APPLIED ANALYTICAL CHEMISTRY W/LAB
CHT 2110

Class Hours: 2.0  Credit Hours: 4.0
Laboratory Hours: 6.0  Date Revised: Fall 2001

NOTE: This course is not designed for transfer credit.

Catalog Course Description:

The principles and practices of quantitative analysis. The laboratory work focuses on techniques associated with a wide variety of analytical methods used in industry, including gravimetric and volumetric methods and instrumental methods such as chromatography and spectroscopy. Course includes two hours of lectures and six hours of laboratory applications per week.

Entry Level Standards:

Students entering this course must have completed one year of college chemistry.

Prerequisite:

CHT 1120

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

Laboratory Notebook

I. Week/Unit/Topic Basis:

*This schedule is a guide and it may vary, depending on class progress.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Statistical Analysis of data</td>
</tr>
<tr>
<td>2</td>
<td>Statistical Analysis of data</td>
</tr>
<tr>
<td>3</td>
<td>Gravimetric analysis</td>
</tr>
<tr>
<td>4</td>
<td>Sampling</td>
</tr>
<tr>
<td>5</td>
<td>Gravimetric analysis</td>
</tr>
<tr>
<td>6</td>
<td>Titrmetric methods of analysis</td>
</tr>
<tr>
<td></td>
<td>Aqueous solutions</td>
</tr>
</tbody>
</table>
II. Course Objectives*:

A. Use statistical analysis methods to evaluate experimental data. I, II, III

B. Follow a written analytical procedure and use the apparatus and technics for gravimetric and volumetric analysis to obtain accurate results. I, II, III, IV

C. Make calculations for gravimetric and volumetric analyses. III

D. Follow a written analytical procedure to calibrate and operate modern analytical instruments to analyze samples accurately. I, II, III, V

E. Demonstrate an understanding of the theory underlying analysis by the common volumetric, gravimetric and instrumental analytical technics. I, II, IV

F. Demonstrate an awareness of the overriding importance of good samples in chemical analysis and demonstrate the methods for obtaining good representative samples and of handling, storing, documenting and securing samples. I, 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, Transitional Strategy, 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. Do library research and prepare a report on a new analytical method and on a new analytical instrument.  
   Communication Outcome, Problem Solving and Decision Making Outcome, Technological Literacy Outcome, Information Literacy Outcome, Active Learning Strategy

4. Participate in laboratory experiments 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

5. Perform laboratory experiments, collect data and keep a research style lab notebook. 
   Communication Outcome, Problem Solving and Decision Making Outcome, Technological Literacy Outcome, Information Literacy Outcome, Active Learning strategy

*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. Use a spreadsheet, calculate standard deviation from a data set.  A
2. Understand the concept of degrees of freedom in statistical calculation.  A
3. Use a spreadsheet calculate mean from a data set.  A
4. Recognize when a data point may be a candidate for rejection.  A
5. Calculate rejection quotient and use it correctly.  A
6. Use the "t" test for comparison of experimental averages.  A
7. Read written analytical procedures and follow steps correctly.  B
8. Demonstrate correct use of an analytical balance.  B
9. Demonstrate mastery of gravimetric techniques by obtaining accurate and precise results in determination of sulfate content in an unknown.  B
10. Demonstrate correct use of burettes and pipettes.  B
11. Demonstrate equipment-cleaning techniques.  B
12. Standardize acids and bases from primary standards.  B
13. Demonstrate mastery of titrimetric techniques by obtaining accurate and precise results in determination of acid or base content of unknowns.  B
14. Make stoichiometric calculations expressing unknowns in different forms, e.g., calcium content expressed either as percent CaO or Ca.  C
15. Calculate normalities of solutions after a series of dilutions using volumetric glassware.  C
16. Calculate concentration in an unknown after following the steps in a titration procedure.  C
17. Follow written procedures to calibrate analytical instruments and equipment.
18. Calculate concentrations from absorbance and transmittance data using Beer's law. D
19. Demonstrate correct technique for analysis using a colorimeter, dual beam spectrophotometer and atomic absorption spectrophotometer. D
20. Demonstrate sample injection procedure for a gas liquid chromatography. D
21. Demonstrate operation of a gas liquid chromatography on an unknown mixture. D
22. Demonstrate an understanding of the theory of analysis of a sample using a gas chromatography with a mass spectrometer detector. E
23. Determine the composition of an unknown mixture using gas liquid chromatography. Use thermal conductivity, flame ionization and mass spectrometer detectors. D
24. Calculate concentration of slightly soluble materials from solubility product constants. E
25. Demonstrate an understanding of filtration and filtrate washing. E
26. Graph the relationship between pH and amount of acid or base added to a solution. E
27. Calculate concentration of a permanganate solution using the standard addition method. E
28. Obtain samples using accepted sampling technics. F
29. Demonstrate good sample handling, storage, and control during analysis of samples. F
30. Describe methods of securing samples to maintain continuity of custody and accountability. F

