Course Outline and Goals

Physical Chemistry II course 50:160:348 is designed as an introduction to the principles of Experimental Physical Chemistry that includes Thermodynamics and Chemical Kinetics.

The specific goals of this course are to:
1. convey the enjoyment of Experimental Physical Chemistry, and the satisfaction to be obtained from doing quality experimental work in Chemistry;
2. deliver practical hands-on working experience in major experimental methods and equipment used in chemical thermodynamics, kinetics, and spectroscopy;
3. provide training on computer-assisted acquisition of data generated during the physicochemical experiment;
4. teach the methods of data collection, modern instrumentation, processing of raw experimental data, and error analysis;
5. provide opportunities to exercise and improve scientific writing via Lab Reports;
6. foster critical analytic thinking and logical reasoning skills that are of a great value in your future work in other advanced courses, graduate or medical school, industrial laboratory or business profession.

Access to Course Materials

A Sakai course site has been created for this course. The course materials will be uploaded as needed. All students must have a Rutgers email address (RU Net ID) in order to access Sakai at https://sakai.rutgers.edu. New email accounts may require 24-48 hours before Sakai courses are
activated. The primary information about the experiments will be posted on Sakai. Students are expected to be able to retrieve the additional information as needed from the Internet sources, texts from the other courses, and the library.

**Attendance**

Attendance of the Labs is strictly required according to the current rotation schedule, and the Sign-up Sheets will be provided during each Lab. The absence during the scheduled lab will be excused for the following documented reasons: 1) serious illness with doctor’s note; 2) an order from the US Military; 3) officially representing the College; 4) death in the immediate family. If unable to attend due to the legitimate reason, please let me know by email before the Lab, so that the make-up Lab can be arranged. No separate make-up labs will be arranged, other than the available Wednesdays during the given Section. *Rutgers severe weather policy*, if announced before the start of the Lab, leads to cancellation of the Lab.

**Work Groups and Rotating Schedule**

Students will be divided into work groups of 2-4 on the first day of labs. These groups will remain for the duration of the semester. Each group will be conducting the same experiment. Rotating schedule of doing experiments will be established during the first lab of the semester. The rotating schedule will be posted during each Lab in SCI-329. Rotation schedule needs to be updated by the Groups as and if needed.

No experiments may be performed without supervision by the instructor, and no other experiments other than those on rotating schedule are allowed. If the instrument does not work as needed, please promptly notify the Instructor. If an experiment fails for technical reasons, the Lab Report should not be written; instead, the group needs to notify the Instructor and repeat the lab the next Wed, when/if the technical problem is fixed.

**Good Lab Practices and Academic Integrity**

When in doubt about any particular detail of the experiment or data processing, please ask the Instructor. On the other hand, students are expected to have read the posted Protocol of the Lab before they start doing that Lab. If nobody in the given Lab Group knows how to do the scheduled experiment (or “where to start”) at the beginning of the Lab, the group is considered
not prepared, and will not be allowed to start this experiment. Please understand that this policy has to do not just with organization matters, but also with the safety in chemical lab. Then, the group is allowed to make-up the lab next Wed, but such re-scheduling will be made only once. If the whole group is not ready for the experiment for the second time, zero grade will be given to everybody in the group for that Lab, and no further make-up Lab will be allowed.

Scientific and academic misconduct e.g. fabrication of data or copying the old data from members of another group or from students who have taken this course earlier is a serious offence that will not be tolerated. If you have any questions related to this point, please contact the Instructor as soon as possible.

While students from the same group will work together, the individual Lab Notebooks and individual typed Lab Reports will be required. That is, those Lab Notebooks and Lab Reports need to be different and unique for each student: each student needs to keep his/her own notebook records, and the Lab Reports need to be different as well. If two (or more) Lab Reports of the members of the same or different Groups, or major parts of those Reports are identical, this is a copy-paste plagiarism that will not be tolerated. Zero grade will be given to all students with verbatim copy-pasted materials in the Lab Reports. The repeated instances of copy-pasted plagiarism by the same student(s) will be treated according to the Rutgers university academic integrity policy http://academicintegrity.rutgers.edu/integrity.shtml.

Please understand that the high quality scientific writing is one of the major goals of the Higher Education in Sciences, and your scientific writing is one of the major assets you will carry with you when graduating from the University.

**Lab Sections and Labs**

There are tentatively 7 experiments to be performed this semester. Those are split into Section I (Thermodynamics) to be conducted before the Spring Break, and Section II (Kinetics) to be conducted after the Spring Break. Only one group will be able to work on each experiment at a time, following the rotating schedule.
### Table 1. Lab Sections and Major Instruments

