Techniques of Process Design, Economics and Safety

CHE / MSE 450, 3 credits
Fall Semester 2014
Mon. and Weds, 4:00PM – 5:15PM, SEM 234 (Scrugham Engineering Mines).
Office Hours: Monday, 10:00 – 11:00AM, in person, other times by appointment.

Instructor

Dr. Alan Fuchs, LME 307, phone - 327-2227,
webpage - http://unr.edu/homepage/afuchs, e-mail - afuchs@unr.edu

Introduction

The capstone design course is a unique experience in the chemical engineering curriculum which brings together concepts from material and energy balances, computer applications, thermodynamics, reaction engineering, thermodynamics and transport phenomenon in order to apply these concepts to real world applications.

In this course, you will learn how to apply the engineering method to the analysis, synthesis, and design of chemical processes. You will begin a design project that will extend through the Spring 2015 Semester (CHE 482), which is coordinated with this course.

After successful completion of the course, you should be able to create and analyze a fairly complicated flowsheet to understand what its major features are and how to modify it when conditions change. You will be able the compare suggested modifications on an economic basis and to analyze the environmental and safety concerns of the process. You will also have begun to develop strategies for dealing with ethical situations that arise in engineering and to plan for your continuing development throughout your career. This knowledge will be applied in the second semester of the process design capstone sequence (CHE 482).

During the Fall 2014, students will be required to provide a proposal of their senior design project. Students will assemble into working groups. The proposed project will be selected such that it is of high interest to the students. The proposal will include background and literature search related to the project proposed as well as a description of the tasks which will be accomplished as part of the design project.

Students will participate in presentations at companies and Nevada’s Governor’s Cup Competition and possibly First Look Out West (FLOW) for Honors projects
and extra credit. Projects with startup companies are also encouraged for Honors projects and extra credit.

**Educational Objectives**

These are listed in the Course Outcomes section at the end of the Syllabus. The outcome which applies to the Silver Core is CO-12 (Ethics).

**How this course will satisfy the Core Objectives:**

**CO-12 (Ethics):** Students will learn about ethically defensible actions, academic integrity, use of citations and sources, objective presentation of data. Discussions of ethical responsibilities are a significant component of the capstone experience. This is done by consideration of the principle and case studies. Some of these case studies relate to topics: mobile truths, moral autonomy, duties and obligations, non-professional responsibilities. Students will have an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity. Many contemporary issues are discussed in class. Students will learn about ethical values and principles, ethical dilemmas, the ethical course of action for a specific decision maker and conduct of research in a professional practice. The recent economic recession is discussed as part of the engineering economics section.

**CO12** learning will be evaluated through specific assignments and exam questions that address the topic of ethics and help gauge student understanding of the issues as they relate to the profession of engineering. Student performance data for these metrics will be recorded, analyzed, and reported as required.

**How Student Learning Related to the Core will be Assessed:**

Assessment of student learning outcomes will be through in class discussions related to the concepts, homework assignment and exams. In addition, a key aspect of the Fall Design Class is preparation of a proposal for the design project which the students will prepare, in the form of a Powerpoint Presentation and present to our industry partners. They will receive feedback from our partners which will be used in the Spring Semester Design Class.

**Textbook**

Corequisite

CHE 485 – Separations Processes

Computer Usage

CHEMCAD III simulation software for design of unit operations processes.

Grading

First Midterm Exam - 20%
Second Midterm Exam – 20%
Final Exam - 35%
Participation - 10%
Homework - 5%
Projects – 5%
Quizzes – 5%

Late homework will be accepted up to 1 week after the due date but will receive 50% of the credit received for the assignment.


Grade Scale

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Total Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>90-100%</td>
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<tr>
<td>B</td>
<td>80-89%</td>
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<tr>
<td>C</td>
<td>70-79%</td>
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<tr>
<td>D</td>
<td>60-69%</td>
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<tr>
<td>F</td>
<td>59% or Below</td>
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</tbody>
</table>

Letter grades of + or – will be given for intermediate total percentages.

Statement on Academic Dishonesty: For example, "Cheating, plagiarism or otherwise obtaining grades under false pretenses" constitute academic dishonesty according to the code of this university. Academic dishonesty will not be tolerated and penalties can include canceling a student's enrollment without a grade, giving an F for the course or for the assignment. For more details, see the UNR General Catalog.
Statement of Disability Services: For example, "Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the Disability Resource Center (Thompson Building, Suite 101) as soon as possible to arrange for appropriate accommodations."

Statement for Academic Success Services: For example, "Your student fees cover usage of the Math Center (784-443 or www.unr.edu/mathcenter/), Tutoring Center (784-6801 or www.unr.edu/tutoring/), and University Writing Center (784-6030 or http://www.unr.edu/writing_center/). These centers support your classroom learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class is the sign of a responsible and successful student."

Statement on Audio and Video Recording: Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded.