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

V. Evaluation:

A. Testing Procedures: 50% of grade (lecture)

Half of the course grade will be determined by the laboratory and half by the classroom. Evaluation of classroom work will be based on 3 one-hour exams homework assignments, a comprehensive final exam, and 2 research papers. To encourage homework completion, all homework turned in will be given a grade of A up to 5% of the course grade (see formula below). Exams and papers will comprise 25% of the course grade and the final will comprise 20% of the course grade. There is no provision for missing an exam because of lack of preparedness.

B. Laboratory Expectations: 50% of grade (lab)

Evaluation of laboratory work will be based on the laboratory notebook. The notebook will be maintained in the style of an industrial notebook used for patent purposes. Precision and accuracy of results will determine one-half the laboratory grade, and experimental write-ups will determine one-half of the laboratory grade.

No. Experiment
1 Preparation of Dilute HCl Solutions
2 Preparation of Carbonate-free NaOH
3 Determination of the Acid/base Ratio
Standardization of HCl against Sodium Carbonate
Standardization of NaOH against Potassium Hydrogen Phthalate
The Acid Content of Vinegar
Determination of Magnesium (EDTA titration, ion chromatography and IAP)
Preparation of 0.02M Potassium Permanganate
Standardization of Potassium Permanganate Solution
Determination of Calcium in Limestone
Potentiometric Titration (acid-base)
The Direct Potentiometric Determination of Fluoride Ion (fluoride ion electrode and ion chromatography)
Electrogravimetric Determination of Copper
Determination of Manganese in Steel (UV/visible spectrometer, colorimeter, ICP)
The Determination of Sodium, Potassium and Calcium in Water by Atomic Absorption Spectroscopy (AA, ion chromatography and IAP)
Separation of Nickel and Zinc by Ion Exchange (IAP)
The Gas Chromatographic Determination of Ethanol in Beverages
Determination of the composition of an unknown using Fourier transform infrared spectroscopy.
Determination of the composition of an unknown using Fourier transform infrared spectroscopy.

C. Field Work:

Outside readings and library research will be required in this course. Two research reports will be written.

D. Grading Scale:

The course grade will be calculated using the formula below:

\[ G = 5\times\frac{H}{HM} + (.25\times(\frac{\sum T}{N}) + .20\times F)(.9 + .1\times\frac{H}{HM}) + .5\times L \]

Where:
- \( G \) = the numerical grade
- \( H \) = the homework grade
- \( HM \) = the maximum homework grade attainable
- \( T(i) \) = the grade on exam number \( i \) (Research papers are included in this category.)
- \( N \) = number of exams and research papers (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:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>90 – 100</td>
</tr>
<tr>
<td>B+</td>
<td>87 – 89</td>
</tr>
<tr>
<td>B</td>
<td>80 – 86</td>
</tr>
<tr>
<td>C+</td>
<td>77 – 79</td>
</tr>
<tr>
<td>C</td>
<td>70 – 76</td>
</tr>
<tr>
<td>D</td>
<td>60 – 70</td>
</tr>
<tr>
<td>F</td>
<td>below 60</td>
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</tbody>
</table>
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 (Pellissippi State Tech 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.