CE 371L - Physical Chemistry Laboratory - Thermodynamics, Dynamics, and the Solid State

Master Syllabus and Sample Syllabus

prepared by

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COURSE DESCRIPTION

This course is designed to be taken concurrently with CE371, Physical Chemistry-Thermodynamics, Dynamics, and the Solid State. The experiments performed complement material studied in CE371. This laboratory requires the use of modern computer platforms and software for data analysis.

Prerequisite: WPE
Corequisite: CE371
This is a Writing Intensive Course

Students Who Need Accommodations:

Students with disabilities who need special accommodations for this class are encouraged to meet with the professor or the appropriate disability service provider on campus as soon as possible. In order to receive accommodations, students must be registered with the appropriate disability service provider on campus as set forth in the Student Handbook and must follow University procedure for self-disclosure, which is stated in the University Guide to Services and Accommodations for Students with Disabilities. Students will not be afforded any special accommodations for academic work completed prior to disclosure of the disability. Students will not be afforded any special accommodations for academic work completed prior to the completion of the documentation process with the appropriate disability service office.

Course Details:

I. Course Goals:
   1. To give the students practical physical chemistry experiences, ones that represent the principles of the discipline and how the discipline is practiced in the twenty first century. The experiments include modern and classical thermodynamics, chemical kinetics, and numerical methods for solving problems of interest to physical chemists.
   2. To fulfill the Writing Intensive Course requirement within the major.

II. Performance Objectives Specific performance objectives will be provided in the instruction sheet for each experiment. Overall, students should be able to perform experiments, do data analysis to determine the physical properties of materials and constants that describe a reaction process, and to write about their work in a grammatically correct professional manner.

III. Methods of Teaching: Since this is a laboratory course there will be no formal lectures. Discussion about the experiment will be personal and group by group at the start of each session.
Students must complete the assigned exercises and experiments in the time allocated including a minimum of 3 hours of productive work outside of scheduled class time. Data collection, data analysis, and data presentation in the form of reports are the three components of the course. All three components must be satisfactorily completed by the students under the supervision of the instructor.

The operation of various instruments, pieces of equipment, and software will be demonstrated by the instructor when necessary; this does not free the students from their obligation to learn about the instruments/software and to prepare to do the assigned work before coming to class. The instructor will be available for consultation during the laboratory session and during regularly scheduled office hours. At the start of each new experiment the instructor will assess student preparedness through an oral or written quiz, review the chemical principles for the experiment and point out any difficulties (and their solutions) that may arise during the course of the experiment. If you are not prepared you will be required to leave the lab until such time as you can demonstrate that you are prepared. Any extra time that you need to complete the assigned work must be made up in your own time. There will be some laboratory exercises that will require students to figure out most of the practical details on their own. These exercises will foster the development of independence and critical thinking in laboratory situations.

The laboratory is a hands on learning situation where group work, collaboration, and collegiality are the norm. Uncivil and rowdy behavior will not be condoned. Loud music is not allowed. Easy listening type music set at low volume will be permitted.

Laboratory reports are due on the assigned day, usually two weeks after completion of the lab but sometimes at the end of the laboratory session. For each week that a report is late the grade will be reduced by one letter regardless of the quality of the report. Physical Chemistry Laboratory has been designated as the Writing Intensive Course for Chemistry Majors. There will be two major written reports required during the semester. These reports must contain original independent written discussion of the experiment in a format that mirrors what would be published in a peer reviewed chemistry journal. First drafts of major reports are due two weeks after completion of the hands-on experimental collection of data.

IV. Writing Intensive Performance Objectives

1. A total of 15 pages of academic/scientific writing distributed as follows:
   a. Two major laboratory reports must be written in the format of a scientific journal article. Each of these reports will contain at least five pages of written text in addition to tables of data and diagrams. Specific instructions on preparation of a laboratory report are give below in section VI.G.5. correct journal citation usage is expected for all references.
   b. Six short laboratory reports. Short laboratory reports include a short introduction, a complete abstract, data analysis, commentary as appropriate to make the report intelligible to a colleague, and written conclusions. Short laboratory reports have from 2-4 pages of written prose.
   c. A laboratory notebook for recording observations.
   d. Full participation in an intercollegiate on-line chemistry conversation on a topic of significance in physical chemistry. Students must demonstrate writing about physical chemistry to students on a distant campus.

