COURSE OUTLINE

Course Time: MWF 12:30 p.m. - 1:20 p.m. 3026 SC
Instructor: V. G. J. Rodgers (4136 SC; 335-1401)
Teaching Assistant: John Elliff (G453 SC; 335-5009)
Office Hours: Teaching Assistant: TBA

Instructors Office Hours: 9:30 – 10:30 TWTh. Many office hours conflict with travel. So please, also schedule time with Professor Rodgers in person or by email: victor-rodgers@uiowa.edu

Website: http://www.engineering.uiowa.edu/~cbe_103

Textbooks:


Suggested Supplemental Information:

Mathcad files for Chemical Engineerings:

Course Description:

This course reviews the principles of thermodynamics as they apply to biochemical and chemical engineering. As an extension to core thermodynamics, this course concentrates on species mass equilibrium for mixtures especially across phase barriers. Chemical engineering thermodynamics is grounded in the fundamental laws of conservation as is the sister field of transport phenomena. However, thermodynamics does not address transient or rates of approach as the former.

Because of the nature of chemical engineering, many problems associated with environmental engineering/science or biomedical engineering also use these basic principles outlined in this course. In addition, the course will help the student develop an appreciation for the applications of thermodynamic principles to pertinent biochemical and chemical engineering problems. Whether it is environmental issues, medical problems, or the biosciences, the chemical and biochemical engineers’ contribution are usually related to this important area. Because thermodynamics prescribes the limitations or extent of mass relationships, it is fundamental in traditional separations methods such as stage equilibrium unit operations (distillation towers, absorbers, etc.). In addition, it only takes a moment to see the importance of this important area many interdisciplinary settings such as determining dosing for drug-delivery patches, determining maximum toxicity level of chemical spills, estimating metabolic limitations of bioremediation processes, infusion of initiators in photo-reactive polymer thin film development and others. As the chemical engineer is becoming more increasingly critical to successful interdisciplinary scientific endeavors, it is paramount that the chemical or biochemical engineer is truly grounded in thermodynamics so that they can appropriately apply it these non-traditional territories.
Course Goals:

This is a goal-oriented course. By the end of the course the student will:

1) understand and be able to apply the laws of thermodynamics to open and closed systems,
2) have acquired a fundamental knowledge of thermodynamic properties of pure substances,
3) have acquired a fundamental knowledge of thermodynamic properties of solutions in single and multiphase systems,
4) acquired a fundamental knowledge of vapor-liquid equilibrium and be able to solve VLE problems using simple models (e.g. Raoult’s or modified Raoult’s laws) and more complex models (gamma-phi formulation),
5) have learned about some important thermodynamic cycles and their engineering applications, including the Carnot and Rankine cycles,
6) be able to apply thermodynamic principles to steady-state flow processes such as nozzles, turbines and pumps, and understand applications to some non-traditional problems,
7) have had opportunities to further his or her professional development through practicing graphical communication skills and successfully using modern computer tools to solve engineering thermodynamic problems.

This is a goal-orientated course, and, as such, it is project based. However, so that the student has formal development of fundamental training, three closed-book exams (Confidence Builders) are offered with one ongoing, project that will be due at the end of the semester. The project will be based on one suggested by the student on a problem of significance to the student. The project goals will be introduced early on in the course and it will be approved by Professor Rodgers. The project will require the student to develop and, then, solve, a tractable problem related to an area of their interest. A series of short presentations will be used for the student to develop the project as well as share with the class what they are doing. The final professional report and presentation of the project are due at the end of the semester.

Homework will be assigned on a weekly basis and will be due one week after it is assigned at the beginning of the class (unless otherwise noted). Mr. Elliff will grade the homework.

In addition, a series of Brain Strains will be administered randomly throughout the semester.

Grading will be based on a curve system with the average grade being a B/B-. Grades two standard deviations or more above the mean will be considered A+ and grades two standard deviations or more below the mean will be considered F. Professor Rodgers will grade all exams and projects.

Keep in mind that the purpose of this course is to help you become experts in chemical engineering so that you are competitive with entry-level graduates throughout the world. It is not designed to weed you out of our program. Therefore this course will be rigorous. However it will be in a supportive setting. To this end, I will have an open-door policy for help and support with any aspect of this course. Take advantage of soliciting for help as often as necessary. Answers to the homework will be made available on the website for the course the day after the homework is due. No homework will be accepted late. Because growth is essential, the closed-book exams will be weighed on an increasing scale with the project counting significantly to the final grade. Professional and technical qualities are of the utmost importance.

Exam Schedule and Grading:

<table>
<thead>
<tr>
<th>EXAM</th>
<th>POINT</th>
<th>DATE and DATE</th>
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<tbody>
<tr>
<td>Presentation I (Preliminary)</td>
<td>100</td>
<td>TBA</td>
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<tr>
<td>1st Confidence Builder</td>
<td>200</td>
<td>Wednesday, 7:00 p.m. – 9:00 p.m. February 16, 2005</td>
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<tr>
<td>2nd Confidence Builder</td>
<td>300</td>
<td>Wednesday, 7:00 p.m. – 9:00 p.m., March 23, 2005</td>
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<tr>
<td>Presentation II (Intermediate)</td>
<td>150</td>
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<tr>
<td>3rd Confidence Builder</td>
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<td>7:30 a.m. May 9, 2005</td>
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<tr>
<td>Presentation</td>
<td>200</td>
<td>TBA</td>
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<tr>
<td>Project Due</td>
<td>500</td>
<td>Noon, Friday, May 13, 2005</td>
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<td>TOTAL</td>
<td>1850</td>
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Collaboration Policy:

Any questions about homework problems should be addressed to Professor Rodgers. Discussion of homework problems with other students in the class is acceptable but direct copying of complete or part of an assignment is not allowed. Violation of this policy will result in a zero given for the homework set. Cheating on exams and/or plagiarism in projects will result in an F grade given for the course.

TOPICS (We will follow Sandler)

- **INTRODUCTORY MATERIAL**  
  CH. 1

- **CONSERVATION OF MASS AND ENERGY**  
  CH. 2

- **ENTROPY**  
  CH. 3

- **PROPERTIES OF REAL SUBSTANCES**  
  CH. 4

- **EQUILIBRIUM STABILITY IN ONE-COMPONENT SYSTEMS**  
  CH. 5

- **MULTICOMPONENT MIXTURES**  
  CH. 6

- **GIBBS FREE ENERGY AND FUGACITY ESTIMATES OF MIXTURES**  
  CH. 7

- **PHASE EQUILIBRIUM IN MIXTURES**  
  CH. 8

- **CHEMICAL EQUILIBRIUM FOR CHEMICALLY REACTIVE SYSTEMS**  
  CH. 9