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Descriptive Title</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SECTION I</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Mutual Solubilities of Liquids in a Binary Two-Phase System</td>
<td>Water thermostat model RTE-111 from Neslab; Two 10-ml graduated cylinders;</td>
</tr>
<tr>
<td>13</td>
<td>Solid-Liquid Equilibrium in a Binary System</td>
<td>K-Type Thermocouple (TC) probe with mini-TC connector; NI USB-TC01 digital data acquisition board for temperature measurements; Device driver for NI USB-TC01 board; Lab PC with Windows XP</td>
</tr>
<tr>
<td>16</td>
<td>Surface Tension Properties of Liquids</td>
<td>Surface tension apparatus, model 59780-90 from Cole-Parmer; Water thermostat model RTE-111 from Neslab;</td>
</tr>
<tr>
<td>17</td>
<td>Viscosity of Liquids, Part I: Low Viscosities</td>
<td>Oswald viscometer, model 7985 from Ace Glass; timer watch; Water thermostat model RTE-111 from Neslab</td>
</tr>
<tr>
<td><strong>SECTION II</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-1</td>
<td>Kinetics of a Homogeneous Reaction in Solution: pseudo first-order kinetics</td>
<td>UV-Vis spectrophotometer Cary 50 Bio; Lab PC with Windows XP</td>
</tr>
<tr>
<td>20-2</td>
<td>The Kinetics of a Homogeneous Reaction in Solution: simple second-order kinetics</td>
<td>UV-Vis spectrophotometer Cary 50 Bio; Lab PC with Windows XP</td>
</tr>
<tr>
<td>25</td>
<td>Kinetics and Mechanism of a Heterogeneous Reaction: Oxidation of Magnesium by Hydrochloric Acid</td>
<td>Differential pressure transducer model PX137-005DV from Omega Engineering; USB data acquisition board, model USB-6009 from National Instruments; Lab PC with Windows XP</td>
</tr>
</tbody>
</table>

### Software Requirements

For processing data and preparation of Lab Reports, you will be expected to be able to use MS Word, MS Excel, ChemDraw and Scientific Data Analysis Software. The Scientific Data Analysis Software is installed on every PC in the lab room SCI-329. In addition, the installation .exe file of Scientific Data Analysis Software and .pdf file with Instructions are posted on sakai, under the Schedule of the first lab of the semester. The Scientific Data Analysis Software is the plugin to MS Excel that allows linear or non-linear curve fitting, digital differentiation and integration of curves, and other math functions to be performed on the data in Excel worksheet.
Typed Lab Reports

The typed individual Lab Reports will be required from each student for each experiment. There is no length requirement on the Report, but the Report should be more than two and less than 5 pages. The detailed Format for the typed Lab Reports is posted on sakai. These Reports are due two weeks after an experiment is completed. No extension of the deadline will be provided, and zero grade will be given for the Lab that is turned in past due.

Lab Reports are accepted as hardcopies (preferred) or by email. The ways to deliver the hardcopy Lab Reports are:

1. slide it under the door of the Instructor’s office, 306-C Science bldg; it is checked daily.
2. hand it to the Instructor during the Lab, Class or office hours of the Instructor;
3. place it into the mailbox of the Instructor in the secretary’s office (1-st floor of Science bldg.) with the signature of the secretary and the date of submission.

This is the responsibility of the student to ensure that the secretary’s office is open, when the submission needs to be done. Although this office is normally open during normal business days and hours, the Instructor has no control over whether the secretary’s office is open or closed. Ultimately, the best way to ensure that everything is furnished to the Instructor by the deadline is not to postpone the submission until that deadline day, but rather submit the materials few days before that deadline: the earlier, the better.

Lab Notebooks

Each student has to have the own Lab Notebook that is the standard composition notebook with at least 200 pages. The standard laboratory notebook keeping techniques should be followed that are outlined in the document Good Laboratory Practices that is posted on sakai and in the Appendix at the end of this Syllabus. Please become familiar with those recommendations. Specifically, the pages must be numbered, and pages should never be removed from the notebook. This is an upper level course, and the students are supposed to be familiar with the good record keeping practices. If unsure, please see me.

Lab notebooks will be graded twice during the semester: 1) over the Spring Break and 2) at the end of the semester. Deadlines for submission of Lab Notebooks for grading are: 1) for SECTION I: the day of the last Lab before the Spring Break and 2) for SECTION II: the day of
the last Lab in the semester. The graded Lab Notebooks will be returned to the students 1) at the first lab of SECTION II and 2) on demand.

The ways to deliver the Lab Notebooks to the Instructor are:

1. hand the Lab Notebook to the Instructor during the Lab, Class or office hours of the Instructor;
2. place the Lab Notebook into the mailbox of the Instructor in the secretary’s office (1-st floor of Science bldg.) with the signature of the secretary and the date of submission on front cover.

This is the responsibility of the student to ensure that the secretary’s office is open, when submission needs to be done. Although this office is normally open during normal business days and days, the Instructor has no control over whether the secretary’s office is open or closed. Ultimately, the best way to ensure that everything is furnished to the Instructor by the deadline is not to postpone the submission until that deadline day, but rather submit the materials few days before that deadline: the earlier, the better.

**Quizzes**

All students should have a working knowledge of gas laws, basic thermodynamics and basic chemical kinetics. Occasional graded Quizzes on basic concepts in this material of a fundamental importance will be given during the lab time.

