AMATH 731 APPLIED FUNCTIONAL ANALYSIS FALL 2019

Instructor: Giang Tran (giang.tran@uwaterloo.ca)

Office Hours: MC 6526, Tuesday 2:30 pm - 4:30 pm, or by appointment

TA and Office Hour: Marina Chugunova, Friday 1 pm - 2pm at MC 6323

Lecture Time/Location: Tuesday and Thursday 1 - 2:20 pm at MC 4064

Course Websites:

- LEARN, `https://learn.uwaterloo.ca`, Syllabus + Announcements during the term + Grades
- `https://uwaterloo.ca/scholar/g6tran/classes/AMATH731`, Syllabus + Course Materials

Course Description: This is a core course for graduate students in Applied Mathematics. It will also be of interest to students in Engineering and Science who wish to understand and use methods from functional analysis. Basic concepts from functional analysis are introduced and illustrated with applications in various areas such as numerical analysis, control theory, boundary value problems for PDEs, and optimization. Tentative topics that will be covered in this course include:

1. Normed linear spaces, Banach spaces, Hilbert spaces, and Sobolev spaces
2. Fixed-point theorems and their applications to differential equations
3. Linear operators, inverse, approximate solutions to operator equations
4. Fréchet derivatives, Newton-Kantorovich method
5. Orthogonality, duality, Dirichlet principle, and Lax-Milgram theorem
6. Riesz representation theorem, Ritz method, generalized solutions
7. Compact operators, Spectral theorem

Texbooks

- (Main Texbook 1) *Applied Functional Analysis: Applications to Mathematical Physics (Applied Mathematical Sciences, Volume 108)*, by E. Zeidler
- (Main Textbook 2) *Applied Functional Analysis, Course Notes for AMATH 731*, by D. Siegel. Available at WStore, South Campus Hall.
- Supplementary Notes for Main Textbook 2: `http://links.uwaterloo.ca/amath731`, by E. Vrscay.
- (Recommended, not required) *Introductory Functional Analysis with Applications*, by E. Kreyszig
- (Recommended, not required) *Methods of Applied Mathematics*, by T. Arbogast and J. L. Bona
- (Recommended, not required) *Applied Functional Analysis*, by J. T. Oden and L. F. Demkowicz
- (Recommended, not required) *Partial Differential Equations*, by L. C. Evans (for section about Sobolev spaces)

Prerequisite: Advanced calculus, linear algebra, and elementary real analysis. I will review related materials, if necessary.

Homework, Exams, and Grade Policy

- Homework will be assigned regularly. Students are encouraged to work in groups; however, each student must write up their own work.
- There will be an in-class midterm exam on October 24th, 1-2:20pm.
- The final exam will be comprehensive, three hours and no aids. Tentative date for the Final exam will be during December 6 - December 10, 2019.
- The final grade will be based on the following formula: 30% Homework + 30% Midterm + 40% Final.
- No make-up exams. The weight of the missed midterm (with documentation) will be transferred to the Final exam.

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 `https://uwaterloo.ca/academic-integrity` 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, `https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70`. 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 adviser, or the undergraduate associate dean. For information on categories of offenses and types of penalties, students should refer to Policy 71, Student Discipline, `https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71`. For typical penalties check Guidelines for the Assessment of Penalties, `https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties`.

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, `https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72`.

Note for Students with Disabilities: The Office for Persons with Disabilities (OPD), 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 OPD at the beginning of each academic term.