



CME 320 Engineering Thermodynamics

Spring 2013

University of Kentucky College of Engineering, Paducah

Lecture: 12:30PM-1:45PM TR CLC 202

Recitation: 12:00PM-12:50PM M CLC202

Course Web Page: <http://www.engr.uky.edu/~silverdl/CME320/>

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| INSTRUCTOR: | Dr. David L. Silverstein | |
| | 209 Crouse Hall (270) 534-3132 (Office) SilverDL@engr.uky.edu | Office Hours: Open door policy-- when I am there, I am usually available. To guarantee availability, make an appointment. |
| CATALOG COURSE SUMMARY: | Fundamentals of thermodynamics, review of first law, second and third laws, VL, LL, and SL equilibria, homogeneous and heterogeneous chemical reaction equilibria. Prereq: CME200 (C or better), PHY231, MA213. | |
| REQUIRED COURSE MATERIALS: | Required: <i>Introduction to Chemical Engineering Thermodynamics</i> , Seventh Edition, Smith, Van Ness, and Abbott, New York, McGraw Hill, 2005. i>Clicker student remote (Generation 1 or above). | |
| COURSE OBJECTIVES: | Thermodynamics is used to solve problems in diverse areas such as petroleum refining, chemical separations, power generation, biological systems, pollution control, reactor design, etc. This course will enable students to understand classical thermodynamic principles and solve various problems by acquiring in-depth knowledge in the area of energy transformation, process irreversibility, property calculations involving single and multi-component systems, phase equilibria, equilibrium reactions, etc. | |
| STUDENT LEARNING OUTCOMES: | At the conclusion of this course, you should be able to: <ol style="list-style-type: none"> 1) Demonstrate conceptual understanding of the 1st and 2nd Laws of thermodynamics 2) Carry our energy balances on material and power systems 3) Conduct 2nd Law analyses on systems 4) Thermodynamically design expanders, compressors, pumps, reactors, and separators. 5) Develop, analyze, and interpret thermodynamic property and physical and chemical equilibrium evaluations on non-ideal flash devices.. 6) Carry out material and equilibrium evaluations on non-ideal flash devices. 7) Demonstrate an elementary understanding of molecular thermodynamics 8) Successfully work in teams to formulate and solve problems using computer software | |
| COURSE POLICIES: | <p>Attendance is expected at all lectures. Instructor reserves the right to administer unannounced quizzes on reading or lecture material during classes. Bring your calculators to all classes. Homework assignments will be distributed in class.</p> <p>Homework is due within the first five minutes of the scheduled start of the period for which it is assigned. Late homework will receive no credit.</p> <p>Handwritten homework must be submitted on 8.5"x11" green engineering paper (except for computer printouts), one side per page. All pages should be numbered and contain your name. Multiple pages should be secured by paper clip and not folded or stapled. Individual solutions should stand alone-- no reference to the source of the original problem should be required to understand the context and meaning of the solution you present. Each solution should contain a problem statement, a list of assumptions, a diagram (if appropriate), and a solution containing adequate steps and explanations to ensure understanding of your solution by the instructor. The final solutions to a homework problem must be boxed or otherwise distinguished from the remainder of the problem.</p> <p>Problems solved using a computer must contain all information required to reproduce your solution. Among other things, this means a spreadsheet printout only containing numbers is not sufficient. The formulas used must be included on the printout. All numbers must be identified and labeled with appropriate units. You must submit the data file for problems solved with computers. Specific guidelines for completing programming problems will be provided with the first programming assignment.</p> <p>Homework assignments are individual tasks. No copying of solutions is permitted. You are, however, encouraged to work in small groups to discuss methods of solving the homework problems. Bear in mind that setting up problems is the most difficult part of most problems, and</p> | |

