CHM 348 - Physical Chemistry Laboratory

2 Credits
Winter 2006 – Section 001 CRN 10599

Instructor: John V. Seeley            E-mail: seeley@oakland.edu
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Office Hours: By Appointment           Class Location: HHS 344
Class Time: TR 2:15-5:55 PM

Catalog Description:
Experiments in thermodynamics, kinetics, phase equilibria, and advanced spectroscopy with emphasis on mathematical treatment of experimental data. This class satisfies the General Education requirements for writing intensive in the major.

Course Prerequisites: CHM 220, 325, and 342 or 343.

General Course Overview:
CHM 348 is a laboratory course where physical quantities and molecular properties are determined using a variety of experimental and theoretical techniques. It is assumed that each student has a solid general chemistry background, has taken courses in computational chemistry and analytical chemistry, and completed at least one physical chemistry course. Students will be evaluated primarily on the quality of their reports describing the experiments. The experiments will examine important topics in physical chemistry including chemical thermodynamics, chemical kinetics, spectroscopy, and quantum chemistry.
Course Objectives:
- Students will increase their understanding of physical chemistry concepts through the preparation, execution, and analysis of laboratory experiments.
- Students will become proficient in writing reports that adhere to a standard format within the scientific community.
- Students will master the use of modern software packages for efficiently converting experimental data into useful results.
- Students will gain experience in constructing simple experimental apparatuses.
- Students will become proficient in estimating the uncertainty of results determined from one or more experimentally measured quantities

Cross-Cutting Capacities and/or Knowledge Exploration Areas:
- Effective communication

Required Text:
“Experiments In Physical Chemistry”
Authors: Carl W Garland, Joseph W Nibler, David P Shoemaker
Publisher: McGraw-Hill Science/Engineering/Math
7th edition
ISBN: 007231821X
Course Procedures:

Students will complete eight laboratory experiments over the duration of the semester. Students will work in groups with 3 members. Each group will work as a team to complete the laboratory experiment. It is expected that all of the group members will be present when each experiment is being conducted. It is also expected that each group member will be prepared to execute the experiment prior to starting. In other words every group member participates and no free-loading. If you are cursed with a free-loading lab partner, tell the instructor. It is also important that the equipment is not harmed and that safe laboratory practices are followed: Thus, it is imperative that each student understands the what's, why's, and what-if's of their actions. The instructor will demonstrate the proper use of each instrument and will also be glad to help answer any questions. It is expected that each student will adhere to the practices outlined in the "Undergraduate Laboratory Safety Manual".

After each lab is completed, each group member will prepare their own lab report. Group members are expected to analyze their data independently - copying text, spreadsheets, graphs, etc. are all forbidden. However, you can (and should) compare your calculated results with your partners prior to handing the labs in. This is a great way to catch small and large errors.

Grade Determination:
Grades will be based on laboratory reports handed in after each experiment, a 100 point mid-term exam, and a 100 point final exam. The reports will count for 100 points each. There will be 8 experiments. Thus, your written reports will count for 80% of your final grade.

The laboratory reports will be judged on their content, clarity, and the accuracy of the final results. Additional information on the requirements for reports is found in a subsequent section of this syllabus. The reports are due approximately 2
weeks after the laboratory experiment is begun. The exact due date is shown later in this syllabus. 50% will be taken off if the report is handed in late. **Any report that is more than two weeks late will receive no credit.** Confused and/or uncertain students are encouraged to review rough drafts of their reports with the instructor several days prior to the due date. The first report will be graded by the instructor. The students will be allowed to revise the first report for a re-grade.

Final grades will be determined by the percentage of points accumulated by the student. A final percentage of 90% or greater will be given a final grade of 4.0. A final percentage 45% will be given a grade of 1.0. A student earning less than 45% of the possible points will receive a 0.0. All percentages between 90% and 45% will be given a linearly interpolated numerical grade between a 4.0 and 1.0 (e.g., a student obtaining 75% of the points will receive a 3.0).

**Make-up Exams or Deadline Extensions:** Make-up exams or deadline extensions will only be granted for students who have experienced extreme circumstances and notified the instructor within 24 hours of the missed exam or deadline. If the instructor is not notified within 24 hours of a missed exam, then the student will automatically receive a score of 0 for the exam.

**Closing of the University:** In the event that the University closes on a day when class is held forcing the class to be cancelled, the scheduled events for the cancelled class day will be conducted on the next meeting.