2. All writing is to be free of spelling and grammatical errors. Citations should follow proper journal format.

3. Drafts of major laboratory reports are due two weeks after completion of the experiment. These will be reviewed by the instructor and returned to the student for revision prior to
final submission. Final drafts are due two weeks after return of the first draft. The instructor will be available for consultation during the revision process.

4. For full laboratory reports the quality of the written components comprise 30% of the grade of the report. Another 30% is assigned to the data analysis and the final 40% to the quality of laboratory work and preparation prior to the start of the laboratory period. For short laboratory reports the quality of the written components comprise 10% of the grade of the report. Another 50% is assigned to data analysis and the final 40% to the quality of the laboratory work and preparation prior to the start of the laboratory period.

V. Text: There is no official text. Experimental procedures and or notes will be made available at least a week before each experiment. The physical chemistry laboratory has a large number of laboratory texts and materials for students to use before, after, and during the laboratory session. The Mathcad 8.0 Manual will be available in the laboratory for you to refer to as needed.

Class materials and laboratory experimental instructions are drawn from standard texts, laboratory experiments developed at other universities, and the Journal of Chemical Education. A current list of experiments is included in this syllabus in Section VII. The list of experiments is updated yearly with new experiments being added and old ones deleted as equipment becomes available in the department and the instructor has time to explore alternative experiments. Every effort will be made to keep this course as modern as possible to prepare students for careers that depend on chemistry as a major or minor area of concentration for a bachelor degree.

Software for preparing reports and doing data analysis are available in the departmental laboratories. Mathcad, ChemOffice Ultra and Spartan software are available in the physical chemistry and general chemistry laboratories. Excel and Word are available on computers in all University laboratories.

VI. Course Requirements
A. Laboratory Hours. Students are expected to spend a **minimum of three** hours per week in the laboratory collecting and analyzing data. Most experiments can be completed in two afternoons of work or less if you are efficient and well prepared. Some experiments only require using a computer. These experiments should be completed outside of assigned laboratory data collection time. Occasionally solutions for an experiment must be prepared a day ahead in order to complete the experiment as scheduled. It is up to you to read the laboratory instructions sufficiently ahead of time to decide if you need to come in early on the day before to prepare solutions. On those occasions when you may finish an experiment early you are required to spend your time preparing laboratory reports or in the chemistry reading room working on data analysis or the on-line project for the semester. You must sign in and out for every lab session. If I can’t find you, you are absent and will loose points. Serious students with eyes on professional careers do not wander off and chit chat with friends in other laboratories. Serious students do not waste laboratory time in frivolous activities. Laboratory reports are required for each experiment. These reports are prepared, for the most part, on your own time. Be sure to leave enough hours in your schedule to permit preparation of quality reports.

B. Groups. All experiments are done in groups of two or three. Groups of two are the norm.

C. Reports. The laboratory report must be submitted two weeks after completion of the experiment. There are ample opportunities for you to start data analysis in the scheduled laboratory class time. It is a sure sign of inefficiency and poor laboratory discipline when you wait till after school or some other time to initiate and continue work on laboratory reports. The grade on laboratory reports is based on the quality of the results and the clarity and accuracy of the written presentation. The reports should be **brief** but thorough. Reports
that require only data analysis should take no longer than an average physical chemistry homework assignment. If you use every hour of laboratory time efficiently then you should be able to finish the experiment and the report within the allotted time plus only a little extra of your own time. I cannot lower the standards of expected performance because you are unprepared, inefficient, or inadequately motivated to complete your work. For those experiments requiring only a brief laboratory report the major portion of your grade for the work of that day will depend on my observations of your performance, evaluation of your final data, and the final data analysis that you complete for the experiment.

D. **Attendance** is mandatory. There are no make up labs.

E. **End of Lab responsibilities**: Students are required to turn off/clean/put-away all equipment as instructed. Students must "sign out" at the end of each lab session. This means that you tell me that you are done and leaving the laboratory. You are expected to remain in the laboratory for the entire period. You must find other physical chemistry projects, laboratory reports, computer exercises, or manuscript preparation for the on-line project etc. to fill the assigned time if you have completed the experimental work assigned for the day. Do not waste this time. Use this time efficiently.

F. **Notebooks.** Students are required to record all experimental data in a bound laboratory notebook. Before an experimental laboratory session you should determine the type of data you will be collecting and have a plan for the orderly collection and recording of this data in your note book. For computer laboratory experiences you are to save your work on a diskette for use throughout the experiment. This diskette is to be turned in as part of your laboratory report for the computer activity. Make backups of your diskettes.