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| | <p>failure to practice setting problems up independently will likely result in an inability to set problems up on exams. You must indicate whom you work with on assignments completed with assistance from a group. Certain assignments may be designated group problems and must be solved as a group. Details on group problems will be provided when assigned.</p> <p>Any disputes regarding grading must be resolved within 5 school days of the original issuance of the grade. Requests to re-grade a problem may result in the entire assignment being re-graded and adjustments to all scores being made. This can potentially result in a decrease of score. Any grades not challenged within the five school day period are considered final. This applies to both homework and exams.</p> <p>Cheating is strictly forbidden, and anyone found doing so will be turned over to the University Registrar and dealt with in accordance with University policy. Working together on homework is encouraged, but each person must independently write-up their own work and cite any assistance they have had from classmates. Copying homework (problems, graphs, figures, computer files, etc.) between individuals or from solutions manuals is cheating.</p> | | | | | | | | | | |
| GRADING: | <table> <tr> <td>Final Exam:</td> <td>25%</td> </tr> <tr> <td>Hour Exams:</td> <td>50% (lowest counts as 10%, other two as 20%)</td> </tr> <tr> <td>Homework Assignments (drop lowest)</td> <td>10%</td> </tr> <tr> <td>Quizzes:</td> <td>5%</td> </tr> <tr> <td>Project (Video):</td> <td>10%</td> </tr> </table> <p>A weighted grade of 90 or above is guaranteed an A, 80 or above at least a B, 70 or above at least a C, and 60 or above at least a D. A grade of E will be assigned to anyone earning a weighted grade below 60.</p> <p>For grades near the endpoints in the above distribution, consideration will be given to homework performance, class participation, and performance trends as a function of time.</p> <p>Homework and exam problems will be graded based on the following factors: correct assumptions, correct diagrams, legibility, clarity, neatness, identification of paper, clearly defined answer, correct approach to problem, adherence to submission guidelines, and the correct answer. These criteria will be weighted according to the instructor's judgment for a particular problem. Satisfactory completion of homework may be required to pass the course.</p> <p>Your homework grade will include a participation component and inquiry activities. Your project grade will arise from video production project. Concept inventories will not count toward your grade beyond the participation component.</p> <p>Mid-term grades will be posted in myUK by the deadline established in the Academic Calendar (http://www.uky.edu/Registrar/AcademicCalendar.htm)</p> | Final Exam: | 25% | Hour Exams: | 50% (lowest counts as 10%, other two as 20%) | Homework Assignments (drop lowest) | 10% | Quizzes: | 5% | Project (Video): | 10% |
| Final Exam: | 25% | | | | | | | | | | |
| Hour Exams: | 50% (lowest counts as 10%, other two as 20%) | | | | | | | | | | |
| Homework Assignments (drop lowest) | 10% | | | | | | | | | | |
| Quizzes: | 5% | | | | | | | | | | |
| Project (Video): | 10% | | | | | | | | | | |
| HOMEWORK: | <p>Approximately 14 assignments will be given. Some homework assignments will require use of a computer software package. Unless otherwise specified, any suitable software package may be used to complete your homework (Maple, Mathcad, Matlab, C/C++, FORTRAN, Visual BASIC, spreadsheet). At least one major project will be assigned.</p> | | | | | | | | | | |
| EXAMINATIONS: | <p>Short graded quizzes may be administered throughout the term. These quizzes will cover material in assigned reading, homework, and lecture.</p> <p>There will be three in-class examinations and a final examination. The in-class exams will be cumulative since the previous exam. No make-up hour exams will be given except with the advance consent of the instructor. The final exam will be comprehensive. There will be no make-up final exam. Exams are scheduled for February 14, 2013, March 21, 2013, and April 18, 2013. These dates may be changed by mutual consent with at least one week warning. The Final Exam will be held on May 6, 2013.</p> | | | | | | | | | | |
| EXCUSED ABSENCES: | <p>Students need to notify the professor of absences prior to class when possible. S.R. 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.</p> <p>Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Information regarding dates of major religious holidays may be obtained through the religious liaison, Mr. Jake Karnes (859-257-2754).</p> | | | | | | | | | | |

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| | <p>Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused or unexcused) per university policy.</p> <p>Students may be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request “appropriate verification” when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.</p> | |
| <p>ACADEMIC INTEGRITY:</p> | <p>Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed.</p> <p>Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: http://www.uky.edu/Ombud. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.</p> <p>Part II of Student Rights and Responsibilities (available online http://www.uky.edu/StudentAffairs/Code/part2.html) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about the question of plagiarism involving their own work, they are obliged to consult their instructors on the matter before submission.</p> <p>When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording or anything else from another source without appropriate acknowledgement of the fact, the students are guilty of plagiarism. Plagiarism includes reproducing someone else’s work, whether it be a published article, chapter of a book, a paper from a friend or some file, or something similar to this. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work which a student submits as his/her own, whoever that other person may be.</p> <p>Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone. When a student’s assignment involves research in outside sources of information, the student must carefully acknowledge exactly what, where and how he/she employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas which are so generally and freely circulated as to be a part of the public domain (Section 6.3.1).</p> <p>Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.</p> | |
| <p>ACCOMODATIONS DUE TO DISABILITY:</p> | <p>If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, (859) 257-2754, email address: jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities. See Denise Brazzell for more information.</p> | |
| <p>COURSE CONTENTS:</p> | <ol style="list-style-type: none"> 1. 1st and 2nd Laws of Thermodynamics 2. Closed and Open Systems 3. Phase Rule 4. Reversibility 5. Real Gas Behavior 6. Generalized Correlations 7. Molecular Theory 8. Heat Effects 9. Heats of Reactions 10. Entropy 11. Irreversible Processes 12. Thermodynamic Properties | <ol style="list-style-type: none"> 13. Expanders/ Compressors 14. Partial Properties 15. Fugacity/ Residual Properties 16. Liquid Solutions/ Excess Properties 17. Liquid Phase Properties 18. Predictive Equations 19. Energies of Mixing 20. Modified Raoult’s Law 21. Flash Calculations 22. K-Values 23. Ionic/Multiple Reactions |

