SC/CHEM 4090 (3 credits) Topics in Materials Sciences

Term
Winter 2021

Time and Location
Lectures (online, via Zoom) TW 11:30-13:00

Prerequisite
SC/CHEM 3021 3.00 and SC/CHEM 3030 3.00; SC/CHEM 3031 3.00 is strongly recommended.

Course Instructor
Dr. Thomas Baumgartner
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Office hours: via Zoom, by appointment

Course Description
Exploring the chemistry behind novel materials relevant to electronics, alternative energy sources, life sciences and polymer sciences. The following are the topics that will be covered in detail:

1. From Molecules to Nanostructured Materials (Definition of important units/features/properties)

- Molecule vs. Material - what makes a material?
- Materials classification via dimensionality (0D, 1D, 2D, 3D)
- Selected materials-specific characterization techniques

2. Selected Applications of Materials

- Organic Electronics (OLED, OPV, OFET)
- Sustainable energy storage (batteries, fuel cells, photocatalysts)
- Biomedical applications (sensing, MRI, PDT, bioconjugates)

3. Selected Classes of Materials (including synthesis and properties)

a) *Carbon-based materials* (0D → 3D)

- Conjugated materials, carbon nanotubes, graphene, block copolymers
- Hybrid systems containing main group elements

b) *Si- and Au-based nanomaterials* (0D → 3D)

- nanoparticles
- nanowires
- thin films
- mesoporous silica

c) *Metal-Organic Frameworks and Zeolites*

4. State-of-the-art materials research (student presentations)

Purpose and Objectives of the Course

The purpose of the course is to introduce important aspects for materials chemistry and build upon knowledge gained in previous organic, inorganic, physical and analytical chemistry courses. Particular attention will be paid to the synthesis of materials, the understanding of the materials' physical properties and of important structure–property relationships. Students will also be introduced to the functional properties of materials and their practical applications.

At the end of the course, the students should be able to:

1. communicate effectively with chemists in the field using proper terminologies;
2. propose means to prepare different types of materials with control over the composition, and microstructure;
3. determine and rationalize the properties of materials;
4. explain which and how analytical tools can be used to elucidate the chemical structure and properties of materials;
5. read, understand and summarize important points from the literature.

Textbooks

The course will be based in part on a variety text books, but also on review articles. The course notes will be self-sustained, but references for further reading will be provided throughout the term via eClass.

Organization of the Course

Much of the lectures will be delivered by the Course Instructor but will require active participation of the students in the form of discussions as well as informal and formal presentations. Content slides will be posted ahead of the class on eClass. It is the student's responsibility to sign up for an account. See https://eclass.yorku.ca for details.

Evaluation

The level of proficiency in the material will be assessed through the elements listed below. The final grade for the course will be based on the following items weighted as indicated.

Assignments (4): 40%
Presentation: 20%
Final Exam:
a) Written Research Proposal: 25%
b) Oral Defense of Research Proposal: 15%

Four assignments (10% each) will involve course-specific themes. The assignments will reinforce topics and concepts that align with the progress in class. Depending on the assignment, students will either be expected to provide a written response using concise, scientific writing, or to give a brief 10-minute presentation of their findings to the class.

The presentation (20%) will involve a 25-minute in-class lecture by each student on a topic related to the course, followed by a 5-minute discussion. The topic can be selected from a list or chosen by the student (with approval from the instructor). Students will examine the peer-reviewed literature and extract the appropriate information to be included as it relates to the course content. The presentation will form the basis for the final exam component.

Final Exam:
The written final exam portion (25%) will be in the form of a research proposal that summarizes and builds on the topic of the formal in-class presentation by including an original research idea. The 3-page proposal should follow the general structure of a NSERC Discovery Grant proposal using concise, effective scientific writing (on three pages, instead of the five required by NSERC). For reference see here: http://www.nserc-crsng.gc.ca/ResearchPortal-PortailDeRecherche/Instructions-Instructions/DG-SD_eng.asp.

The final exam defense portion (15%) will involve a 15-20 minute Q&A session with the instructor, in which elements of the written proposal will be discussed.

Grading Scheme, Assignment Submissions, Lateness Penalties, Academic Integrity

The grading scheme for the course conforms to the 9-point grading system used in undergraduate programs at York (e.g., A+ = 9, A = 8, B+ - 7, C+ = 5, etc.). Assignments and Mid-term exams will bear a corresponding number grade (e.g. A+ = 90 to 100, A = 80 to 89, B+ = 75 to 79, etc.)

For a full description of York grading system see the York University Undergraduate Calendar: https://calendars.students.yorku.ca/2020-2021/grades-and-grading-schemes

Proper academic performance depends on students doing their work not only well, but on time. Accordingly, the assignments must be received on the due date specified for the assignment, which are to be emailed to the Course Instructor. **Assignments received later than the specified time on the due date will result in no credit (0%).** Exceptions to the lateness penalty will be entertained by the Course Instructor only when supported by written documentation (see above). The grading scheme will be adjusted accordingly.

Important Dates

January 11:	Classes start
February 13 – 19:	Reading Week (no classes)
March 23 & 25:	Student presentations (in-class)
April 8:	Last class
April 21:	Written research proposal due
April 26-28:	Defense sessions

Important Course Information

Students must make themselves aware of university policies on Academic Honesty/Integrity, Access/Disability, Student Conduct, Religious Observance and other matters. The corresponding links are as follows:

a) https://secretariat-policies.info.yorku.ca/policies/academic-honesty-senate-policy-on/

b) https://registrar.yorku.ca/enrol/dates/religious-accommodation-guidelines-2020-2021

Academic Honesty

CEAS July 2019

During 2018-19 academic year, numerous students were found guilty of aiding and abetting in cases where they had uploaded assignments to websites like Course Hero, if their work was then submitted by a student who accessed this material. Members of the CEAS panel recommend that professors add the following to their course outlines in the section on Academic Honesty.

Numerous students in Faculty of Science courses have been charged with academic misconduct when materials they uploaded to third party repository sites (e.g. Course Hero, One Class, etc.) were taken and used by unknown students in later offerings of the course. The Faculty's Committee on Examinations and Academic Standards (CEAS) found in these cases that the burden of proof in a charge of aiding and abetting had been met, since the uploading students had been found in all cases to be wilfully blind to the reasonable likelihood of supporting plagiarism in this manner. Accordingly, to avoid this risk, students are urged not to upload their work to these sites. Whenever a student submits work obtained through Course Hero or One Class, the submitting student will be charged with plagiarism and the uploading student will be charged with aiding and abetting.

Note also that exams, tests, and other assignments are the copyrighted works of the professor assigning them, whether copyright is overtly claimed or not (i.e. whether the © is used or not). Scanning these documents constitutes copying, which is a breach of Canadian copyright law, and the breach is aggravated when scans are shared or uploaded to third party repository sites.