Class Hours: 4.0  Credit Hours: 5.0
Laboratory Hours: 3.0  Date Revised: Fall 2001

NOTE: This course is not designed for transfer credit.

Catalog Course Description:

Basic calculations in chemical engineering technology. Special subject areas include unit conversion, graphical presentation, material balances, first and second law of thermodynamics, energy balances, and simultaneous mass and energy balances. The laboratory will provide an opportunity to perform calculations under supervision.

Entry Level Standards:

Students shall have familiarity with chemistry equivalent to completion of one semester of college chemistry.

Prerequisite:

MATH 1731

Textbook(s) and Other Reference Materials Basic to the Course:


I. Week/Unit/Topic Basis:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Flow Diagrams, Units Conversions</td>
</tr>
<tr>
<td>2</td>
<td>Material Balances without Chemical Reaction or Phase Change</td>
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<td>3</td>
<td>Material Balances with recycle and bypass</td>
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<td>4</td>
<td>Material Balances with Chemical Reaction</td>
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<td>5</td>
<td>Phase Diagrams, One and Two Component</td>
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<td>6</td>
<td>Material Balances with Phase Change</td>
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<tr>
<td>7</td>
<td>Phase Diagrams, Three Component</td>
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</table>
II. Course Objectives*:

A. Draw properly labeled flow diagrams which accurately represent standard operations and typical conditions in chemical processing. II, III, IV, V

B. Perform mass balances on multi-operation chemical processing systems involving bypass, feedback phase change and chemical reaction among multi-component material streams. I, II, V, IV

C. Interpret binary and ternary phase diagrams in terms of amounts and compositions of phases present under changes in temperature and composition. II, III

D. Perform First Law of Thermodynamics energy balances on standard physical operations involving interconversions among heat, work, and the energy content of matter. I, II, III

E. Perform energy balances on operations involving chemical transformation and which are constrained by Second Law of Thermodynamics limits. I, II, III

F. Make calculations involving combined mass and energy balances—such as flash calculations and adiabatic flame temperature. II, III

*Roman numerals after course objectives reference goals of the Chemical/Environmental Engineering Technology program.

III. Instructional Processes*:

Students will:

1. Attend lectures and discuss concepts. Communication Outcome, Problem Solving and Decision Making Outcome, Information Literacy Outcome, Active Learning Strategy

2. Solve assigned problems out of class and be prepared to discuss the problem solutions. Communication Outcome, Problem Solving and Decision Making Outcome, Numerical Literacy Outcome, Information Literacy Outcome, Active Learning Strategy

3. Participate in laboratory problem solving sessions which are direct applications of the concepts studied. Communication Outcome, Problem Solving and Decision Making Outcome, Technological Literacy Outcome, Information Literacy Outcome, Active Learning Strategy, Transitional Strategy
4. Work as part of a group to complete laboratory assignments. *Communication Outcome, Problem Solving and Decision Making Outcome, Technological Literacy Outcome, Information Literacy Outcome*

*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. Translate a statement of flowrates compositions, and process conditions into a flow diagram showing streams and operations. A

2. Convert physical units of material flowrate and composition into consistent, standard forms whose products are stream component quantities. A

3. Identify the components of process stream quantitatively as part of a conservation of material expression. A

4. Apply the principles of the conservation of mass to operations at steady state or with inventory change. B

5. Derive vapor pressure versus temperature data using the Clausius-Clapyron relation, the law of corresponding states and Cox charts. B

6. Apply Henry's Law and Raoult's Law to the computation of composition changes during vaporization processes. C

7. Know the main three-phase invariant reactions of binary phase diagrams and relate them to the effect of temperature on composition. C

8. Apply tie lines and the lever rule to calculating the compositions and amounts of phases in binary systems using phase diagrams. C

9. Determine phase compositions and amounts in ternary systems using triangular phase diagrams. C

10. Perform material balances involving bypass and recycle. B

11. Calculate material balances involving composition changes mediated by phase equilibria. B

12. Calculate material balances involving chemical reaction. B

13. Integrate the effects of, bypass, recycle, phase equilibrium and chemical reaction in multicomponent material balances within a process operation. B

14. Generalize the computation of material balances on a single process operation to multiprocess, multicomponent systems. B

15. Estimate specific heats and phase transition enthalpies of chemical compounds using generalized correlations. C

16. Estimate enthalpies of formation for organic compounds using generalized correlations. D

17. Apply the energy release or absorption of chemical reactions from standard enthalpies of
formation of energy balances on closed systems. D

18. Predict ideal work effects of closed systems without chemical reaction. D

19. Predict ideal work effects of closed, chemically reacting systems at standard state. E

20. Calculate the ideal work of steam turbines using the entropy function. E


22. Generalize the first law of thermodynamics to open systems with multiple operations. D

23. Adapt the first law energy balance to incompressible fluid flow (Bernoulli's Equation). D

24. Adapt the Bernoulli equation to pilot tubes and other head meters for calibration of flowrates. D

25. Evaluate heat engine performance by comparison with the Carnot Cycle. E

26. Calculate the effect of temperature upon heat of chemical reaction. F

27. Calculate the adiabatic flame temperature of combustion reactions which proceed the completion. F

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

V. Evaluation:

A. Testing Procedures: 70% of grade

The student's progress will be evaluated by 4 exams (40% of grade) and an additional comprehensive final exam (30% of grade).

B. Laboratory Expectations: 20% of grade

The laboratory work will comprise 20% of the course grade and the grade will be based on the laboratory problems submitted. Assigned laboratory work will follow the lecture subjects closely. Computations may be completed out-of-class but attendance at all laboratory sessions is required.

C. Field Work: 10% of grade

Homework assignments are an important part of this course and all homework assignments completed and submitted will be graded "A" and will comprise up to 10% of the course grade (as calculated below). Outside readings and library research will be required in this course. A report on an assigned topic may be required.

D. Grading Scale:

The course numerical grade will be calculated using the formula below:

\[ G = 10 \times \frac{H}{HM} + 0.4 \times \frac{\sum T(i)}{N} + 0.3 \times F + 0.2 \times L } \div (0.9 + 0.1 \times \frac{H}{HM}) \]

where

- \( G \) = the numerical grade
- \( H \) = the homework grade
- \( HM \) = the maximum homework grade attainable
- \( T(i) \) = the grade on exam number \( i \)
N = number of exams (excluding the final exam)
F = the grade on the final exam
L = the laboratory grade.

Letter grades will be awarded based on the following schedule:
90 to 100 = A
87 to 89 = B+
80 to 86 = B
77 to 79 = C+
70 to 76 = C
60 to 70 = D
less than 60 = F

VI. Policies:

A. Attendance Policy:

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

Chemical/Environmental Engineering Technology Program:
Regular attendance in this course is required. Students who miss the equivalent of 10% of either classroom hours or laboratory may, at the discretion of the instructor, have their course grade dropped by one letter. Students who arrive late for a class after the roll as been called have the responsibility of seeing the instructor after class the change their status from A (absent) to T (tardy).

B. Academic Dishonesty:

In keeping with college-wide policies, the student is expected to adhere to the general rules and regulations relevant to academic and classroom misconduct as outline in the catalog.