Green Chemical and Energy Technologies (52:237); SPRING 2013
CBE:5405
Syllabus Version 1 (January 11, 2013)

1. Time and Place of Course
   Lecture: 11:00-12:15 Tues, Thur, in Room 3321SC

2. Instructor
   Charles O. Stanier
   Office: 4122 Seamans Center
   Phone: 335-1399
   Email: cstanier@engineering.uiowa.edu
   Office Hours: by appointment

3. Teaching Assistant
   Ben Ungs
   benjamin-ungs@uiowa.edu

4. Textbook
   no textbook.
   see ICON for coursepak details

5. Website
   http://icon.uiowa.edu contact instructor if you have trouble logging in

6. Overview of course

This course is structured differently from most engineering courses. The course has many class periods that are (1) lead by students rather than the faculty member, (2) based on extensive background readings, (3) include small and large group discussions, (4) include practicing in class with calculations relevant to the reading. Practice will typically be in small groups. These class periods will use active / collaborative learning techniques to engender a lively and productive interaction between the teacher and students, and among students. Each student will be responsible for co-leading one class period. The rationale for this approach is that technical discussion of energy and sustainability issues takes practice. It is not enough to know about energy, environmental impacts, and emissions – students need to discuss alternatives and champion projects within organizations. This is difficult and we practice it.

Introduction to environmental issues, science, energy, and regulations -- hopefully review for most students. We do a lot of reading here, there are some problem sets. We cover energy and combustion basics, rudimentary climate science, biofuel basics, key environmental regulations, and touch on some air and water pollution issues.

Tools for environmental and energy assessment. We establish standard methods for greenhouse gas inventories. We look at chemical, physical and biological properties needed for sustainability assessment (e.g. global warming potential, bioaccumulation factor, ozone depleting potential, etc.). We then cover property estimation methods, green chemistry principles, pollution prevention, industrial ecology, and tier 1 – tier 3 environmental assessments. This culminates in our coverage of Life Cycle Assessment.

Case studies, application of the tools, and process integration. In this section, we examine case studies that involve the assessment tools, and look more in depth at improving energy efficiency and reducing waste in continuous chemical processes. Process heat integration and pinch technology are discussed.

Contemporary issues. As if that was not enough ... throughout the course we will be discussing (as time allows) contemporary environmental issues such as localism, life cycle assessment of popular products, biofuels, fuel cells, hybrid vehicles, nanotechnology, green buildings, Asian dominance of production in rare earth elements needed for green technologies, and climate science disputes. A new hot topic that we may try to fit in for 2013 is unconventional fossil fuels. For many students, this is their favorite part.

Projects. The course includes a final project component. In S2013, it will culminate with a poster for the research open house on April 4, 2013.

7. Topic coverage

A detailed class-by-class schedule and lists of readings, quiz dates, etc. can be found on ICON

A general outline is here

- Ice-breaker, objectives, syllabus, discussion and active/collaborative learning (1 class period)
- Where are we going with all of this? Sustainability, principles of Green Design, Grand Challenges (1 class period)
- Energy and Greenhouse Gas Inventories (~5 class periods)
    - Introduction to Energy; Conventional fossil technologies for electricity production
    - Alternative / renewable technologies for electricity production.
    - GHG Inventory Methods with focus on fossil and biofuel energy sources
    - Energy in transportation
    - Alternative liquid fuels with focus on well to wheels efficiency of corn ethanol
- Climate science, ozone layer, and the links between energy futures and climate change (~3 class periods)
- Estimation of Environmentally Important Properties of Chemicals (~1 class period)
- Green chemistry (~2 class periods)
- LCA and Industrial ecology (~2 class periods)
- Tier 1 / Tier 2 Assessment of Chemical Processes (~2 class periods)
- Review of process heating and cooling; opportunities for efficiency and integration (~1 class period)
- Heat and Mass Exchange Networks (~4 class periods)
- Review of energy intensive unit operations and opportunities for efficiency: drying, cooling towers, motors (~1 class period)
- Flowsheet optimization (~1 class period)
- Contemporary issues and guest lectures (~1-3 class periods)
- Cornucopian vs. Limitist Environmental Philosophies (~1 class period)

8. Learning goals
    1. To have students be able to competently discuss the intersection of chemical engineering and sustainability.
    2. To have students knowledgeable about specific environmental and sustainability challenges faced by developed and developing economies, and able to engage in fact-based debates on issues (e.g. climate change, energy policy, environmental regulations, hazardous substances regulations and policies).
    3. To have students able to critically review written and verbal claims about sustainability and environmental performance.
    4. To have students be able to perform greenhouse gas inventories, Tier 1 and Tier 2 environmental performance analyses.

5. To have students be able to perform practical pollution prevention and energy conservation in industrial and commercial settings.
6. To give students good research skills with respect to environmental, safety, energy, and sustainability issues – so that when things come up after the course, they know what resources may be available.

9. <u>Grading</u>

Grades will be assigned using the following weights.

