PELLISSIPPI STATE TECHNICAL COMMUNITY COLLEGE
MASTER SYLLABUS

CHEMICAL ENGINEERING FUNDAMENTALS
CHT 2000

Class Hours: 3.0  Credit Hours: 4.0
Laboratory Hours: 3.0  Revised: Spring 04

Catalog Course Description:

A study of material and energy balances, numerical methods, and computer workshop on applications to problem solving. The course includes three hours lecture and three hours of laboratory with report writing required. Computer hardware and software will be required as specified on the syllabus.

Entry Level Standards:

Students should be able to apply mathematical techniques, including integral and differential calculus, to the solution of chemical engineering problems. They must have a working knowledge of the computer and Internet.

Prerequisites:

ENS 1210, ENS 1310, CHEM 1120

Corequisites:

MATH 1920

Textbook(s) and Other Course Materials:


Personal Computer with Internet Explorer 6.0, Microsoft Office, MatLab software.

I. Week/Unit/Topic Basis:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Computer orientation and material balance without chemical reaction</td>
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<tr>
<td>2</td>
<td>Material balance without chemical reaction</td>
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<tr>
<td>3-4</td>
<td>Material balance with chemical reaction</td>
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<tr>
<td>5-6</td>
<td>Gas law calculations</td>
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<tr>
<td>7-8</td>
<td>Gas liquid system calculations</td>
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<tr>
<td>9-10</td>
<td>Energy balances without chemical reactions</td>
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<tr>
<td>11-15</td>
<td>Energy balances on reactive processes</td>
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II. Course Objectives*:

A. Understand the processes and calculations used in material balances with and without chemical reactions. I, III, V, VI, VII

B. Develop knowledge of various Gas Laws used in basic chemical engineering calculations. I, III, V, VI, VII

C. Develop the knowledge needed to perform calculations in Gas Liquid systems. I, III, V, VI, VII

D. Understand the concepts used in Energy balance calculations with and without chemical reactions. I, III, V, VI, VII

E. Develop team building and computer skills to complete projects in the field of chemical engineering. I, II, III, IV, V, VI, VII

*Roman numerals after course objectives reference goals of the university parallel program.

III. Instructional Processes*:

Students will:

1. Read, analyze, and solve problems from the text and reference materials available. Communication Outcome, Problem Solving and Decision Making Outcome, Numerical Literacy Outcome, Information Literacy Outcome, Translational Strategies

2. Complete computer modules, projects, and laboratory exercises to develop knowledge in problem solving and data analysis. Communication Outcome, Personal Development Outcome, Problem Solving and Decision Making Outcome, Technological Literacy Outcome, Numerical Literacy Outcome, Information Literacy Outcome, Active Learning Strategies

3. Write computer programs to solve problems based on other learning objectives. Communication Outcome, Problem Solving and Decision Making Outcome, Technological Literacy Outcome, Numerical Literacy Outcome, Information Literacy Outcome, Active Learning Strategies

4. Write acceptable engineering reports. Communication Outcome, Personal Development Outcome, Technological Literacy Outcome, Information Literacy Outcome, Active Learning Strategies

5. Work as a team member to complete group projects. Communication Outcome, Personal Development Outcome, Problem Solving and Decision Making Outcome, Technological Literacy Outcome, Numerical Literacy Outcome, Information Literacy Outcome, Active Learning Strategies

6. Locate and evaluate related scientific information on the Internet. Communication Outcome, Technological Literacy Outcome, Information Literacy Outcome, Translational Strategies, Active Learning Strategies

*Strategies and outcomes listed after instructional processes reference Pellissippi State’s goals for strengthening general education knowledge and skills, connecting coursework to experiences beyond the classroom, and encouraging students to take active and responsible roles in the educational process.