**Grading**

- Typed Lab Reports: 84 pts. = 7 x 12 pts.
- Notebooks: 16 pts. = 2 x 8 pts.
- Bonus Quizzes: 10 pts. = 5 x 2 pts.

**Work/Study Ethics and Professional Behavior**

Work/Study Ethics and Professional Behavior [http://studentconduct.rutgers.edu/university-code-of-student-conduct](http://studentconduct.rutgers.edu/university-code-of-student-conduct) are essential for success of your learning and your future professional career. Disruptive behavior of the students during Classes will not be tolerated. Disruptive behavior includes, but not limited to, patterns as on Rutgers website [http://studentaffairs.camden.rutgers.edu/classroomdisruption.html](http://studentaffairs.camden.rutgers.edu/classroomdisruption.html).
The repeated lack of professional attitudes and/or disruptive behavior of the student in the group work setting will result in the loss of up to 20% of the earned points for the whole Lab Course. Rutgers university academic integrity policy: http://academicintegrity.rutgers.edu/integrity.shtml will be enforced.

Disabilities

If you have a disability that may require some modification of seating, testing, or other class or lab procedures, please see me after the Class/Lab or during my office hours to discuss the appropriate modifications. You should also contact the Disabled Student Services of Rutgers Camden, http://campuscenter.camden.rutgers.edu/disabled_services.html

Appendix

Guidelines for keeping Laboratory Notebook

A laboratory notebook should provide a complete description of everything that has been done by a researcher or the student in the laboratory. In a research environment (both academic and corporate), it is essentially a legal document that clearly indicates what a given single investigator has done. Records in the lab notebook should be complete enough to permit anyone with proper training in the same scientific discipline to repeat the work. The following is required in this course, and should serve as a guide to how to maintain a laboratory notebook after you graduate:

1. The notebook should be a bound notebook. Loose leaf binders and spiral notebooks are not permitted. The pages should be permanently bound, and page numbers should be printed (by manufacturer or by the owner using ink) on each page. Pages should never be removed from a notebook. If a page is not to be used, a line should be drawn across the page and an explanation should be written at the bottom explaining the problem.

2. All entries in the lab notebook should be made in ink. Mistakes should not be erased; instead, a single line should be drawn through the error, and the correction placed adjacent to the error. An explanation should be provided on the same page so that there is no ambiguity about why the change was made.
3. The first few pages of the notebook should be used to maintain a Table of Contents. Start the first experiment entry on page 5 or so. Fill in the Table of Contents as you do the experiments.

4. Major sections of the records in the lab notebook should be as follows: 1) Title; 2) Date; 3) Name of the student and lab partners; 4) Purpose of the lab; 5) safety considerations for this specific lab; 6) short Background on the topic (several sentences); 7) detailed description of experimental procedures performed, sketches of any apparatuses used, raw data collected or the folder paths to digital files with data; 8) Calculations; 9) Processed data; 10) Discussion; 11) Conclusions; 12) References; 13) optional Appendix. Appendix may include printouts of digital data.

5. Provide a brief summary of the Purpose of an experiment on the first page of each day's work. If you are doing two or more different experiments on the same day, do not interleave entries for the two experiments on the same page. Instead, keep the two experiments on separate pages. Make sure there is no ambiguity. Use sketches to describe experimental setups used.

6. The notebook should be complete, neat, and well organized. Details may be perfectly clear to you at the moment, but a few months later you may have trouble recalling what exactly and how exactly was done. If in doubt, write more details. Write down everything relevant or significant you observe in the experiment. If an instrument is drifting or behaving in an unusual way, make a note of it with an explanation, if any.

7. Each entry page for an experiment should have the day’s date at the top right corner. Write on one side of a page. As additional pages are used for an experiment, always place the date at the top right corner. Always start a new page for each experiment and each day. Do not crowd too much information onto a page.

8. All information relevant to the experiment should be recorded in the notebook. Loose paper and notes (e.g. from a weighing) should not be used. Take your notebook with you to the balance and record the exact weight immediately. Any information that you think should be on a scrap piece of paper or a paper towel should be entered directly in the lab notebook. All calculations should be clearly written. The notebook is a detailed record of everything you have done. For example, if you have to make up a new solution in the middle of an
experiment, make sure this is perfectly clear and there is no ambiguity in the data where this change was made.

9. All “raw data” should be entered directly into the notebook when practical. Alternatively, the file names and folder paths should be specified for each set of digital data acquired, and those need to be referenced to the experiment conducted. Plots of the data should be entered or sketched in the notebook as the data is being collected. This can help in detecting problems with experimental design. It is normally not a good idea to do an experiment "blind", i.e. without looking at what data is being obtained. Instead, look at the data as it is being collected. At the same time, you must be careful that such information does not bias your observations.

10. Computer data such as graphs should be printed out if possible and attached with tape or staples on the appropriate page of the notebook. Clearly, this is not possible with large data files containing hundreds if not many thousands of data points. The computer file names and the storage location (e.g. hard drive, CD, or DVD name) must be clearly indicated instead. A printout of spectra and scans should be attached whenever possible for clarity.