DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Mathematics & Statistics
MATH 4140
Introduction to Functional Analysis
Winter 2018-2019

Instructor(s): Keith Taylor keith.taylor@dal.ca

Lectures: 1:35-2:25 MWF Dunn 302

Course Description

An introduction to the basic principles of functional analysis including the following topics: infinite dimensional vector spaces, normed spaces, inner-product spaces, Banach and Hilbert spaces, linear and continuous linear functionals, the Hahn-Banach Theorem, the principle of uniform boundedness, dual spaces, weak topology, and the Alaoglu theorem, the open mapping and closed graph theorems, and consequences and applications.

Course Prerequisites

MATH 3502.03

Course Objectives/Learning Outcomes

The objective of this course is for the student to develop a solid understanding of basic functional analysis. At this level, it is expected that the student is adept at creating and writing mathematical arguments, but this course will refine those skills. Specific outcomes for the student are:

- Refined skill in creating clear and correct mathematics.
- A working knowledge of Banach spaces as presented in the course.
- A working knowledge of Hilbert spaces and operators on Hilbert spaces as presented in the course.
- The ability to use concepts from the course to analyse novel problems appropriate to the level of the course.
- A demonstrable overview of how the major theorems presented in the course depend on the web of preliminary results.

Course Materials

None.

Course Assessment

Assessment is based on 8 assignments, which will be due on Monday of most weeks, a take-home term test, and a final examination.

Component	Weight (% of final grade)	Date
Assignments	30%	Most Mondays.
Term Test	20%	Take-home early February.
Final Exam	50%	To be scheduled.

Conversion of numerical grades to Final Letter Grades follows the <u>Dalhousie Common Grade Scale</u>

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

If a student is not able to hand in an assignment on time, she or he should contact the instructor to see if some value can be earned by handing it in late. Typically, it will be reduced value.

Course Content

Overview: This course introduces the study of topological vector spaces with an emphasis on those related to Hilbert spaces and the theory of operators on Hilbert space. Specific topics will include the list below: A given topic may require more than one lecture to cover.

- Normed linear spaces and Banach spaces.
- Continuous linear functionals.
- The Hahn-Banach Theorems.
- Baire category and the Principle of Uniform Boundedness.
- Weak and weak* topologies.
- The Alaoglu-Bourbaki Theorem.
- Geometry of Hilbert space and orthonormal bases.
- Lattice of projections on a Hilbert space.
- Self-adjoint and normal operators.
- The group of unitary operators.
- The Fourier Transform as a unitary operator.
- The Wavelet transform.
- Compact operators.
- The spectral theorem for compact self-adjoint operators.

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