What's in phys-chem?

Chemistry Curriculum Mapping Project – Physical/Theoretical Chemistry Stream

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Department of Chemistry

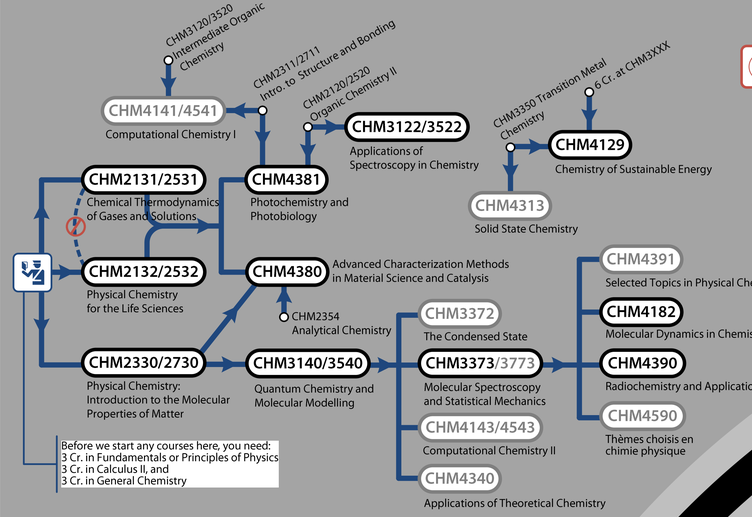

Figure 1: The sequence of courses in this project. Detailed investigations cover all courses labelled in black.

LEGEND

- Prerequisite course outside this project
- BLACK: Course discussed in this project
- GREY: Reserved course never offered or offered occasionally
- No combined credits
- CHM4380: Prerequisite pathway
- Students must complete all courses before the connecting arrow(s) prior to registration.

1 Introduction

The Department of Chemistry is evaluating all chemistry courses offered in the University of Ottawa in order to improve teaching quality and offer students the best academic experience. Accordingly, a Curriculum Mapping Project (Phase 2) has been applied to assess the course structures, learning objectives and teaching techniques of all physical/theoretical chemistry courses offered in recent academic years (Figure 1). Integrated with student performance, the research involves a clear overview of the current undergraduate chemistry programs (physical chemistry section) to an appropriate depth. This project also suggests any possible improvements or revisions such as identifying any discrepancies between English and French sections, removing redundancies in course materials and proposing changes in some course structures. Correspondingly, these recommendations will help the Department construct a reinforced program for future undergraduate chemistry education.

Info zone
This project covers:

- 1/3 of all courses in chemistry
- 9* French courses
- 17* English courses
- 540** hours of lectures
- >700** students

*Including reserved courses **In academic year 2014-2015

2 Methodology

The main research methodologies include three stages. The first stage involves building a database containing information (course materials, available textbooks, evaluation methods, etc.) from the most recent course syllabi mainly academic year 2014-15. Based on the information in the database, the second stage investigates the course structures in detail by analyzing any connectivity and discrepancies between courses, preparing questionnaires and conducting interviews for chemistry instructors for their teaching experience. Eventually, in stage three, the final curriculum map will be built from the results in the first two stages. In addition, this project also takes into account the evaluation of teaching and course results (S-reports) and student academic performance to analyze students' perspective of chemistry. (Figure 2)

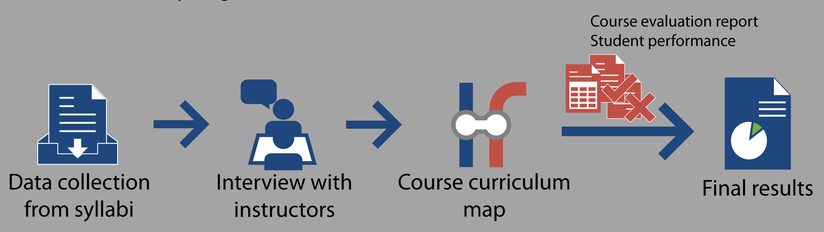

Figure 2: The main methodologies implemented in this project

Figure 3.1

LEGEND

- A: Each coloured line represents an individual course in this project.
- B: Course code. See Figure 1 for detailed names.
- C: This course contains lab portions.
- D: Main course topic.
- E: (black connection point) Area of overlap.
- F: (grey connection point) Connective topics in two courses.

Course contents may vary each year. For reference only.

Scan here and see the map!

