PMATH 453/753 Functional Analysis, Course Outline, Fall 2020

Lectures: This is a special online offering of the course and there are no in-class lectures. Course materials will be available on LEARN and at www.math.uwaterloo.ca\∼snew

Instructor: The course instructor is Stephen New. He can be contacted by email at snew@uwaterloo.ca

Text: Lecture notes will be provided. There is no required textbook. Here is a list of some books that might be useful.

A Course in Functional Analysis, by J.B. Conway; Spinger-Verlag
Real Analysis, by J. Bruckner, A. Bruckner, B. Thomson; Prentice Hall
Topology, by J. Munkres; Prentice Hall

Course Outline: We will cover the following material.

Preliminaries: definitions and examples of Hilbert spaces and Banach spaces, bounded and continuous linear operators, the operator norm and the space of bounded linear operators, the dual space of continuous linear functionals, and the dual spaces of the ℓ_p spaces.

Hilbert Spaces: orthogonal projection on closed subspaces, unconditional convergence of unordered series, formulas involving orthonormal indexed sets, Hilbert bases, the dual space, the dual and adjoint of a bounded linear operator, the Riesz Representation Theorem for Hilbert spaces, weak convergence, compact operators, and the Spectral Theorem for compact self adjoint operators.

Banch spaces: finite dimensional normed linear spaces and Riesz's Theorem, the Hahn Banach Theorem, separation of convex sets, the adjoint of a bounded linear operator and reflexive spaces, bounded variation and the Riesz Representation Theorem, the Uniform Boundedness Principle, The Open Mapping Theorem, and the Closed Graph Theorem.

Topological Spaces: the box and product topologies, nets, separation axioms, Urysohn's Lemma, the Tietze Extension Theorem, the Tychonoff Theorem, the weak and weak* topologies, and the Banach-Alaoglu Theorem.

Assignments: there will be 4 assignments. You must complete all 4 assignments. The assignments must be submitted using Crowdmark. Each assignment must be submitted before 11:00 pm on the due date (it is recommended that you submit them well in advance in case technical difficulties arise). Here is the schedule.

Assignment 1 covers the Preliminaries and is due on Fri Oct 2,
Assignment 2 covers Hilbert Spaces and is due on Fri Oct 23,
Assignment 3 covers Banach Spaces and is due on Fri Nov 13,
Assignment 4 covers Topological Spaces and is due on Fri Dec 4.

Tests: There will be no midterm test and no final examination.

Course Mark: For students enrolled in PMATH 453, the final course grade will be entirely based on your assignment marks, and each assignment counts for 25% of your grade. Students enrolled in PMATH 753 will be encouraged to work on a project and, for those who do, the assignments will count for 70% of the grade and the project will count for 30% of the grade.

Persons with Disabilities: Access Ability Services located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the Access Ability Services at the beginning of each academic term.

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. (Check www.uwaterloo.ca/academicintegrity/ for more information.)

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4,
http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm.
When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity to avoid committing academic offenses and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the undergraduate associate dean. For information on categories of offenses and types of penalties, students should refer to Policy 71, Student Discipline,
http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm.
For typical penalties check Guidelines for the Assessment of Penalties,
http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals, http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.