IV. Expectations for Student Performance*:

Upon successful completion of this course, the student should be able to:

1. Convert process flow rates between mass and molar units given the appropriate process data.
2. Convert process flow rates between mass and volume given the appropriate process data. A

3. Construct a flow chart from a written description of a process. A, E

4. Perform material balances for single process units. A

5. Balance material flow sheets incorporating multiple process units with recycle, and bypass streams for processes without chemical reactions. A

6. Determine the limiting and excess reactants in a reaction. A

7. Perform material balances on reacting systems using extents of reaction. A

8. Calculate extents of reaction, fractional conversion, yield, and selectivity for systems with multiple chemical reactions. A

9. Calculate equilibrium compositions for reacting systems. A

10. Balance a material flow sheet incorporating multiple process units, and recycle, purge, and bypass streams for reactive processes given extents of reaction and/or conversion, yield and selectivity data for the reactions. A

11. Calculate the flue gas composition for a combustion reaction involving multiple fuels, excess oxygen, and incomplete combustion. A

12. Calculate the fuel composition for a combustion reaction involving multiple fuels, excess oxygen, and incomplete combustion. A

13. Work as a team member to evaluate alternatives for a simple process flow sheet using flow sheet simulation software. A, E

14. Obtain physical property values from reference literature. B, E

15. Use the ideal gas law to calculate properties (P, V, n, and T) of pure gases and gas mixtures. B

16. Calculate whether or not a gas mixture constitutes a fire or explosion hazard, given upper and lower flammability limits for the mixture. B

17. Estimate the properties of real gases and gas mixtures using a generalized compressibility chart. B

18. Use a computer to estimate the properties of real gases using a non-ideal gas equation of state. B, E

19. Use vapor pressure data to calculate the molar composition of the gas phase of saturated and unsaturated gas-vapor systems in terms of relative saturation or absolute composition. C

20. Calculate whether or not a mixture of a toxic vapor in air poses a health hazard, given OSHA Permissible Exposure Limit information for the toxic substance. C

21. Calculate the compositions of binary multiphase systems using Raoult’s Law. C

22. Calculate the compositions of binary multiphase systems using Henry’s Law. C

23. Calculate the compositions of binary multiphase systems using tabulated vapor-liquid equilibrium data. C

24. Use steam tables in the solution of energy balance problems involving saturated steam, super heated steam and “wet” steam. D

25. Calculate process flow rates and heat transferred by performing simultaneous mass and energy balances. D
26. Perform energy balances using the psychrometric chart. D
27. Select useful reference states for energy balance problems. D
28. Calculate heats of reaction using heats of formation and heats of combustion. D
29. Calculate quantity of heat transferred by performing energy balances on reactive processes. D
30. Perform energy balances for a system involving mixing or dissolution. D
31. Calculate the adiabatic flame temperature for a combustion process. D

*Letters after performance expectations reference the course objectives listed above.

V. Evaluation:

A. Testing Procedures:

   Testing Procedures: 85% of grade
   Six 1-hour Module tests 70%
   Homework Quizzes 15%

B. Laboratory Expectations:

   15% of grade

C. Field Work:

   0% of grade

D. Other Evaluation Methods:

   0% of grade

E. Grading Scale:

   90 – 100 A
   87 – 89.99 B+
   80 – 86.99 B
   77 – 79.99 C+
   70 – 76.99 C
   60 – 69.99 D
   below 60 F

VI. Policies:

A. Attendance Policy:

   Pellissippi State Technical Community College expects students to attend all scheduled instructional activities. As a minimum, students in all courses must be present for at least 75 percent of their scheduled class and laboratory meetings in order to receive credit for the course. Individual departments/programs/disciplines, with the approval of the vice president of Academic and Student affairs, may have requirements that are more stringent.

B. Academic Dishonesty:

   Plagiarism, cheating, and other forms of academic dishonesty are prohibited. A student guilty of academic misconduct, either directly or indirectly through participation or assistance, is immediately responsible to the instructor of the class. In addition to other possible disciplinary sanctions that may be imposed through the regular Pellissippi State Procedures, as a result of
academic misconduct, the instructor has the authority to assign an F or zero for the exercise or examination or to assign an F in the course.

C. Other Policies:

A readiness test on units, data representation and composition measurements will be administered during the first week. It will count as one homework quiz and may be taken as many times as you wish during the first week of the course (only the last grade counts). Chapters 1-3 of the text and the online study guide provide further information on these topics.

There will be six Module Tests (hour tests) during the term, built around the course learning objectives. Students who do not demonstrate achievement of all learning objectives on the Module Tests may be subject to further testing on the objectives that caused them trouble.