

**FAIRLEIGH DICKINSON UNIVERSITY**  
TEANECK CAMPUS

**PHYSICAL CHEMISTRY II LAB (CHEM 3244)**  
**(SPRING 2006)**

Instructor: Dr. Arthur R. Murphy Office: DH 4456  
Office Hours: M W F 10:00 AM- 11:00 AM and by appointment  
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Phone: (201)-692-2322  
Day: Wednesday  
Time: 5:25 PM – 8:50 PM  
Rooms: Computer Lab 2nd floor Dickinson Hall,  
Physical Chemistry Lab (fifth floor DH)  
Some experiments in Physics Lab. Becton Hall (Teaneck) and  
computer lab (Room TBA)

**Required text:** None

**Catalog Description:** Physical Chemistry Laboratory II. Laboratory experiments demonstrating fundamental laws, concepts and mathematically derived relationships involving selected physico-chemical properties of matter and energy.  
Corequisites: CHEM3242 Physical Chemistry II.

**Introduction:**

The Physical Chemistry II laboratory experiments are chosen so as to reinforce, augment, and amplify the material that is discussed in the Physical Chemistry II lecture course. Experiments involving the thermodynamics of solutions, phase equilibria, quantum chemistry, spectroscopy, kinetics, electrochemistry will be explored.

**Expectations, Policies, Procedures**

- 1) All cell phones, beepers, and pagers must be turned off during lecture.
- 2) Students are expected to arrive for lab on time so as not to disrupt the proceedings.
- 3) Late Lab reports will not be accepted. Usually, lab reports are usually due two weeks after an experiment is concluded. Exceptions to this rule will be stated in due course.
- 4) All safety procedures must be followed exactly. Details regarding safety will be discussed during the first lab period. No student will be permitted into laboratories wearing shorts, halter-tops, open toed sandals, undershirts, tank tops or any other inappropriate attire. All students must purchase a white laboratory coat that can be used for any Biology or Chemistry class that requires a lab. This rule applies to everyone taking the lab.
- 5) In addition to performing the experiments, students will be expected to become proficient in the use of scientific software packages (e.g. Mathcad )
- 6) Last Day for dropping the course with a grade of "W" is March 31<sup>st</sup>.

**Grading Policy: Lab Reports: %100**

The exact lab report format to be followed will be discussed during the first lab period. Lab reports will be graded on the basis of neatness, thoroughness, adherence to the

required lab report format, as well as on experimental accuracy and precision. A thorough discussion of errors must accompany each lab report.

### **Academic Integrity Policy:**

Each student must submit his or her own laboratory report. Copying of reports in full or in part is strictly forbidden and such cheating will be dealt with harshly. Also note that the sharing of computer files in full or in part is strictly forbidden too.

A copy of the current Fairleigh Dickinson University Academic Integrity Policy is available on FDU's web site.

### **Course Objectives and Outcomes:**

**Objective 1:** To promote proper laboratory practices and report preparation

*Outcome 1.1:* Know location of safety equipment, and be familiar with emergency procedures. Become aware of proper laboratory attire, and understand laboratory etiquette.

*Outcome 1.2:* Understand proper laboratory report format to be used, and grading criteria to be employed.

*Outcome 1.3:* Use Microcomputers to assist in report preparation.

*Outcome 1.4:* Learn/Review limitations associated with data and experimental uncertainties are handled.

**Objective 2:** Become proficient at handling chemicals and using laboratory equipment..

*Outcome 2.1:* Be trained in handling of various chemicals.

*Outcome 2.2:* Be trained in proper use of equipment found in standard Physical Chemistry Laboratories: analytical balances, heating units, accurate thermometers, tensiometers, various spectrophotometers, various electronic and electrochemical devices.

### **Additional Outcomes:**

Students who have successfully completed this course should have reinforced their knowledge of the material covered in the Physical Chemistry II lecture course. Specifically, students should have an understanding of the behavior of both ideal and non-ideal solutions, of the application of quantum chemistry to both molecular structure and spectroscopy, of introductory kinetics and electrochemistry. If time permits students will also receive an introduction to statistical mechanics.

Students who successfully complete this course should have deepened their knowledge of the theoretical material discussed in Physical Chemistry I lecture. The topics discussed are all fundamental, and they should serve as a basis for taking

additional chemistry courses such as Physical Chemistry II , Inorganic Chemistry, Biochemistry etc.

### **Core Competencies**

As part of FDU's "Writing Across the Curriculum" initiative, all students will be required to write formal laboratory reports. Standard English and standard grammar must be employed. Students should use computers (Word Processors, Spreadsheets, MathCad) as much as possible to prepare reports, graphs etc.

### **Teaching Methodologies / Activities**

Laboratory experimentation is, by its nature, a hands-on activity requiring a structured approach to the exploration and analysis of various scientific problems. Students should learn to appreciate how meaningful answers are obtained to these problems. Laboratory experimentation requires that the student pay attention to detail, have the ability to carryout multi-step procedures so as to acquire meaningful data, and also have the ability to analyzed the experimental results by a variety of means. All of these are important attributes in many fields.

In addition to supervising the performance of experiments, your Instructor will use computer and web resources where applicable.

### **Possible Experiments**

Experiments will be chosen from the following list

- Determination of Conventional Entropies
- Determination of Partial Molar volumes
- Determination of  $pK_a$  of a Dye
- Determination of activities (Freezing Point Method)
- Determination of Fugacities
- Determination of a Binary Phase Diagram
- Conductivity Experiment
- Determination of Planck's Constant
- The Franck Hertz Experiment
- Visible Spectra of Cyanine Dyes
- Analysis of Vibrational/Rotational Spectra
- Molecular Mechanics Investigation (Hyperchem)
- Huckel Theory and Applications (MathCad)
- Ab Initio Quantum Methods (Hyperchem)
- Kinetics I Hydrolysis of an ester
- Kinetics II The rate of Inversion of Sucrose
- Powder Diffraction Analysis

During the first lab session, students will be divided into groups, and a weekly schedule of experiment for each group be developed.

### TENTATIVE LABORATORY SCHEDULE

Week #	Date	Experiment
1	Jan. 30	Safety Review. Introduction to the Experiments. Convention Entropies + Fugacities (Computer Experiments)
2	Feb 6	Partial Molar Volume
3	Feb. 13	Activity coefficients
4	Feb. 20	Phase Equilibria or colligative property experiment.
5	Feb. 27	Determination of $pK_a$
6	Mar. 5	Planck's Constant or Frank Hertz experiment.
7	Mar. 12	Cyanine Dye Experiment
8	Mar. 19	Spring Recess
9	Mar. 26	Analysis of Rotational-vibrational Spectra
10	Apr. 2	Molecular Modeling I – Using HyperChem to explore Molecular Mechanics
11	Apr. 9	Molecular Modeling II - Using Mathcad and Hyperchem to explore Huckel Theory and Ab Initio Methods.
12	Apr. 16	Reaction Kinetics I
13	Apr. 23	Kinetics II or Powder Diffraction
14	Apr. 20	TBA
15	May 7	Check-out.