**Academic Conduct Policy:** Cheating on examinations, plagiarism, falsifying reports/records, and unauthorized collaboration, access, or modifying of computer programs are considered serious breaches of proper academic conduct. It is the student’s responsibility to consult the instructor if uncertainty exists on what may or may not be deemed misconduct. The Oakland University policy on academic conduct will be strictly followed with no exceptions. See
catalog under Academic Policies and Procedures. Students found guilty of academic misconduct by the Academic Conduct Committee will receive a course grade of 0.0.

**Add/Drops:** The University add/drop policy will be explicitly followed. It is the student’s responsibility to be aware of the University deadline dates for dropping the course.

**Special Considerations:** Students with disabilities who may require special considerations should make an appointment with campus Disability Support Services. Students should also bring their needs to the attention of the instructor as soon as possible.

**Scheduled Experiments:**

**First Rotation**
- Exp. 6: Heats of Combustion
- Exp. 13: Vapor Pressure of a Pure Liquid
- Exp. 17: Conductance
- Exp. 19: Activity Coefficients from EMF Measurements

**Second Rotation**
- Exp. 21: NMR of a Reversible Hydrolysis Reaction
- Exp. 37: Vibrational Rotational Spectrum
- Exp. 41: Electron Spin Resonance Spectroscopy
- Exp. A: Ab Initio Calculation of Molecular Energies

**Exams (2 hour length - Cumulative)**
- Midterm: February 23
- Final: Tuesday April 23 3:30 pm
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<tr>
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<tr>
<td>Jan 5</td>
<td>First Day of Class</td>
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<tr>
<td>Jan 10</td>
<td>Begin First Exp. Of Rot. 1</td>
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<td>Jan 12</td>
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<td>Jan 17</td>
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<td>Jan 19</td>
<td>Begin Second Exp. Of Rot. 1, Report 1 Due</td>
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<td>Jan 24</td>
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<td>Jan 31</td>
<td>Begin Third Exp. Of Rot. 1, Report 2 Due</td>
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<td>Feb 2</td>
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<td>Feb 7</td>
<td>Begin Fourth Exp. Of Rot. 1, Report 3 Due</td>
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<td>Feb 14</td>
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<td>Feb 21</td>
<td>Mid-term Review Session, Report 4 Due</td>
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<td>Feb 28</td>
<td>Spring Break</td>
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<td>March 2</td>
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<td>March 7</td>
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<td>March 14</td>
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<td>March 16</td>
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<td>March 23</td>
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<td>March 28</td>
<td>Begin Third Exp. Of Rot. 2, Report 6 Due</td>
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<td>March 30</td>
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<td>April 4</td>
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<td>April 6</td>
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<td>April 11</td>
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<td>April 13</td>
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<td>April 18</td>
<td>Review Session for Final, Report 8 Due</td>
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<td>April 25</td>
<td>Tuesday 3:30 – final exam</td>
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Import Information Regarding the Reports

The reports should be written at a level that would allow a physical chemistry student to understand the goals of the experiment, what you actually did, how you analyzed your data, and your final results. Enough information should be given so that all of your calculations can be verified. The reports should include the following:

Abstract: The goal of an abstract is to provide a summary of the entire project. So a paragraph or two describing the goal of the analysis, the experimental approach used, the final result, and a qualitative statement of the agreement of the result with any literature values is normally sufficient.

Introduction: A brief description (1-2 pages) of the theory behind the experiment and the logic of the experimental approach. After reading your introduction I should know in general what you are going to do, why you are going to do it, and how you intend to analyze the results. You should not just paraphrase the textbook.

Experimental: A concise description of what was done. If a procedure in a book, hand-out, or article was followed exactly then a simple reference is sufficient; however, any alterations should be noted.

Results: Tables and graphs of pertinent data, sample calculations, and final numerical result. Formulas used should be written out (by hand is OK). Enough information should be presented to allow the instructor to check the validity of your calculations.

Discussion: A few paragraphs describing the final results and comparing the results to literature values.

References: Complete references to any source cited in the report
Name: ____________________________________
Experiment: ______
Score: ______

__ Report turned in on time
__ Experiment Completed (25 pts)

Abstract
__ Adequate summary of experimental goals, approach, and results (5 pts)

Introduction
__ Sufficient background material provided (5 pts)
__ Demonstration of an understanding of the experimental design (5 pts)

Experimental
__ Adequate information provided to repeat the experiment (5 pts)

Results
__ Raw data presented properly (5 pts)
__ Example calculations shown (5 pts)
__ Data analyzed correctly (10 pts)

Discussion
__ Answer reported properly (5 pts)
__ Appropriate comparison to the literature values (5 pts)
__ Appropriate systematic error analysis (5 pts)

Random Error Analysis
__ Correct equations (5 pts)
__ Correct result (5 pts)

General
__ Acceptable grammar (5 pts)
__ Adequate and proper references (5 pts)