CHM 348 – Physical Chemistry Laboratory  
Winter 2006 – Section 001 CRN 10599

Instructor: Joel W. Russell  
E-mail: Use WebCT email  
Office: 244 SEB  
Office Phone: (248) 370-2086  
Office Hours: By Appointment  
Class Location: 290 SEB  
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 intensive writing in the major.

Course Prerequisites:  
CHM 220 – Introduction to Computational Chemistry  
CHM 325 – Analytical Chemistry  
CHM 342 – Physical Chemistry I  
or  
CHM 343 – Physical Chemistry II

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 has 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, 7th Edition
Carl W. Garland, Joseph W. Nibler, and David P. Shoemaker
McGraw-Hill
ISBN: 007231821X

Course Procedures:
Students will complete eight laboratory experiments over the duration of the semester. Students will work in groups with three or four 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 with 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 all students 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 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.”

All experimental data must be entered in ink directly into a bound notebook. The notebook is a repository of original data. It is not expected to be a report nor is it expected to be correction free. If data is corrected, a single line should be drawn through the incorrect value and the corrected value written next to the original entry. Laboratory notebooks will be checked periodically by the instructor who will assess the completeness of recorded data and the understanding of the experiment by the student. The notebook should record all changes in procedures from those outlined in the textbook. All experimental data should include an estimate of its error. If data is recorded in tabular form, error estimates need be shown for subsequent entries only if they change.

After each lab is completed, each group member will prepare his/her 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 submitting your reports. This is a great way to catch small and large errors.

Grade Determination:
Grades will be based on laboratory reports submitted after each experiment, a 100 point mid-term exam, and a 100 point final exam. The reports will count for 100 points each. (See the grading sheet at the end of this syllabus.) With eight experiments the laboratory reports count as 80% of your final grade.

The laboratory reports will be judged on the content, clarity, and 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 two weeks after each laboratory experiment is
begun. The exact due dates are shown later in this syllabus. A report submitted one lab period late will receive a 25% score reduction. A report submitted two to four lab periods late will receive a 50% score reduction. **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 laboratory report will be returned by the instructor within a week of its due date. This first report may be revised and submitted within one week for a re-grade. All subsequent reports will be graded only once.

Final grades will be determined by total points accumulated from all laboratory reports and the two exams. The following grade scale will be used with linear interpolation between these points.

<table>
<thead>
<tr>
<th>Total Points</th>
<th>&gt;720</th>
<th>660</th>
<th>600</th>
<th>540</th>
<th>480</th>
<th>420</th>
<th>360</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Grade</td>
<td>4.0</td>
<td>3.5</td>
<td>3.0</td>
<td>2.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.0</td>
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**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 with 24 hours of the missed exam or deadline. If the instructor is not notified within 24 hours of a missed exam, the student will automatically receive a zero score for the exam.

**Closing of the University:**

In the event the University closes on a day when class is held forcing the class to be cancelled, the scheduled events for the cancelled class 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 the 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/Drop/Withdraw:**

Due to experiments being conducted by groups of students and the requirement that all students must be present for each experiment, no add slips will be signed after the first experiment begins on Tuesday, January 9. The last day to withdraw from the course without a “W” grade and with a 100% tuition refund is Thursday, January 18. The last day to withdraw from the course with a “W” grade is Thursday, March 15.

**Special Considerations:**

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

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

**Second Rotation**
- Exp. 37 – Vibrational-Rotational Spectra of HCl and DCl
- Exp. 41 – Electron Spin Resonance Spectroscopy
- Exp. A – Kinetic Study of Reduction of Methylene Blue by Ascorbic Acid
- Exp. B – Ab Initio Calculation of Molecular Energies

**Exams (2 hour length)**
- Midterm – Thursday, February 22, 2:15-4:15 PM
- Final – Friday, April 20, 3:30-5:30 PM

**Course Calendar**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>Introduction to course</td>
</tr>
<tr>
<td>1/9</td>
<td>Begin 1st Exp. of 1st Rot.</td>
</tr>
<tr>
<td>1/11</td>
<td>Cont. 1st Exp. of 1st Rot.</td>
</tr>
<tr>
<td>1/16</td>
<td>Cont. 1st Exp. of 1st Rot.</td>
</tr>
<tr>
<td>1/18</td>
<td>Begin 2nd Exp. of 1st Rot. Report 1 Due</td>
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<tr>
<td>1/23</td>
<td>Cont. 2nd Exp. of 1st Rot.</td>
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<tr>
<td>1/30</td>
<td>Begin 3rd Exp. of 1st Rot. Report 2 Due</td>
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<tr>
<td>2/6</td>
<td>Cont. 3rd Exp. of 1st Rot.</td>
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<tr>
<td>2/8</td>
<td>Begin 4th Exp. of 1st Rot. Report 3 Due</td>
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<tr>
<td>2/13</td>
<td>Cont. 4th Exp. of 1st Rot.</td>
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<td>2/20</td>
<td>Midterm Review Report 4 Due</td>
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<td>2/22</td>
<td>Midterm Exam</td>
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<tr>
<td>3/6</td>
<td>Begin 1st Exp. of 2nd Rot.</td>
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<tr>
<td>3/8</td>
<td>Cont. 1st Exp. of 2nd Rot.</td>
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<tr>
<td>3/13</td>
<td>Cont. 1st Exp. of 2nd Rot.</td>
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<tr>
<td>3/15</td>
<td>Begin 2nd Exp. of 2nd Rot. Report 5 Due</td>
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<tr>
<td>3/20</td>
<td>Cont. 2nd Exp. of 2nd Rot.</td>
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<tr>
<td>3/27</td>
<td>Begin 3rd Exp. of 2nd Rot. Report 6 Due</td>
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<tr>
<td>4/3</td>
<td>Cont. 3rd Exp. of 2nd Rot.</td>
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<tr>
<td>4/5</td>
<td>Begin 4th Exp. of 2nd Rot. Report 7 Due</td>
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<tr>
<td>4/10</td>
<td>Cont. 4th Exp. of 2nd Rot.</td>
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<tr>
<td>4/12</td>
<td>Continue 4th Exp. of 2nd Rot.</td>
</tr>
<tr>
<td>4/17</td>
<td>Final Review Report 8 Due</td>
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<tr>
<td>4/20</td>
<td>FRIDAY Final Exam 3:30-5:30</td>
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Report 4 and Report 8 will be accepted with 25 % penalties at the midterm and final exam respectively. These reports may not be subsequently submitted for a 50 % penalty.
Important 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. A paragraph or two describing the goal of the experiment, the experimental approach used, the final results, and a qualitative statement of the agreement of the results with any literature values is normally sufficient.

Introduction: Provide 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 terms 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 alternations should be noted.

Results: This section should include tables and graphs of pertinent data, sample calculations, and final numerical results. 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: Provide a few paragraphs describing the final results and comparing the results to literature values.

References: Complete references to any source cited in the report are required.

A copy of the grading sheet the instructor will use is shown on the next page.
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 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.)