10% Performance as "discussion leader"
20% Problem sets
20% Individual project
10% Attendance and participation
40% Quizzes, midterm exam, final exam.
Relative weightings will be 40 / 25 / 35 quiz, midterm, final for students that take all three.
Relative weightings will be 62 / 38 quiz, midterm for students that take only those two.
Relative weightings will be 53 / 47 quiz, final for students that take only those two.

Frequency of quizzes and exam exemption are based on student performance and are covered in the "Instructor Guidance" document on ICON.

Grading is based on the meeting of the following criteria. The course is not curved. Grading is based on the criteria below. Attendance and participation grade will have a deduction of 0.33 GPA units for each class period missed without prior instructor approval.

- Participation, and performance as "discussion leader"

- A is characterized by
  - participates in discussion in nearly every class;
  - demonstrates that readings have been done.
  - Shows efforts to synthesize existing knowledge and experience with class materials
  - Adds non-required research (e.g. reading, web searches, etc.).
  - Shows enthusiasm, leadership, and good teamwork in group projects.
  - As discussion leader, well prepared, discussion stays on track, discussion is covers a broad range of topics and has wide participation
  - As discussion leader, only minor problems and in only one or two areas: (preparation, keeping discussion on track, eliciting broad participation, discussion covers multiple facets of the topic, active listening).

- B is characterized by
  - participates in discussion most classes.
  - demonstrates that readings are usually done prior to class.
  - Good teamwork in group projects.
  - As discussion leader, between the B and C criteria

- C is characterized by
  - occasional participation in classes.
  - As discussion leader, major problems in two or more areas: (preparation, keeping discussion on track, eliciting broad participation, discussion covers multiple facets of the topic, active listening).
- D is characterized by
  - showing little to no comprehension of material
  - several readings not completed

Exams, problem sets, and calculation-based projects

- A is characterized by neat and easy to follow. Shows complete understanding of concepts, checking of answers for physical plausibility, good use of units, proper use of significant figures, and reasonable care to avoid calculation error. Problems set up properly.
- B is characterized by somewhere between A and C. A few minor errors, or difficulty with one concept.
- C is characterized by more than 25% incomplete OR shows lack of understanding of more than one major concept OR many minor errors combined (e.g. non-physical answers, bad units, & messy)
- D is characterized by showing little to no comprehension of material. or lower work will be returned to the student for redoing.

10. Bibliography

A bibliography of materials in the coursepak is available upon request to charles-stanier@uiowa.edu.

11. Guidelines on Academic Misconduct and Other Matters

- Cheating on hour or final exams will result in an F in the course. Examples of cheating include but are not limited to looking at your neighbor’s exam papers, discussing problems during an exam, or copying answers from another exam paper.
- Cheating on a quiz will result in a zero for the quiz portion of the class (e.g. a zero for all quizzes in the class). Examples of cheating include but are not limited to looking at your neighbor’s quiz papers, discussing problems during a quiz, or copying answers from another exam paper.
- Plagiarism or other academic misconduct on the group project may result in penalties up to an F in the course for all group members.
- Plagiarism or other academic misconduct on the individual project may result in penalties up to an F in the course and written report of disciplinary action.
- A second offense of academic misconduct (either one offense in this course and one in another, or two in this course) can result in dismissal from the department.
- Acceptable collaboration on homework is defined as working on problems together. However, each student should write out the final calculation for themselves, and calculate any quantities using their own calculator or spreadsheet.

Additional Policies

Accommodations for Disabilities. If you feel that you may need an accommodation based on the impact of a disability please contact Prof. Charles Stanier privately to discuss your specific needs. You may also contact the Office of Student Disability Services (319/335-1462) to discuss the accommodations that are available for students with documented disabilities.

Policy on Make-up Assignments. A student may request to turn in an assignment late in the case of an illness or unavoidable situation. Students should get prior approval from the instructor to reschedule the assignment if there is a professional schedule conflict.

Policy on Cross Enrollments. This course is given by the College of Engineering. This means that class policies on matters such as requirements, grading, and sanctions for academic dishonesty are governed by the College of Engineering. Students wishing to add or drop this course after the official deadline must receive the approval of the Dean of the College of Engineering. Details of the University policy of cross enrollments may be found at: http://www.uiowa.edu/~provost/deos/crossenroll.doc.

Complaint Policy. If you feel that we have treated you unfairly or acted unprofessionally or otherwise failed to meet our responsibilities as instructors, please bring the matter to our attention so that we can work together to resolve the problem. If you remain unsatisfied you may contact (choose one) the chair of our department, [Alan Guymon, 335-1400]. If your concerns have still not been resolved at that point, you may submit a written complaint to the Associate Dean for Academic Programs, 3100 SC (335-5764) (for undergraduates), the Graduate College, 205 Gilmore Hall, 335-2137 (for graduate students).

Policy on Sexual Harassment. Sexual harassment is illegal and will not be tolerated. The course will follow guidelines set forth in University of Iowa policies.