

Faculty of Science Course Syllabus
Department of Chemistry

Advanced Main Group Chemistry, CHEM 4101/5101
Winter 2020

Instructor: Dr. Saurabh S. Chitnis, Chemistry Room 412

Lectures: Mon, Wed, Fri 1035-1125 h, Chemistry Room 223

Office Hours: Mon and Wed 1130-1200 h; Fri 1130-1230 h; Location: Chemistry 412

Course Description

Following a brief overview of the fundamental aspects of preparation, structure and bonding for familiar systems, selected topics are examined in some detail. An emphasis is placed on novel structure and bonding arrangements in comparison with carbon chemistry.

Course Prerequisites

CHEM 3103 (grade of C- or better)

Course Objectives/Learning Outcomes

- Derive molecular orbital (MO) diagrams for main group compounds and understand the relationship between MO manifold, molecular structure, and reactivity
- Understand and apply quantitative energy decomposition schemes to understand structure and bonding in s and p-block compounds
- Rationalize the structure and reactivity of multiply-bonded main group compounds
- Understand Lewis acid/base interactions quantitatively and the concept of Frustrated Lewis Pairs
- Understand the reactivity of molecular s-block compounds
- Understand the reactivity of amine-borane and phosphine-borane adducts as hydrogen sources and precursors to polymers

Course Materials

- An electronic textbook will be provided. Due to copyright issues, *this textbook must not be publicly shared*.
- A presentation containing selected segments from the textbook will be provided.
- Resources pertinent to the presentation component of the assessment (see below) are available upon request

Course Assessment

Component	Weight	Date
Term Test 1	20	Jan 29, 2020
Term Test 2	20	Mar 11, 2020
Presentation	20	Mar 25 - Apr 06
Final Exam	40	Set by registrar

Please note that dates may change in the event of unplanned university closures.

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

Course Policies

Class announcements: Dr. Chitnis will post announcements on the lecture Brightspace sites when possible. However, anything stated or announced in lecture will be considered common knowledge.

Meeting with Dr. Chitnis outside of office hours: Please note that outside of office hours, meeting with Dr. Chitnis is by appointment only. If you wish to set up a meeting, please email Dr. Chitnis, clearly indicating the reason you wish to meet as well as your availability.

Short-term absence policy: As of January 1, 2018, the university has adopted a new policy regarding short-term absences, as detailed here : https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html.

In accordance with the new policy, students will no longer submit a sick note or medical certificate in case of a missed academic requirement due to short-term absence (defined as “absence of 3 consecutive days or fewer due to minor physical or mental health conditions, or other extenuating circumstances such as caregiving duties; immediate family illness, injury or death; involvement in an accident; legal proceedings or being a victim of a crime, domestic or intimate partner violence”). Instead, they will:

- (1) notify the instructor by email within 24 h of the missed academic deadline or test
- (2) submit a **Student Declaration of Absence (SDA)** form on-line within 3 calendar days following the last day of absence.

The SDA can be used a maximum of TWO times. Note that the submission of the SDA form does not provide an automatic exemption from any academic requirements that were missed or late during an absence. Once the form is submitted, course policies will apply regarding procedures for making up the missed academic requirement (see below).

- **Missed term test:** If you miss a term test for any reason, no make-up will be offered. Once the SDA form is submitted, the points from the missed term test will be transferred to the final exam.

- **Missed presentation:** If you miss your presentation for any reason, no make-up will be offered. Once the SDA form is submitted, the points from the missed presentation will be transferred to the final exam.

- **Missed final examination:** If you miss the final exam for any other reason, as per Dalhousie policy, the SDA form does not apply. You must contact Dr. Chitnis by email (saurabh.chitnis@dal.ca) within 24 h of the missed exam for further instructions. Appropriate documentation (e.g. medical certificate indicating dates and duration of illness and a description of the impact it had on your ability to fulfill academic requirements) must be submitted to Dr. Chitnis within 3 calendar days of the missed final exam if you wish to write a make-up. If no appropriate notification and documentation for the absence is provided within the timeframe described above, no make-up will be allowed, and you will earn a mark of "zero" for the missed exam component.

Please note that if you are 30 minutes or more late to write a test or exam, it will be considered a missed test/exam.

Course Content

Date	Lecture	Section	Title
06-Jan	1	Syllabus + Intro	Introduction to the course
08-Jan	2	1.1, 1.2, 1.3.1	Atomic Orbitals, Hybridization trends
10-Jan	3	1.3.1, 1.3.2	MO Diagrams
13-Jan	4	1.3.3	MO Diagrams cont.
15-Jan	5	1.3.3, 1.3.4	MO Diagrams cont.
17-Jan	6	1.4, 1.5	Relativistic effects, Dispersion Effects
20-Jan	7	1.6	Formalism
22-Jan	8	2.1	Components of bonding
24-Jan	9	2.2	Bonding in diatomics
27-Jan	10	Review/catch-up	
29-Jan	11	Term Test 1	
31-Jan	12	2.3.1	E ₂ (E = N, P, As, Sb, Bi)
03-Feb	13	2.3.2	E ₂ vs E ₄ (E = N, P)
05-Feb		2.3.3	Heavy alkynes
07-Feb		Munro Day - No Class	
10-Feb	14	2.3.3	Heavy alkynes
12-Feb	15	2.3.3 + selection of presentation topic	Heavy alkynes + presentation intro
14-Feb		No Class	
17-Feb		No Class	
19-Feb		No Class	
21-Feb		No Class	
24-Feb	16	2.3.4	Heavy alkenes
26-Feb	17	2.4.1	Molecular s-block hydrides
28-Feb	18	2.4.2	TM chemistry of s-block elements
02-Mar	19	2.5.1	Lewis Acid/Base interactions
04-Mar	20	2.5.2, 2.5.3	Lewis Acid/Base interactions
06-Mar	21	2.5.4, 2.5.5	Lewis Acid/Base interactions
09-Mar	22	Review/catch-up	
11-Mar	23	Term Test 2	
13-Mar	24	3.1	Reactivity of heavy alkynes
16-Mar	25	3.2	Reactivity of s-block compounds
18-Mar	26	3.3	Reactivity of Frustrated Lewis Pairs
20-Mar	27	3.4	Reactivity of NB/PB Adducts (hydrogenation)
23-Mar	28	3.4	Reactivity of NB/PB Adducts (dehydrocoupling)
25-Mar	29	3.5	Presentations 1, 2
27-Mar	30	3.5	Presentations 3, 4
30-Mar	31	3.5	Presentations 5, 6
01-Apr	32	3.5	Presentations 7, 8
03-Apr	33	3.5	Presentations 9, 10
06-Apr	34	3.5	Presentations 11, 12

Please note that dates may change in the event of unplanned university closures.

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>