CHE / MSE 450 Course Outcomes

Students will be able to demonstrate:

(1) an ability to apply knowledge of mathematics, science, and engineering.
   - Use the skill for all math, science and engineering classes in 3.5 years of CHE curriculum.
   - The focus of this class is solving engineering problems. Students begin to plan the Spring semester design project. Chem Cad and other computer tools are used as part of this class. This includes understanding the principles of process design and synthesis – process flow diagrams, block diagrams and process and instrumentation diagrams, batch vs. continuous, process recycles and bypasses, conditions of special concern. Applications are carried through collaboration with industries including: Genentech, Barrick and Micromidas.

(2) an ability to design and conduct experiments, as well as to analyze and interpret data.
   - In the first semester of Capstone design the students plan for the experiments they will run in the second semester. Students will utilize computer simulation techniques in design – chemical component / physical properties database, thermodynamic models, unit operations parameters, equipment topology and process optimization

(3) an ability to design a system, component, or process to meet desired needs within
realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

- The focus of this class is design of systems, components and processes for many different areas.

(4) an ability to identify, formulate, and solve engineering problems.
- Students are required to do a literature search for their project proposal and need to seek other ways to develop their design project.

(5) an understanding of professional and ethical responsibility.
- We discuss professional issues in class discussion using case studies.
- Many contemporary issues are discussed in class. Discussions of ethical responsibilities are a significant component of the capstone experience. This is done by consideration of the principle and case studies. Some of these case studies relate to topics: mobile truths, moral autonomy, duties and obligations, non-professional responsibilities. The current economic recession is discussed as part of the engineering economics section.

(6) an ability to communicate effectively and the ability to function on multi-disciplinary teams.
- The students propose the design project which will be the Spring semester project. These are team projects.
- Students prepare a Powerpoint presentation of their proposed design project. They present homework problems in class discussion.

(7) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context, and knowledge of contemporary issues.
- Examples relate to global engineering and global context are discussed often in class. This may be related to engineering economics. Students will apply economics, safety, social and ethical considerations in design - , estimation of capital and manufacturing costs, discrete and cumulative cash flow diagrams, depreciation, taxation, profitability analysis, discounted and non-discounted methods, incremental analysis, equipment alternatives and ethics case studies.

(8) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice, and a recognition of the need for, and an ability to engage in life long learning.
- Simulation software, ChemCad is used to provide modern engineering tools needed for process design.
- Students learn to do literature searches which allows them to practice life long learning activites.
Weekly homework assignments are required to be turned in on time and of high quality. Assignments are reviewed in class on a regular basis with either students or the instructor demonstrating competence.

Notes:
1) The participation grade will include attendance at the weekly seminar series.
2) To receive a grade in CHE 450, you must present a signed Advising Form for Spring 2015 before the end of the semester.
3) Class attendance is mandatory.

Anticipated Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topics</th>
<th>Chapters</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>8/25, 8/27</td>
<td>Outcomes Assessment and Chemical Process Diagrams Process Simulators</td>
<td>1, 13</td>
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<tr>
<td>2</td>
<td>9/1 (Labor Day, no class), 9/3</td>
<td>Process Flow Diagrams</td>
<td>2, 12</td>
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<td>3</td>
<td>9/8, 9/10</td>
<td>Batch Processing / Product Design</td>
<td>3, 4</td>
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<td>4</td>
<td>9/15, 9/17</td>
<td>Recycle, Bypass</td>
<td>5</td>
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<td>5</td>
<td>9/22, 9/24</td>
<td>Process Conditions</td>
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<td>6</td>
<td>9/29, 10/1</td>
<td>Capital Costs</td>
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<td>7</td>
<td>10/6, 10/8</td>
<td>Manufacturing Costs</td>
<td>8</td>
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<td>8</td>
<td>10/13, 10/15</td>
<td>Cash Flow, Depreciation</td>
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<td>Exam #1 (10/16)</td>
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<td>9</td>
<td>10/20, 10/22</td>
<td>Profitability</td>
<td>10</td>
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<td>10</td>
<td>10/27, 10/29</td>
<td>Heuristics</td>
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<td>11</td>
<td>11/3, 11/5</td>
<td>Input/Output</td>
<td>16</td>
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<tr>
<td>12</td>
<td>11/10, 11/12</td>
<td>Process Performance</td>
<td>17</td>
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<tr>
<td>13</td>
<td>11/17, 11/19</td>
<td>Individual UO’s</td>
<td>18</td>
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<td>Exam #2 (11/20)</td>
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<td>14</td>
<td>11/24, 11/26</td>
<td>Multiple UOs</td>
<td>19</td>
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<td>15</td>
<td>12/1, 12/3</td>
<td>Reactor Performance</td>
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<td>Ethics and Professionalism</td>
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<tr>
<td>16</td>
<td>12/8</td>
<td>Final Exam</td>
<td>23</td>
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<tr>
<td>Final</td>
<td>Tues. Dec. 16, 2:45PM-4:45PM</td>
<td>Final Exam</td>
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