

APPLIED FUNCTIONAL ANALYSIS FALL 2020

AMATH 731

CLASS SCHEDULE

| Section | Location | Time | Instructor(s) |
|---------------|----------|-------------------------------------|-----------------------------------|
| AMATH 731 041 | None | midnight - midnight | Giang Tran g6tran@uwaterloo.ca |
| AMATH 731 141 | M3 1006 | Wednesdays 3:30 p.m. - 4:20 p.m. | |

INSTRUCTOR / TA INFORMATION

Instructor: Giang Tran, giang.tran@uwaterloo.ca

Office Hours: Thursday (time TBA) - on Zoom

Tutorials: Wednesday, 3:30 pm - 4:20 pm EST, Building M3 - 1006 and on Zoom for students that are not on campus

Teaching Assistant: Esha Saha, esaha@uwaterloo.ca

TA Office Hours: Tuesday (time TBA) on weeks an assignment is due - on Zoom

COURSE DESCRIPTION

Calendar Description for AMATH 731

Basic concepts of functional analysis. Topics include: theory of linear operators, nonlinear operators and the Frechet derivative, fixed point theorems, approximate solution of operator equations, Hilbert space, spectral theory. Applications from various areas will be used to motivate and illustrate the theory. A previous undergraduate course in real analysis is strongly recommended.

In addition to the topics described in the course calendar, we will also discuss Sobolev spaces and Reproducing kernel Hilbert spaces (RKHS). Tentative topics that will be covered in this course include:

1. Normed linear spaces, Banach spaces, Hilbert spaces, RKHS, and Sobolev spaces
2. Banach and Schauder fixed point theorems and their applications to numerical linear algebra and differential equations
3. Bounded linear operators, compact operators, Neumann series
4. Riesz representation theorem, linear and nonlinear Lax-Milgram theorem
5. Spectral theory

This is an asynchronous online course. Recorded lectures and course notes will be uploaded on LEARN every Monday and Thursday. The tutorials given by the instructor on Wednesday will be on campus and live on Zoom. The tutorials are in Q&A format, where we discuss the posted materials. If time permits, during tutorial sections, we also cover enriched topics that will not be tested on. The tutorials will not be recorded but the prepared notes for the tutorials will be uploaded on LEARN.

LEARNING OUTCOMES

No explicit learning outcomes defined for this course.

TENTATIVE COURSE SCHEDULE

To be updated.

TEXTS / MATERIALS

Course Resources (Optional)

| Title / Name | Notes / Comments | Required |
|------------------------------------------------------------------------------------------------------------------------------|------------------|----------|
| Applied Functional Analysis: Applications to Mathematical Physics (Applied Mathematical Sciences, Volume 108), by E. Zeidler | | No |
| Applied Functional Analysis, Course Notes for AMATH 731, by D. Siegel | | No |
| Introductory Functional Analysis with Applications, by E. Kreyszig | | No |
| Lectures in Functional Analysis, by R. Vershynin | | No |
| Functional Analysis, Sobolev Spaces and Partial Differential Equations, by H. Brezis | | No |
| Methods of Applied Mathematics, by T. Arbogast and J.L. Bona | | No |

Many books from the list are available online through UWaterloo library portal.

STUDENT ASSESSMENT

| Component | Value |
|--------------------|-------|
| Assignments | 50 |
| Midterm | 25 |
| Final presentation | 25 |

Assignments: Assignments will be posted on LEARN on alternate Fridays and are due the following Friday by 12:00 noon EST. You are encouraged to discuss assignment problems with your classmates and consult sources such as textbooks and the internet. However, you must **write your solutions in your own words** without copying other students or sources, and you must credit all of your collaborators on your assignments. **Late submissions will not be accepted.** With respect to how to write mathematical proofs and how to give appropriate amount of details, here is a good reference:

<https://sites.math.washington.edu/~lee/Writing/writing-proofs.pdf>

(<https://sites.math.washington.edu/~lee/Writing/writing-proofs.pdf>)

Midterm: The midterm will be 90 minutes and will be proctored online on October 28, time TBA.

Final Presentation: Each student will present a topic (a theorem, an application of functional analysis,...) to the whole class. You can choose your own topic or can discuss potential topics with the instructor. Each presentation is around 20 minutes during the week of Dec 7-11, time TBA.

ASSIGNMENT SCREENING

No assignment screening will be used in this course.

ADMINISTRATIVE POLICY

IMPORTANT WEBSITES

- **LEARN:** To check course outline, course notes, recorded videos, assignments, supplementary materials, and important announcements.
- **Crowdmark:** To submit and see marked assignments. For each assignment, you will receive an invitation from Crowdmark to submit your assignment.
- **Discussion Forum:** To pose questions about lectures, assignments, textbooks, ... Please sign up for the course discussion board at Piazza, via the following link:
[piazza.com/uwaterloo.ca/fall2020/amath731](https://piazza.com/class/keuf7syoyo497ix) (<https://piazza.com/class/keuf7syoyo497ix>) . The instructor will monitor the discussion board daily and will respond to unanswered questions. You are welcome to discuss and answer questions yourselves on Piazza. **The instructor will not answer course content-related question sent via emails. Please use Piazza for those questions.**
- Also, all lecture notes and assignments will also be posted on my website:
https://uwaterloo.ca/scholar/g6tran/classes/amath731_applied_functional_analysis_fall2020
(https://uwaterloo.ca/scholar/g6tran/classes/amath731_applied_functional_analysis_fall2020)

OTHER POLICIES:

- Any requests for remarking of an assignment or Midterm must be received by the instructor within one week of receiving your grades in order to be considered.
- No extensions will be given on the assignments for any reason. In case of exceptional circumstances results in a missed assignment, please email the instructor within 48 hours.
- There will be no make-up midterm. In case of exceptional circumstances results in the missed midterm, please email the instructor within 48 hours.

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 [the Office of Academic Integrity](https://uwaterloo.ca/academic-integrity/) (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-general-counsel/node/100) (https://uwaterloo.ca/secretariat-general-counsel/node/100) . 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 an academic offence, and to take responsibility for his/her actions. [Check [the Office of Academic Integrity](https://uwaterloo.ca/academic-integrity/) (https://uwaterloo.ca/academic-integrity/) for more information.] A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate associate dean. For information on categories of offences and types of penalties, students should refer to [Policy 71, Student Discipline](https://uwaterloo.ca/secretariat-general-counsel/node/97) (https://uwaterloo.ca/secretariat-general-counsel/node/97) . For typical penalties, check [Guidelines for the Assessment of Penalties](https://uwaterloo.ca/secretariat-general-counsel/node/131) (https://uwaterloo.ca/secretariat-general-counsel/node/131) .

Appeals: A decision made or penalty imposed under [Policy 70, Student Petitions and Grievances](https://uwaterloo.ca/secretariat-general-counsel/node/100) (https://uwaterloo.ca/secretariat-general-counsel/node/100) (other than a petition) or [Policy 71, Student Discipline](https://uwaterloo.ca/secretariat-general-counsel/node/97) (https://uwaterloo.ca/secretariat-general-counsel/node/97) 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-general-counsel/node/99) (https://uwaterloo.ca/secretariat-general-counsel/node/99) .

Note for students with disabilities: [AccessAbility Services](https://uwaterloo.ca/disability-services/) (https://uwaterloo.ca/disability-services/) , located in Needles Hall, Room 1401, 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 AccessAbility Services at the beginning of each academic term.

Turnitin.com: Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin in this course.

It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit alternate assignment.