

**HARVEY
MUDD
COLLEGE**

To: Senior Research Students
From: Professor Van Ryswyk
Date: March 2009
Subject: Senior Research Instructions and Dates

A chemistry major must satisfactorily complete 4 to 6 credit hours of Chemistry 151-152. A student electing to major through the Joint Major in Chemistry and Biology must satisfactorily complete 6 credit hours of Chemistry 151-2 or Biology 193-4.

Read the attached instructions and outline for Chemistry 151-152 and note especially the deadlines for the first semester report (December 18, 2009) and date of submission of the first draft of your thesis (April 9, 2010).

Retain this document for reference during the year. A copy of this document will be available at:

www.hmc.edu/academicsclinicresearch/academicdepartments/chemistry1.html

Turn in the final page of this document, properly filled in, to Kim Young in the Chemistry department office in order to confirm your research mentor.

If you choose to enroll in Biology 193-4, be sure to obtain the relevant guidelines concerning deadlines, reports, drafts, and final copies from the Biology Department.

OUTLINE OF CHEMISTRY 151-152 SENIOR RESEARCH FALL 2009/SPRING 2010

The courses that you have taken in chemistry and other fields provide you with most of the basic concepts and tools necessary to begin an independent research study. Such a study gives you an opportunity to review, transfer, and apply many of the things you have learned. It also provides a unique opportunity to learn a great deal about an area of chemistry of your choice — the kinds of problems that are current in the area and how those problems are approached. Perhaps of greatest importance, a research course gives you a chance to learn more about yourself, particularly how you function in a less structured academic endeavor and some ideas about the kind of chemistry that you like to do. If you have general questions concerning why or how research is conducted, please discuss these matters with members of the chemistry faculty.

1. The following is an outline that provides some advice, some guidelines, and some deadlines that are associated with the course. Senior research is an academic course. The lack of weekly “homework” does not mean that the course requires minimum effort. One unit credit for research is equivalent to four hours per week spent on the project (laboratory, library, writing). If there is any key to success, it is well-planned regular effort. Sporadic effort rarely leads to good over-all performance. Your research advisor will encourage strongly, perhaps demand, regular appearance in the laboratory. It is useful to maintain a log of the time that you actually spend working on your research problem. Remember, you need to plan your activities ahead of time to be effective in the laboratory.

2. The scheduling of your senior research time is not something to be left to chance. If you are planning on taking 3 units of research in the fall, your schedule should have 12 hours of time blocked out for these 3 units. Do not plan on “fitting your research in between your other classes.” Your overall experience (and your grade) will suffer if you do that. For example, one student might plan to have two 4-hour blocks for experimental work on Monday and Thursday afternoons, along with two 2-hour blocks for library work and spectral analysis on Tuesday and Thursday mornings. Another student may be signing up for 2 units, and they have four 2-hour blocks set up for coding, job submission, and results analysis on Monday, Tuesday, Wednesday, and Thursday afternoons. Since this schedule is most certainly a function of what you are doing for research and whom you are working with for Chemistry 151-152, you need to consult with your faculty mentor before settling on a class schedule for each semester. Failure to do this may compromise your ability to complete Chemistry 151-152 in a satisfactory fashion.

3. A portion of Chemistry 151-152 is devoted to learning about the chemical literature. Two sessions at the beginning of the fall semester will provide you with the basic tools to help you get started on your research problem (see item 3 below). **These sessions will be held at 11 am on the first and second Tuesdays of the fall semester, September 1, 2009 and September 8, 2009.**

4. In September, students in the course will be asked to present brief (ten minute) talks. In this talk you should define your research problem, suggest the method of attack on the problem, and suggest what results might be expected. (This talk should be based on discussions with your instructor and on your own literature review.)

5. You will be required to submit a draft of the introduction to your thesis and an experimental progress report by 5:00 p.m. Friday, December 18, 2009. Both the thesis introduction and progress report are important and useful. They provide you with a gauge of your progress and an

opportunity to think seriously about the writing of a thesis. Keep in mind that time will be at a premium as the year draws to a close, and plan to work on both the thesis introduction and the experimental progress report throughout the semester. Ideally, a draft of an introduction to your thesis will include a clear statement of the objectives of your project, a rationale for why the project is of interest, a comprehensive survey of the literature (including properly cited references) to establish the background for the project and detail the scope of earlier and/or related investigations, and an outline of the approach to be used for experimentation and analysis. The experimental progress report should not only review progress to date but also outline the proposed investigations for the spring semester. The progress report may serve as a draft for the experimental section of your thesis with detailed descriptions of reagents, procedures, instrumentation, techniques, etc. Please note that both the draft thesis introduction and the experimental progress report are required. Enrollment in the second semester is contingent on submission of these items.

6. A single letter grade appears on the transcript for Chemistry 151-152 and is assigned after the completion of the spring semester. You will receive a grade of “N” at the end of the fall semester, which is a placeholder for the grade that will be inserted at the end of the spring semester. Your instructor will begin forming an assessment of your performance during the fall, so your performance during this period is important. The final grade will reflect such factors as: (1) your effort and progress on the project (particularly in light of the number of research units in which you are enrolled), (2) an evaluation of your department presentation to introduce the project, (3) an evaluation of your final presentation during Presentation Days, (4) the quality of your introduction draft and experimental progress report, submitted in December, and (5) the quality of your final thesis. If you have questions about your performance you should consult with your advisor. A strong performance in Chemistry 151-152 requires continued dedication to and active involvement in the research project throughout the entire academic year.