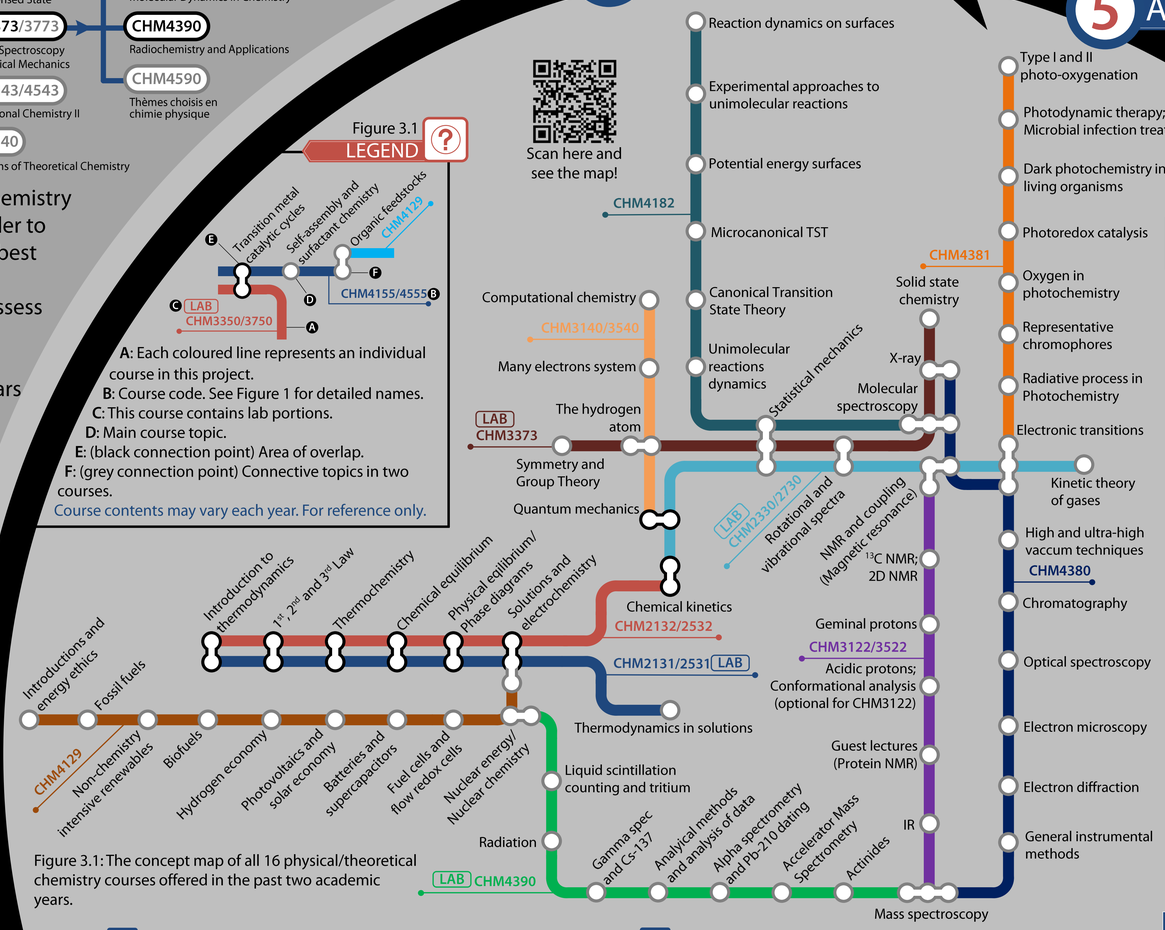

Figure 3.1: The concept map of all 16 physical/theoretical chemistry courses offered in the past two academic years.

Proposal 1 — CHM2311: Intro. to Structure and Bonding

No credits for chemistry programs

All students in specialization in chemistry are required to complete CHM2311 in their studies. However, some course contents contain significant overlap with their other compulsory courses and the redundancies can be suitably covered in the replacement courses shown in Figure 3.2.

Figure 3.2: The main topics in CHM2311 and their corresponding replacement courses.

This course will not be cancelled as it is the only source of Quantum chemistry for students in other science programs.

Proposal 2 — CHM3373: Molecular Spectroscopy and Statistical Mechanics

Mandatory for chemistry programs

CHM3373 covers important topics in molecular spectroscopy and statistical mechanics which are essential for fourth-year advanced physical chemistry courses. This course is also a supplement to symmetry and Group theory covered in CHM2311. It is highly recommended that all students in chemistry programs take this course so that they have a wider selection of optional courses at the 4000 level. Correspondingly, the Department will be motivated to offer more courses at senior levels once the demand and enrollment of these courses are augmented. (Figure 3.3)

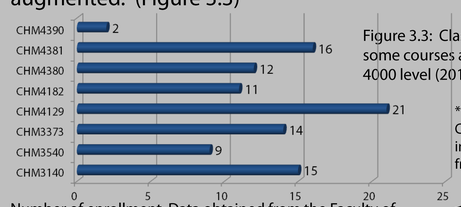

Figure 3.3: Class size of some courses at 3000 and 4000 level (2014-15)***.