G. **Grades** on laboratory reports are determined by consideration of:
   1. Compliance with sections A - F above.
   2. Experimental data must be complete and clearly presented. All writing must be in correct scientific format and be free of grammatical errors. Good writing style is important too. Sample calculations must be clearly shown with correct units. All calculated quantities must be compared to literature values. Literature values are available if you look for them. You may use a spreadsheet program or Mathcad to prepare your reports. Mathcad will probably be the better choice as you will increase your skill with this software if you use it regularly.
   3. Participation during the laboratory is essential. Absence from assigned laboratory periods, habitual lateness and crude behavior are unprofessional and will reduce the grade for an experiment or cause you to be fired. **Being fired** means that you may not continue working in the laboratory until you have corrected the situation that caused you to be fired. Part of the grade of a laboratory activity is determined by observation of student behavior during laboratory time. This part of the grade will include student technique, record keeping style, willingness to work through difficult situations, and application of information learned in lecture and in physics or mathematics classes. Physical chemistry cannot be done in a vacuum. The full weight of all previous experience in science and mathematics must be brought to bear on each problem as dictated by the problem. Inability to reason through a textbook description of directions for computation and data analysis indicates a need to improve your skills.
   4. Laboratory reports must be handed in promptly. For each week the report is past due the grade for the report will be reduced by one-half a letter grade.
   5. **Formal laboratory reports** should consist of the following items in the following order:
      a. **Title**: A title is a very brief informative abstract.
      b. **Abstract**: This appears second but **is written last**. It should only consist of a few informative sentences. An abstract is one clear succinct paragraph that summarizes the purpose and principle results of the experiment. (5%)
c. **Introduction**: A brief (approximately one page) discussion of the background, objectives, and approach used in the experiment. Tell me what you are doing, why and how. Remember, lab reports are not review articles. (15%)

d. **Experimental**: A brief description of the experimental method including key materials and techniques required to complete the experiment. (10%)

e. **Data and Results**: Collecting, presenting, and processing data is the most important part of an undergraduate laboratory report. Experimental data and calculated data should be tabulated or graphed and all tables or graphs numbered sequentially in order of the discussion in the body of the report. The contents of the tables and graphs should be explained in good prose and important relationships revealed in the text of the report, usually in the discussion section. All Tables, Graphs and Figures should have captions explaining their contents. Graphs should be clearly labeled. All information must be prepared with word processing software and all graphs must be produced with the appropriate graphing software. Being fired during lab reduces this portion of your grade by 10%. One is fired (dismissed from the laboratory) for serious breaches of conduct or experimental practice. The laboratory is not a social arena. (50%)

f. **Discussion (and conclusions if any)**: This is probably the most difficult section to write. At the minimum, the data must be compared to available literature sources and any discrepancies clearly analyzed. The literature value should be included in the table of results for the report and percent deviation between the experimental and literature values calculated. Appropriate statistical techniques should be applied in all cases. For example, in a linear regression the standard deviation in the slope and the intercept should be computed and reported with the equation for a straight line. Finally, the data should be interpreted chemically. For example, if you were to study the density of a series of liquids, the variation in density for various liquids should be related to their chemical composition. The discussion section would also contain the responses to any questions found in the notes distributed along with the laboratory instructions. (10%)

g. **Quality of Preparation**: Evidence of adequate preparation is shown by answers questions you are asked at the start of the laboratory period. To prepare for lab students should make notes about the experiment in their lab note book before coming to lab. This includes a list of all measured and calculated quantities to be obtained during the lab session. When I check your notebook I should see that you are prepared. (10%)

h. **Brief reports** consist of all data, calculated results, graphs and figures. The report should contain sufficient annotation so that the reader can understand what was done and how the data was analyzed. A full data analysis is required as for formal lab reports. Comparison of experimental values to literature values is also required.

i. The WI requirements are as follows. For full laboratory reports the quality of the written components comprise 30% of the grade of the report. Another 30% is assigned to the data analysis and the final 40% to the quality of laboratory work and preparation prior to the start of the laboratory period. For short laboratory reports the quality of the written components comprise 10% of the grade of the report. Another 50% is assigned to data analysis and the final 40% to the quality of the laboratory work and preparation prior to the start of the laboratory period.

H. All notebooks must be turned in at the end of the semester. A diskette with all of your
spreadsheet or Mathcad work must be turned in at the end of the semester. These items will not be returned. If you want a copy of your computer files then make a backup copy of your diskette. The set of completed laboratory reports and electronic files form a collection of materials for assessment of student progress in the chemistry curriculum.

