DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus Fall 2020 **(revised June 2020)**
Department of Mathematics & Statistics
MATH 4140/5140 (online)
Functional Analysis
Fall 2020

Instructor(s): Suresh Eswarathasan sr766936@dal.ca Office Hours: On Zoom or Collaborate BB via appointment; synchronized class times can be used as office hours as well.

Lectures: **Asynchronous lectures** via video clips that will be uploaded at the beginning of each week. Scheduled lecture times will be used in a manner as suggested by students.

Tutorials: No tutorials will be held.

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, MATH 2135 (or MATH 2040 as a substitute)

Learning Objectives

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.
- Familiarity with theory of Banach 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

- Required textbook: Real Analysis, 4th edition, by H. Royden and P. Fitzpatrick
- Required reading, in the form of instructor-written notes, will be uploaded onto BrightSpace and must be studied in tandem with the lecture videos.

DALHOUSIE UNIVERSITY

Course Assessment

Component	Weight (% of final grade)	Date [1,2]
Assignments	**85%**	**Fridays before 5pm (student's time zone)**
Tests/quizzes	**0%**	
Final presentation (4140)	**15%**	**December 9, 2020, if presentation chosen**
Final report (4140)	**15%**	**December 18, 2020, if report chosen**
Take-home exam (5140)	**15%**	**December 18, 2020**

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

- Any excuse must be valid as per the current Dalhousie University guidelines. Given the fluidity of the situation, particularly in light of the COVID-19 pandemic, the university may change these policies and therefore certain leniencies will be in place. Medical notes are not absolutely required for late submissions.
- Students are expected to use the Student Declaration of Absence form for late or missed submissions, and can be used as many times as needed.
- If a student misses a deadline, arrangements can be made (following one-on-one discussions) for latter submissions or substitutions.
- Students are expected to work on their own and consult regularly with the instructor as they progress through the exercises.

Course Content

- Basic topology
- Baire Category Theorem
- Normed linear spaces
- Linear operators
- Uniform boundedness principle
- Open mapping theorem
- Closed graph theorem
- Linear functionals
- Hahn-Banach Theorem
- Reflexive spaces
- Alaoglu's Theorem
- Hilbert Spaces (and more generally, inner product spaces)
- Compact operators
- Hilbert-Schmidt Norms
- Fredholm operators