LIBs) to undergraduate and graduate students. The course will be reviewing working principles of LIBs, hands on experience on their assembly, charge-discharge testing, data analysis and related safety aspects. Strong emphasis will be given on the Li-ion battery technology, nanotechnology implementation and the materials design. Beyond conventional Li-ion systems and Pb-acid batteries, next generation Na-ion, K-ion and Li-S batteries will be discussed and designed. Students will be fabricating and testing high energy density batteries utilizing engineered electrodes, electrolytes and separators. Broader perspectives on sustainable, cost effective, longer lasting battery manufacturing will be provided.

**Reason:** This course has been taught as CHE 59700 Energy Storage Systems Laboratory, in the Fall 201 semester with 14 students, in the spring of 2012 semester with 37 students, during the Fall 2014 semester with 27 students, in the fall 2016 semester with 26 students and spring 2020 semester with 19 students.



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Sangtae Kim  
Jay and Cynthia Ihlenfeld Head of Chemical Engineering

## ChE 59700-Energy Storage Systems Laboratory - *Syllabus*

INSTRUCTOR: Prof. Vilas G. Pol, 765-494-0044, [vpol@purdue.edu](mailto:vpol@purdue.edu)

Theory: G124 TR / 2184 [Experimental/Lab](#): FRNY 2184

PROF. OFFICE HOURS: Monday 10-11 am

TYPE OF COURSE: Elective

### COURSE DESCRIPTION:

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### MAJOR TOPICS COVERED:

- Introduction to Energy Storage Systems: Overview, definitions, history, market, theory, thermodynamics, kinetics and safety.
- Challenges of Li-ion Battery Technology, Selection criteria for commercial batteries
- Experimental techniques, Promising cathode materials, Anode materials, Electrolytes, current distribution and related issues
- Electrode slurry preparation, lamination, drying, pressing, manufacturing of coin cell batteries and testing for rate capabilities and long cycle life
- Battery types and Chemistry: Cell charging, Cell discharge testing, Electrochemical impedance spectroscopy (EIS)
- Kinetics and thermodynamics of electrochemical reactions
- Beyond Li-ion battery technologies, next generation Li-S batteries, Sodium ion batteries, K-ion batteries will be reviewed.

This course will provide detailed understanding of battery science, technology and engineering background making next generation researchers ready to handle the upcoming challenges related to LIBs. Such background could provide job opportunities in numerous industries including Apple, Google, Tesla; national labs as well as faculty positions to create next generation scientific and advanced intellect. This course applies to various disciplines including MSE, Chemistry, ChE, ME, AAE, Physics, Technology and EE. Taking this advanced elective course on rechargeable batteries will not only provide theory background but also hands on experience to the undergraduate and graduate students.

The course assessment will be done by weekly homework, mid-term written exam, quizzes on hands on experience, scientific presentation and scientific reports preparation.