I. Make back up copies of all your computer files on a second diskette. Leave this second diskette in a locked drawer in the laboratory. Do not use the diskettes from this course in other computers on campus or elsewhere. Do not bring diskettes that you have used elsewhere into the laboratory. This will prevent the spread of computer viruses. If a virus infects a machine or several machines it may destroy the hard disk and all of the software on it will become unusable. It may take a week or more for me or the folks in ITS to correct the problems generated by a computer virus situation. This is your laboratory and the computers are for your use. Take care of them and they will always be available for you when you need them to do your work.

J. Do not loan your diskettes to anyone. Every student is to write their own laboratory reports. You may discuss data analysis as appropriate and share files created in joint collaboration with your laboratory partner. You are ethically responsible for sharing the work load and being sure that each student working in a group understands the data analysis when files are shared.

VI. List of Experiments: The experiments described below are examples of what will be done in the course. The instructor reserves the right to change the required experiments shown here as conditions warrant.

*† Full formal lab reports are required for these experiments. See Section VI.G.5 for the parts of a full report. For full reports, one student's hands in a written report following the full format. The partner then does an oral presentation of the material based on the written report and data collected. The grade is determined by the quality of the writing and the presentation. Students must work together to support each other in order to get an optimum results from their work. Each group of students must do TWO of these experiments. It is prudent to start these early in the semester so that the revision, optimization, and oral presentation can be completed a week before final exam week.

† Short reports are required for these experiments. Only data, graphs, calculations, annotations, and a brief discussion comprise the components of a short report. Some of these experiments are computer experiments that can be done in your own time. These computer experiments require a one to two page essay that provides a summary of the material and concepts learned while completing the computer experiment. Required diskettes showing your work must be included with your essay.

** This experiment will also take time to complete. Each person is to submit a detailed progress report for the experiment assigned to you from the Journal of Chemical Education.

All work must be neatly prepared and typed using a Word and Excel or Mathcad. Mathcad has the nice feature of being able to combine text with mathematical analysis. It has a not so nice feature of producing blocks of black print that can't be read. If this happens you must ask me how to get rid of them and you should give me the diskette for the lab report to read on my computer.

If I can't understand what you have done then your work is unsatisfactory.

1. *† Heat of Ionic Reaction - Use of the Solution Calorimeter - (15)- In this experiment you will measure the heat of reaction between pairs of solutions and use the resulting calculated heats of reaction to compute ΔH for an ionic reaction, Cu^{2+} + 2en → Cu(en)_2^{2+}. You will use Cu(en)
2SO₄ synthesized in the Inorganic Chemistry course or material provided by your instructor. Supplementary notes will be provided for the data collection for the heat of ionic reaction.

2. **Mathcad Tutorial.** (10) A laboratory session dedicated to exploring the features of Mathcad. Emphasis here is to become fluent with a variety of fundamental techniques available in this software so that you can use it for physical chemistry homework and laboratory reports. Documents to use to gain familiarity with the software will be assigned from the set of Mathcad documents available at the New Traditions Mathcad Web site. Specific documents will be assigned before the laboratory period. Students will obtain the required documents from the website. It is expected that students will become functional at the introductory level of using this software and that their skills will increase during the semester as they use the software and work with it for class and laboratory assignments. Students will start this activity in a laboratory period but will complete it as a home work assignment.

3. **Determination of the Heat of Reaction from the Temperature Dependence of the Equilibrium Constant.** (15) In this experiment the solubility product constant for sodium tetraborate is measured as a function of temperature. A plot of ln(K) vs. 1/T yields the ΔH and ΔS for the reaction. This experiment also required that the students do a linear least squares fit of the data to determine the thermodynamic parameters. In addition to doing a linear least squares fit the students must compute the standard deviation for ΔH and ΔS as part of the final data. This gives students an opportunity to explore reasons for rejection of data collected during an experiment. One primary objective here is to learn the fundamentals underlying linear least squares fitting of a straight line to a set of data. A detailed Mathcad document that you can use to learn about least squares linear curve fitting will be provided to you to help you complete the report for this project.

4. **Explorations in Crystallography.** (10) A study of cubic crystal systems and the basic principles of crystallography. Mathcad documents and worksheets will provide students with basic tools and assignments for learning crystallography and interpretation of powder patterns obtained from x-ray studies. Links to modern crystallography will show how this area of research is essential to modern chemistry and biochemistry. This Mathcad exercise will be started in a laboratory session but must be completed as homework.

