CHM 1488: CURRENT DIRECTIONS IN EXPERIMENTAL PHYSICAL CHEMISTRY
Winter 2022 Course Syllabus

I TEACHING TEAM

INSTRUCTOR (Weeks 1 – 4 and weeks 9 - END)
Name: Professor Al-Amin Dhirani
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Online student hours: by appointment

INSTRUCTOR (Weeks 5 – 8 and weeks 9 - END)
Name: Professor Cynthia Goh
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Research: http://www.gohlab.com/
Online student hours: by appointment

II COURSE OVERVIEW

Welcome to **CHM1488H** ***Current Directions in Experimental Physical Chemistry!***

Experimental physical chemistry / chemical physics are obviously huge subjects, much too large to cover in a single course (indeed, even in a lifetime). At the same time, they are very active areas with significant cutting-edge opportunities: energy storage, cleaning our environment including our water and air, novel optoelectronics, state of the art spectroscopies, quantum materials and technologies are just a few applications.

Chlorophyll fluorescence

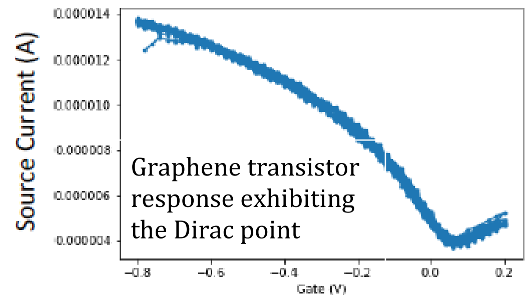
So, how should one start?

This course will provide a hands-on introduction to this subject using a combined guided and open-ended approach. In particular, the course will:

1) Discuss important fundamental principles and techniques commonly used in experimental physical chemistry/chemical physics;
2) Provide practice exercises (take-home kits with fundamental electro-optical components, an Arduino microcontroller, and an introduction to programming and data acquisition); and
3) Provide an opportunity to design and conduct your own experiment. (We will spare you the steps relating to raising funding!)

Examples of potential experimental projects include fabricating and characterizing:

- graphene transistors (Right panel)
- energy storage materials (e.g. carbon-based supercapacitors)
- electrochemical cells
- solar cells
- photoactive materials (see above)
- student's choice



Graphene transistor response exhibiting the Dirac point

The course content will be split 50:50 between electronics and optics – taught by Profs. Dhirani and Goh, respectively. Both instructors enjoy combining physical principles and experimental methods + apparatus to solve interesting and useful problems. We hope to share that sense with all students in this course.

PREREQUISITE COURSE(S):
This course assumes you have a fundamental understanding of undergraduate physical chemistry and 1st year calculus.

REFERENCE MATERIAL:
There is no required textbook for this course. For the electronics related portions of the course, "*The Art of Electronics"* by Horowitz and Hill is useful reference for extra reading. The classic book for anyone attempting to build scientific apparatus is *"Building Scientific Apparatus"* by JH Moore et al., and even more classic is E. Bright Wilson's "*An Introduction to Scientific Research*" available as a Dover edition. It's a little bit dated (it was written in 1952 after all) but covers everything a researcher should know! None of these are textbooks but would make for excellent education!

III HOW THE COURSE IS ORGANIZED

- Weeks 1 – 4: fundamental of electronics and an introduction to data acquisition and programming;
- Weeks 5 – 9: optics and experimental design; and
- Weeks 10 – term end: a student-led experiment.

Although the student – led experiment formally begins in week 10, students should start their literature search earlier and complete ordering materials/components so that they arrive by week 10. Students will be given kits at the start of term to practice/extend concepts learned in classes and to use as needed to conduct their own experiment.

IMPORTANT WINTER 2022 SESSIONAL DATES:

- First Day Winter classes: 8th January
- Family Day (no classes): 21st February
- Winter Reading Week (no classes): 22nd – 25th February
- Last Day of classes: 8th April

IV EVALUATION/GRADING SCHEME

Homeworks: 80%
Presentation of student-led experiment: 20%