***The data for CHM 4381 is interpreted from 2013-14

Number of enrollment. Data obtained from the Faculty of Science Office of Undergraduate Programs

Proposal 3 — Discussing the possibility of teaching spectroscopy theory to life science students.

Most life science students who take CHM3122 are not required to complete CHM2330. Adding a topic in spectroscopy theory prior to learning their applications would be useful for them to understand the whole context. This can be accomplished by adding lectures or DGDs in CHM2132 or 3122; nevertheless, the feasibility of this recommendation requires further discussion due to the tight schedules in the current structure.

Proposal 4 — Adding a DGD section to CHM2531 and CHM3522

Consistency between bilingual sections

Proposal 5 — Adding CHM3373 as a prerequisite for CHM4380

Connective topics between two courses

3 Results

Department of Chemistry
Our challenges

The principal current challenge is the limited enrollment of students in chemistry programs. In some cases, the Department of Chemistry does not have sufficient resources to offer some specialized courses for chemistry students. From Figure 1, only 2/3 of courses in this stream are offered annually or biannually, and this issue is particularly apparent in the Francophone section.

Department of Chemistry
Chemistry education

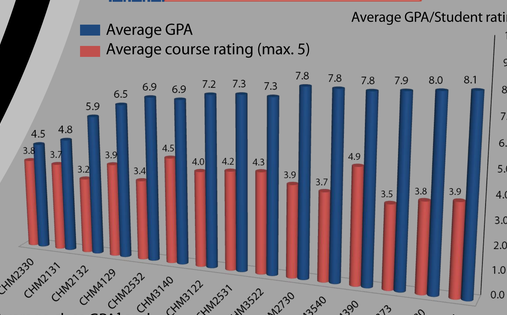

Figure 3.4: Average class GPA[1] and student rating of courses (1-very poor; 5-excellent)[2].
1: Anonymized data obtained from the Faculty of Science Office of Undergraduate Programs.
2: Data retrieved from online evaluation of teaching and course results (S-reports).
All figures correspond with the latest academic data. No data available for CHM4182.

The department of Chemistry is acclaimed for its expertise in undergraduate chemistry education in terms of students' high performance and satisfaction rates (min. 3.2; max. 4.9). All courses at the 3000 and 4000 levels (most are exclusive for chemistry students) have an average above "B" whereas the average grades of some second year courses are relatively low as students in other science disciplines may have a weaker background in chemistry (Figure 3.4) However, students can overcome the challenges by taking advantage of DGD sections and class TAs in most junior courses. Also, a wide range of classroom techniques and evaluation methods allow students to maximize their potential in learning chemistry (Figure 3.5).

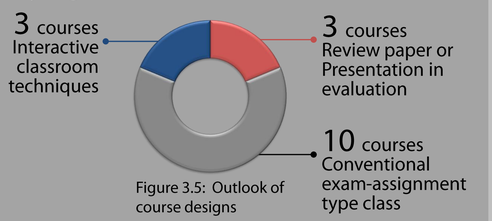

Figure 3.5: Outlook of course designs

Professors' expectations
Tips to succeed

Essential competencies in learning physical chemistry:

- Problem solving
- Laboratory skills
- Critical thinking
- Solid background in calculus

4 Conclusion

Department of Chemistry
Our strengths

Department of Chemistry provides a broad range of theoretical/physical chemistry courses designed for both science and life-science disciplines to fulfill their different learning objectives. Courses are well-structured and follow a natural connection to the knowledge acquired in prerequisites (Figure 3.1) so that students can learn new concepts in an efficient way. Most courses at fourth year level cover the most innovative technology and research in chemistry, offering an ideal gateway for students seeking advanced education in chemistry. A variety of laboratories affiliated with selected courses are also available to help students understand the course concepts and develop their lab techniques.

The Department of Chemistry demonstrates a dynamic progression in education. We can still establish a higher level of achievement and a better incorporation of teaching resources by proactively identifying any adjustments in the course structures and teaching methods. Self-evaluation and inter-department coordination are essential to fulfill the demands of all science students. The next step of this research involves a comprehensive integration of all three components (General, Analytical, Inorganic, Organic and Bio-organic streams) of this curriculum mapping project, thereby illustrating a full vision of the Department.

5 Acknowledgement

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6 About

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The General/Analytical/Inorganic and Organic/Bio-organic streams are conducted by Étienne Rhéaume and Montserrat Zidan.

Reference: Self-evaluation of Undergraduate Programs, Volume I: Self-evaluation Report, Department of Chemistry, University of Ottawa, Oct. 2007.
Report to the CSC Accreditation Committee by the Site Visit Team, Department of Chemistry, University of Ottawa, Nov. 2008.

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