5. **An Introduction to Computational Chemistry with Spartan.** (10) This is a two week experience with using one of the most important computational chemistry programs available. During the first week you will work through the tutorial to learn the Spartan software. In supplementary notes you will be given a set of questions to answer based on your work with the tutorial. During the second lab period you will perform two of the suggested exercises that are found in the Spartan workbook. Each group of students will choose two different experiments from set I will provide. We will emphasize here exercises that illustrate the close connection between physical chemical principles and organic chemistry or biochemistry topics.

6. **Inversion of Sucrose.** (10) Students will use the departmental polarimeter to study the inversion of sucrose catalyzed by HCl (and chloroacetic acid if time permits). Each group of students will do the experiment at one temperature or groups of students will do the reaction with one acid at two different temperatures. The temperatures are 15, 25, 30 and 40 degrees C depending on the acid used. The data analysis will not follow standard text book methods. We will do the analysis using non-linear curve fitting. This will provide the rate constant directly without linearization of the mathematical function for the kinetic model used in this experiment. This is a more accurate method for obtaining a rate constant. You will be provided with information to create a Mathcad document to complete the non-linear least squares fitting. As a class activity the rate constants obtained at each temperature will permit students to compute the heat of reaction for this reaction. It is important that each group of students complete their data analysis so that all groups can complete their final reports. Mathcad document **FirstNonlin8.mcd** contains an introduction to curve fitting using Mathcad. Mathcad document **SucroseDataAnalysis1.mcd** contains an outline of how to analyze polarimeter data to obtain the pseudo rate constant for the inversion of sucrose catalyzed by acid.
7. **Independent Project.** (15) Students will be required to do one kinetics experiment selected from the Journal of Chemical Education. The students will be responsible for ordering required chemicals, choosing the correct instrument, writing the experimental protocol, collecting data, and completing all calculations. Using LabWorks and Mathcad software make the experiment more valuable as a learning experience. This project is a taste of what is known as experimental design. An integral component of this project is a consideration of how the experiment would be extended as a research project. Students may choose from a list of JCE experiments that will be provided at the beginning of the semester. Each group must do a separate experiment.

8. **On-Line Intercollegiate Cooperative Learning Activity.** During the semester you will be participating in two online intercollegiate cooperative learning activity with some other colleges. You must have a Monmouth email address in order to participate. The online activity assigned to the laboratory will take place in October. The online project that will contribute to your lecture grade will take place in November. This project is worth 15 points toward your laboratory grade. The November online project will count as one exam grade in lecture. Additional information about the projects will be provided in a separate hand out. This project will provide you with the opportunity to write collaboratively with colleagues at a distant campus. You will be expected to describe your work to them and discuss strategies with them about the project.

There are 4 traditional laboratory experiments and 4 computer based laboratory exercises. All 8 must be completed before the end of the semester. The computer based laboratory assignments can be completed during any time that the student chooses in addition to the assigned laboratory hours. Only 3 experiments require full formal laboratory reports. You must start your independent project before the end of the semester in order to complete it by mid November when your first draft of the formal report will be due. Other reports consist of your data, data reduction, results, and a copy of the computer work you completed. The full formal laboratory reports are the reason for requiring the WPE as a prerequisite for the course and for labeling the course as Writing Intensive.

**Semester Agenda**

Students will work through the experiments described above in a systematic way. I suggest that you consider completing experiments at the rate of one every two weeks. I will be able to help you set up one or two laboratory experiments per laboratory session. When I am busy you are required to do things on experiments that you can do alone till I am available. There are sufficient computer exercises for you to practice while waiting for my attention. Two of the experiments labeled with an * require a full laboratory report in proper scientific format. This is part of the intensive writing component of this course. Experiments labeled with a † require only a short report concentrating on properly annotated data analysis and graphs.

**Grading Policy**

The grades in this course are determined by your work during the laboratory period, your ability to function as a practicing professional chemist during the laboratory period, and the reports for each experiment. Based on 100 points the following breakdown holds for this course.

The points for each experiment are noted above. Your grade is determined by the total % according to the scale shown here.
Ethics for Students in Physical Chemistry. (major portions of this section were taken verbatim or adapted, with permission, from the syllabus prepared by Dr. Linda M. Sweeting for her Organic Chemistry course at Towson State University. Most faculty place a statement of this type in their course syllabi.)

