iCons 3 RE NatSci 389H-01 (47064, 47084)

Lab course. Renewable energy 4 credits
Meeting times:
Natsci 389H-01AA: Wednesday 8:30-9:55am Friday 1:25-4:15pm

Meeting place: ISB 355

Instructor:
Irene Dujovne
Hasbrouck 237
dujovne@physics.umass.edu
Office hours: by appointment

TA: Emily Smith
emicsmith@umass.edu

Catalog Description
This course involves student-driven, team-oriented laboratory projects focused on the interrelated principles of energy generation, conversion, storage and consumption, particularly emphasizing the science underlying renewable energy systems. Projects incorporate experimental techniques from the chemical, physical, mathematical, and life sciences. The intent of this course is to develop cross-disciplinary methods to address real world energy-related issues. Students will be expected to understand paths to energy solutions that cross many disciplines, and how an interdisciplinary approach may be used to solve energy problems faced by society.

The iCons 3 Renewable Energy Lab is the third course -- focused on developing and applying science and engineering *laboratory* skills -- in the iCons Program sequence for students in the Renewable Energy track. The essential elements of all courses in the iCons Program include:

- Societal-problem-based science and engineering
- Multidisciplinary student team-based learning
- Student-driven learning
- Metacognitive reflection

The iCons 3 Energy Laboratory is structured as follows:

- Energy Bootcamp: training in safety, concept inventory, and equipment usage
- Unit Project: Extended project; entirely student-designed

Topics for Unit Project are given below. There are suggestions for the topics for the semester long project, but students have the flexibility to choose other topics as well based on discussions and conversations with their peers and instructors. These include energy conversion, energy storage, biomass energy, combinatorial energy design, capturing waste energy, and building efficiency.

The course is designed to provide necessary educational scaffolding, such that skills and knowledge acquired during the early part of the course can be used to inspire students to design and perform creative experiments as the semester progresses. The Energy Bootcamp familiarizes

students with fundamental principles of energy science, laboratory instrumentation, safety, and measurement. With these skills in hand, students are equipped to venture into the more challenging territory of Unit Project. The Unit Project utilizes a team project strategy that includes brainstorming, scientific literature research, consultations with experts, project design, proposal, experimental set up, data acquisition, evaluation, reflection, experimental modifications, more data acquisition, analysis, more reflection, and finally reporting.

This course, taken in combination with the Senior Spring semester iCons 4 course (NatSci 490 SH) fulfills the UMass Amherst General Education Integrative Experience (IE) requirement. In particular, NatSci 389H is designed to meet IE criteria #2 and #3 as indicated on the following list of Student Learning Goals for this course (pg. 2), while NatSci 490 SH is designed to satisfy IE criterion #1.

University of Massachusetts Integrative Experience Criteria[1]

1. IE1 = Providing a structured, credited context for students to reflect on and to integrate their learning and experience from the broad exposure in their General Education courses and the focus in their majors.
2. IE2 = Providing students with the opportunity to practice General Education learning objectives such as oral communication, collaboration, critical thinking, and interdisciplinary perspective-taking, at a more advanced level.
3. IE3 = Offering students a shared learning experience for applying their prior learning to new situations, challenging questions, and real-world problems.

Course goals

Learning goals

- Integrative understanding of RE theory and practice
- Core RE laboratory skills
- Leadership in framing RE experimental investigations
- Multidisciplinary communication
- Synergistic collaboration and project management

Pedagogical elements

- Problem-based science with RE lab focus
- Multidisciplinary teamwork
- Student-driven learning
- Building portfolio

Course objectives

Develop confidence in working in a laboratory environment while developing a portfolio in Renewable energy.

Understand the different steps required in a scientific research. From proposing a scientific question, to coming up with the method of inquiry that will answer that question, to deliver results and understand that not all research will deliver positive results.

Be able to work in a lab setting in a group and build upon the strengths of each team member.

[1] http://www.umass.edu/gened/teachingAdvising/integrativeExperience/ieCriteria.html

The students will deliver their findings in the form of presentations, reports, posters and self assessments.

Linkage Between Course Components and Student Outcomes

- Content: Developed around timely, relevant, and weighty societal challenges (IE3).
- Experimental Skills: Students will develop and enhance their natural sense of curiosity by using laboratory instruments to expand powers of observation (IE2).
- Design: Students will be challenged to design experiments that explore real-world renewable energy systems (IE3).
- Interdisciplinarity: Students from different fields come together to confront relevant challenges (IE2).
- Discovery: Students will engage in an active learning process, discovering scientific principles as they become required for mastery (IE2).
- Teamwork: Students will work in teams to solve problems and to discover concepts. Teams are formed and re-formed as different challenges are presented and different skills are needed (IE2 and IE3).
- Analysis: Students will use primary sources (literature and data) to develop understanding through data interpretation and analytical reasoning (IE2).
- Human Connections: Students will learn to talk to experts on campus and beyond (IE2 and IE3).
- Assessment: Student progress will be evaluated with assessment tools, journaling, peer-reviewed work, oral presentations and written report (IE2).

Topics Covered

Bootcamp topics (not all of them will be covered depending on students background) 2-3 weeks

- Safety
- Electrical measurements for energy
- Energy conversion: Mechanics, thermal, electrical
- Chemical energy
- Hydrogen gas generation
- Fuel cell
- Solar Cell
- Algae as biofuel
- Thermodynamics
- Energy Storage
- Data acquisition, analytics, visualization

Semester long project (a few examples of past menu affinity topics)- About 10 Weeks (depending on progress of groups). The questions being asked will be *entirely* student proposed, chosen, designed and led. Project showcase to other iCons students & faculty

- Photovoltaic energy
- Algae energy

- Efficiency in nature
- Microbial fuel cells
- Electromechanical energy
- Photohydrolysis
- Energy storage
- Hydrogen fuel

Evaluations:

Project:

Initial presentation informal (chalk board presentation)
Initial proposal presentation (talk- 8 minutes)
Initial reflection document
Every week 1 slide with updates
Mid project presentation- talk-5 minutes
Mid project report- Two page report
Final project presentation (or poster presentation)
Final project report
Final reflection document

Peer evaluation
Performance in the lab (by instructor and TA)

Composition of grades

Peer evaluation 12% 1st part semester
Peer evaluation 12% 2nd part semester
Project 67% (Includes presentations, reports: mid and final)
Performance in the lab 6%
Reflection documents: 1%
Bootcamp quizzes and other assignments: 2%

The following grades may be given A, A-, B+, B, B-, C+, C, C-, D+, D, F, SAT.
Attendance to the lab and discussion session is required. After checking in in class, students might go to other lab places to conduct research.

Academic Honesty Policy Statement

Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst.
Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any

person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. The procedures outlined below are intended to provide an efficient and orderly process by which action may be taken if it appears that academic dishonesty has occurred and by which students may appeal such actions.
Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent.
For more information about what constitutes academic dishonesty, please see the Dean of Students' website:
http://umass.edu/dean_students/codeofconduct/acadhonesty/

Disability Statement
The University of Massachusetts Amherst is committed to making reasonable, effective and appropriate accommodations to meet the needs of students with disabilities and help create a barrier-free campus. If you are in need of accommodation for a documented disability, register with Disability Services to have an accommodation letter sent to your faculty. It is your responsibility to initiate these services and to communicate with faculty ahead of time to manage accommodations in a timely manner. For more information, consult the Disability Services website at http://www.umass.edu/disability/.