

Graduate College

Dual-Listed Courses

Departments must request permission to offer courses at the graduate level in conjunction with 300-400 level undergraduate courses. The request is made to the Graduate Curriculum and Catalog Committee. If the dual-listed courses are also experimental courses (400X/500X), submit the experimental course form to the Scheduling Office, 10 Enrollment Services, AND attach an approved copy of the experimental course form(s) to the dual –listed request.

Dual-listed courses permit undergraduate and graduate students to be in the same class but to receive credit under two different course numbers. Credit in the graduate course is not available to students who have received credit in the corresponding undergraduate course. Both graduates and undergraduates receive the same amount of credit for the course, but additional work is required of all graduate students taking the course under the graduate-level course number. This extra work may take the form of additional reading, projects, examinations, or other assignments as determined by the instructor. The instructor must be a member of the Graduate Faculty or a Graduate Lecturer. Each dual-listed course is designated in the catalog with the phrase “Dual-listed with,” although the student’s official transcript of credits, both graduate and undergraduate, does not identify dual-listed courses as such. There is a limit to the number of dual-listed course credits that may be used to meet the requirement for an advanced degree. (For information about procedures for requesting permission to offer dual-listed courses, faculty should consult the *Graduate Faculty* *Handbook*.).

In reviewing proposals for dual-listed courses, this committee needs to understand the department’s rationale for offering the course. When a department submits a request, an explanation should be given of the purpose served by the course and the criteria used by the department to determine if the course is suitable for dual-listing. Please submit the proposal in electronic form as a word attachment to grad\_college@iastate.edu.

The following information should be included in the proposal:

1. Full catalog information for each course to be dual-listed, including the course numbers (or proposed course numbers), title, credits, semester offering (if applicable), prerequisites, and description. Dual-listed courses bear common numbers, e.g., 580 (480).

CH E 410X (Dual-listed with CH E 510X).(3-0) Cr.3. Electrochemical engineering principles in thermodynamics, electrode kinetics, charge and mass transport; modeling and simulation; electrocatalysis; electrochemical reactions; applications of electrochemical engineering in fuel cells, batteries and electrolyzers.

CH E 510X (Dual-listed with CH E 410X) (3-0) Cr.3. Electrochemical engineering principles in thermodynamics, electrode kinetics, charge and mass transport; modeling and simulation; electrocatalysis; electrochemical reactions; applications of electrochemical engineering in fuel cells, batteries and electrolyzers.

1. Graduate faculty status of the proposed instructor.

**The proposed instructor Dr. Li is a graduate faculty.**

1. Number of the dual-listed course credits the department will permit to be used to meet the requirements for an advanced degree. This limit includes dual-listed courses taken in all departments.

**No limit**

1. The differential expectations for graduate students and undergraduates. What additional work will be required for graduate students enrolled in the course? Please describe this work, not in abstract terms (such as "more in-depth participation") but in terms of concrete measurable outcomes or other tangible evidence. Welcome inclusions: specific examples of the additional assignments with details about paper length; the number of additional readings; the length and frequency of oral presentations; portfolio expectations; indications of how these graduate requirements are weighted in the course grade (ex. 40% of final grade); comparisons with undergraduate expectations.
 Examples:
* Graduate students are required to research a topic and write an in-depth paper.
* Graduate students are required to attend additional lectures, and have (X) extra assignment papers (to be determined).

**Graduate students are required to lead the team project in a specific application area (such as direct methanol fuel cell, CO2 electrolyzer, etc.) and lead the project report and presentation. The project (report and presentation) counts 15% of final grade. Graduate students are also required to write a short proposal based on the team project topic, including research / technology development challenges and opportunities, proposed research plan, and expected research outcomes. The proposal will count 15% of the course grade.**

1. Reason(s) the course is considered sufficiently rigorous and of such an advanced nature as to challenge graduate students.

**Electrochemical engineering is an emerging subarea of chemical engineering and directly related with renewable electrical energy conversion and storage systems, and flexible, decentralized chemicals manufacturing. Electrochemical engineering principles are based on and natural expansion of chemical engineering fundamental knowledge, including thermodynamics, kinetics, transport, etc. Increasing number of graduate students will need advanced knowledge and skills in electrochemical engineering to better prepare them for their research in catalysis, reaction engineering, biorenewables and materials. However, presently ISU does not provide such an advanced course. The proposed electrochemical engineering course will meet this need. This course will cover electrochemical engineering fundamentals: thermodynamics, electrode kinetics, ionic mass transport, modeling and simulation, electrocatalysis, electrochemical reactions. Electrochemical engineering applications: industrial electrochemical processes, electrolyzers, fuel cells and batteries. Specific topics in electroanalytical spectroscopy, electrochemical conversion of biorenewables, theoretical electrocatalysis, photoelectrochemistry will be introduced and basic electrochemical engineering lab demonstration will be offered. Graduate students will have capability to apply the knowledge and skills acquired from this course to their future projects or research.**

1. Academic advantages and disadvantages accruing to graduate students taking this course with undergraduates.

**Advantages: to learn chemical engineering frontier areas in electrochemistry, energy and catalysis; to acquire mentoring skills from leading team project; to strengthen fundamental knowledge of thermodynamics, kinetics and transport; and to gain valuable skills from learning electrochemical engineering fundamentals and technologies.**

**Disadvantages: We recognize that two groups of students (undergraduate and graduate) may have different prior coursework preparation and skill sets, and graduate students may perceive the pace of the selected lectures that review electrochemistry fundamentals to be slow. It is likely students at two levels will benefit from reviewing the fundamentals that are relevant to electrochemical engineering before moving on to the applications of electrochemical engineering. We will encourage graduate to team with undergraduate students to study the electrochemistry fundamentals (thermodynamics, kinetics and transport).**

1. The place of the course in a graduate student’s program of study and why it is not considered a "remedial" undertaking intended to overcome deficiencies in the student’s preparation for graduate work.

**Electrochemical engineering is an important subarea of chemical engineering and is directly related with renewable electricity conversion and storage, and sustainable chemical manufacturing processes and technologies. More and more graduate students will conduct research in electrochemical engineering, electrochemical materials, electrochemical processes and devices, however, there are very few courses offered to specifically support these related research. Electrochemical Engineering will serve as a new elective course to meet the graduate students’ education need.**

1. The role of the course in an undergraduate’s degree program and the academic qualifications undergraduates must have to take this course.

**This course is for advanced undergraduates (juniors and seniors). Undergraduate can apply this course towards the chemical engineering electives or professional elective requirement.**

1. The name of the person writing the proposal.

**Wenzhen Li**