In my experience students rarely plan to copy from another on an exam or turn in a copy of someone else’s work as their own. Consequently, I assume that students are honest and responsible in their work unless proved otherwise. This section of the syllabus, in addition to describing attendance policy for class and laboratory, augments statements made above with respect to group work.

ATTENDANCE for class is not optional. Part of your grade is determined by class participation and the way you demonstrate mastery and competence with the course material. Physical chemistry is not a spectator sport. You are expected to be a fully prepared active participant in all class discussions and group work. The schedule of class activities below gives you a bird’s eye view of the course and the schedule for discussion of various topics. It is your responsibility to be prepared and to contribute to class discussions. This is the type of behavior that would be expected from you when you are in professional school or at work as a chemist.

ATTENDANCE is required for all lecture and laboratory periods. Any student arriving late for laboratory may be denied permission to work in the lab or may have points deducted from their laboratory grade for that experiment. Arriving late for lecture will result in a 50% reduction in your class participation score.

ABSENCES: Students who are ill (or whatever) and cannot take a test may be given a makeup exam at the discretion of the instructor. Laboratory work must be made up on your own time and in consultation with your lab partner(s). In any case, for a missed exam you must a) inform me of the reason for your absence and b) supply a note from the doctor, mechanic, etc. attesting to these reasons before being considered for a makeup exam. Forgery of such documentation is equivalent to cheating on the exam. Make up exams are a privilege, not a right: they will be given only if a mutually satisfactory scheduling can be arranged. The make up exams will be more difficult than the original exam that everyone else took at the scheduled time.

HONESTY IN WRITING AND CLASS WORK. Any work copied from a book or journal or another student without reference will be considered plagiarized and no credit will be given for the work. Please remember this when you are writing lab reports and answering questions in the guided reading notes distributed during the semester. Although consultation between students in solving problems is highly encouraged, identical solutions will be considered plagiarized and will be given no credit. Be sure to work out the entire problem in your own hand and understand each part so that you can present it in class if called to do so. If others helped you solve problems or worked with you to do Mathcad documents then they deserve credit too. Please be sure that all group work includes the names of each member of the working group. It is important that each member of a working group fully understand the concepts and methods used in solving a problem or designing a document. Every member of a group will receive the same grade on assigned group projects. You will have individual evaluation of your skills on exams. After completion of group work every member of the group should be able to perform successfully and independently on a similar activity.
Remember that group work is not a bunch of folks watching another person work. Usually only 2 people can work together effectively at a computer to develop a solution to a problem. Larger groups can work together to polish a completed project.

Plagiarism on exams is not permitted. Anything you hand in as part of an exam question must be your own work. Copying work from former students and claiming it as your own is cheating. Using old lab reports, inventing laboratory data, copying solutions to problems from the folios of former students will result in an F for the course. As you know without honesty, there is no science. The foundation of science is the honest reporting of results in a way that others can reproduce them. Adequate citation of sources of information is imperative.

After all who is hurt by cheating or using the work of others in an inappropriate and unethical way? The students who did not succumb to this type of behavior, because they worked hard and actually learned something and yet the usurper gets the same grade without learning. Even with absolute standards, i.e. grading on an absolute scale, the one who takes academic short cuts hurts you, because his or her action reduces the value of your grade and degree. And the person who was unethical could very well take your job or your slot in professional school on the basis of that grade. Or worse yet, that person could go on to misrepresent facts on a research project examining the safety and efficacy of a new drug, killing people as a result. No one wins when unethical behavior is tolerated.

I want this class to be as open and free as possible to promote the fullest level of learning that can be achieved through team work as a learning community. This is best achieved when we are working toward a common goal with high standards of behavior and mutual respect. During the semester we can explore the implications and limits of the role of ethics in cooperative work for learning a subject. Here in this small class we are more like a graduate research group and mutual respect and acknowledgment of the strengths of each individual become important. It is through the strength of a group that we can accomplish more than any of us can accomplish alone. It is like we are a team of chess or racket ball players. We practice together and build each other’s strengths and share strategies for winning but ultimately we compete alone. In the world of work and research the work we do alone brings strength to the group to accomplish complex objectives. The group benefits from the strength and skill of each individual. Individual members of the group may need to compete for contracts or present research at meetings. The success and prestige of the group depends on both the performance of the group as a whole and the performance of individual members of the group. In this course we will work to build both kinds of strength, individual performance and group excellence.

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