Tentative Course Schedule

| Period | Date | Reading Assignment | Problems Due |
|-------------------|-------|-----------------------------------|-----------------|
| Recitation | 01/14 | Read Chapter 1 (pp. 1-15) | |
| Lecture | 01/15 | Ch. 2 pp.21-37 | |
| Lecture | 01/17 | Ch. 2 pp. 37-55 | Problem Set #1 |
| <i>Holiday</i> | 01/21 | MLK Day | |
| Lecture | 01/22 | Ch. 3 pp. 64-90 | |
| Lecture | 01/24 | Ch. 3 pp. 90-111 | Problem Set #2 |
| Recitation | 01/28 | | |
| Lecture | 01/29 | Ch. 4 pp. 122-150 | |
| Lecture | 01/31 | Ch. 5 pp. 159-190 | Problem Set #3 |
| Recitation | 02/04 | | |
| Lecture | 02/05 | | |
| Lecture | 02/07 | Ch. 6 pp. 199-208 | Problem Set #4 |
| Recitation | 02/11 | | |
| Lecture | 02/12 | Ch. 6 pp. 208-220 | |
| EXAM | 02/14 | Chapters 1-5 | |
| <i>Holiday</i> | 02/18 | President's Day | |
| Lecture | 02/19 | Ch. 6 pp. 220-240 | |
| Lecture | 02/21 | Ch. 7 pp. 254-280 | Problem Set #5 |
| Recitation | 02/25 | | |
| Lecture | 02/26 | Ch. 8 pp. 290-312 | |
| Lecture | 02/28 | Ch. 9 pp. 317-332 | Problem Set #6 |
| Recitation | 03/04 | | |
| Lecture | 03/05 | Ch. 10 pp. 338-358 | |
| Lecture | 03/07 | Ch. 10 pp. 358-370 | Problem Set #7 |
| Recitation | 03/11 | | |
| Lecture | 03/12 | Ch. 11 pp. 378-391 | |
| Lecture | 03/14 | Ch. 11 pp. 391-401 | Problem Set #8 |
| Recitation | 03/18 | | |
| Lecture | 03/19 | Ch.11 pp. 401-420 | Problem Set #9 |
| EXAM | 03/21 | Ch. 6- 10 | |
| <i>Holiday</i> | 03/25 | SPRING BREAK | |
| <i>Holiday</i> | 03/26 | SPRING BREAK | |
| <i>Holiday</i> | 03/28 | SPRING BREAK | |
| Recitation | 04/01 | | |
| Lecture | 04/02 | Ch. 12 pp. 430-469 | |
| Lecture | 04/04 | | Problem Set #10 |
| Recitation | 04/08 | | |
| Lecture | 04/09 | Ch. 14 pp. 545-624 | |
| Lecture | 04/11 | Ch. 13 pp. 483-501 | Problem Set #11 |
| Recitation | 04/15 | | |
| Lecture | 04/16 | | |
| EXAM | 04/18 | Ch. 12, 14 | Problem Set #12 |
| Recitation | 04/22 | | |
| Lecture | 04/23 | Ch. 13 pp. 502-532 | |
| Lecture | 04/25 | Property Prediction in ASPEN PLUS | Problem Set #13 |
| Recitation | 04/29 | | |
| Lecture | 04/30 | Ch. 15 pp. 635-644 | |
| Lecture | 05/02 | Ch. 16 pp. 647-674 | Problem Set #14 |
| Final Exam | 05/06 | | 10:30-12:45 |

All material on this schedule is subject to change at instructor's discretion for pedagogical reasons.