By the start of the Spring semester, your thesis adviser will provide you with an appraisal of your Fall research activities, including a letter grade that will reflect such factors as: (1) your effort and progress on the project (particularly in light of the number of research units in which you are enrolled), (2) an evaluation of your departmental presentation to introduce the project, and (3) the quality of your thesis introduction draft and experimental progress report. A strong performance in Chemistry 151-152 requires continued dedication to and active involvement in the research project throughout the entire academic year. In addition, all aspects of the research investigation - experimentation, analysis, literature review, oral and written communication - are considered in awarding grades.

7. The last day for experimental work for thesis presentation is Friday, April 2, 2010. A draft of your thesis must be presented to your supervisor by April 9, 2010. Failure to meet this and the subsequent deadlines may prevent your graduation. (Note that most advisors will be pleased if you want to do additional experimental work — after you have finished your thesis.)

8. You will be required to present a short (20 minute) seminar summarizing the nature of your research and your results. It is important that you plan this presentation carefully and rehearse your presentation at least once in the presence of your research supervisor. These presentations are tentatively scheduled for May 3 to May 5, 2010. The actual date will be announced.

9. Three final sets of the thesis (the original and two clean photocopies) are to be submitted by 5 p.m., Friday, April 23, 2010. The original should be submitted to your supervisor, and the two

copies should be turned into the departmental office (Jacobs 1209), **complete with signature and unbound**, to Kim Young.

10. The draft introduction, experimental summary, and final thesis should be prepared as technical documents according to ACS guidelines. Consult *The ACS Style Guide*, 2nd edition (American Chemical Society, 1997) for general guidelines on writing a scientific paper (Chapter 1), for the correct formatting for numerical references (Chapter 6), for guidance on the preparation of chemical structures, figures, and tables (Chapter 9), for conventions and usage of numbers and units (Chapter 5), and for other conventions in chemistry (Chapter 8).

The following details concerning the preparation of a thesis should be noted carefully.

- a. Theses should be printed on good quality paper. Only good quality photocopied material is acceptable.
- b. Drawings and figures are to be on separate pages with complete captions, and numbered sequentially.
- c. Photocopies of drawings and/or figures taken from literature or your research data are acceptable. They should be on separate pages. Do not cut and paste a photocopy on the typed text page. Further, prepare the photocopy so that the copy is clean; no background lines should be seen.
- d. Elaborate reaction schemes or kinetic pathways should also be separate pages as figures.
- e. References should be numbered sequentially and presented at the end of the thesis. Consult with your research advisor about style.
- f. The thesis should be organized as follows:
 1. Title page (example attached - format)
 2. Abstract - on separate page
 3. Introduction
 4. Experimental (if applicable)
 5. Results/discussion
 6. Conclusions and suggestions for future work
 7. Acknowledgments
 8. References
 9. Appendices
- g. Remember, three sets (one original and two copies) of the thesis are to be submitted. The expense of thesis preparation is to be borne by the student. Do not bind thesis unless requested by advisor.
- h. Both good and poor examples of theses can be found in the Chemistry Conference Room.

Timetable: Senior Research

1. Tues., Sept. 3, 2009 First meeting of chemical literature portion of course at 11 am.
2. Tues., Sept. 8, 2009 Second meeting of chemical literature portion of course at 11 am.
3. Fri., Sept. 18, 2009 Introduction to research problem, a 10 minute talk presented by student, by this date. Actual date TBA in fall.
4. Fri., Dec. 18, 2009 First semester progress report due to thesis advisor.
5. Fri., April 2, 2010 Last day for experimental work on thesis problem.
6. Fri., April 9, 2010 First draft of thesis given to advisor. Returned to student with comments by Monday, April 12, 2010.
7. Fri., April 16, 2010 Revised draft of thesis given to advisor. Returned to student with comments by Monday, April 19, 2010.
8. Fri., April 23, 2010 Final copies of thesis are due by 5 p.m.
9. May 3–May 5, 2010 Research Presentation - 20 minute talks to be presented by students.
10. Sun., May 16, 2010 Graduation!!

DEPARTMENTAL HONORS in chemistry are given to students showing outstanding professional promise as evidence by performance in research, active participation in courses and other departmental activities*, and interest above and beyond the requirements for graduation. Graduation with distinction is awarded by the College Faculty solely on attainment of a fixed GPA--see the catalog. *teaching assistant in laboratory and grader for chemistry courses; tutoring in chemistry (Academic Excellence); other activities.

**PRESSURE STUDIES OF THE AZEOTROPIC COMPOSITION
OF ETHANOL-WATER**

by John Jones

Harvey Mudd College
Claremont, California

Dr. G. W. Rhesus, Research Director

23 April, 2010

Accepted by the Department of Chemistry in partial fulfillment of the requirements
for the Bachelor of Science degree.

Research Advisor

**Chemistry 151-152 Enrollment Form
2009/2010**

Student Name: _____

I have discussed senior research opportunities with various faculty and have selected the following individual to mentor my activities:

Faculty Member Name: _____

Faculty Member Institution: _____

Department: _____

Student Signature: _____

Faculty Member Signature: _____

Please turn this document in to Kim Young
in the Chemistry Department Office, Jacobs 1209