



SYDE 750

Physical and physiological acoustics

Syllabus for Winter 2021

Instructor: Nima Maftoon

Office Location: E7 6426

Course communications: MS Teams

Email: nmaftoon@uwaterloo.ca

Phone: 519-888-4567 x47654 or connect using MS Teams audio/video

Office Hours: Contact the instructor on MS Teams.

1 Schedule and study materials

Check Learn frequently and keep up with the reading following the weekly plans (Course schedule). The course materials will be available on Learn. We will also have synchronous meetings as follows:

Day	Time	Connect via	
Thursday	3:00-5:50 PM	Learn>Connect>Virtual classroom	Synchronous class

2 Course text

Main text:

Kinsler, L. E. (2000). *Fundamentals of acoustics* (4th ed.). Wiley.

Additional required texts:

Rossing, T. D. (2014). *Springer Handbook of Acoustics*. Springer New York. <https://doi.org/10.1007/978-0-387-30425-0>

Blauert, J., & Xiang, N. (2009). *Acoustics for engineers: Troy lectures* (2nd ed.). Springer. <https://doi.org/10.1007/978-3-642-03393-3>

Müller, G., & Möser, M. (Eds.). (2013). *Handbook of Engineering Acoustics*. Springer-Verlag. <https://doi.org/10.1007/978-3-540-69460-1>

Lee, W., Tseng, P., & Carlo, D. D. (2016). *Microtechnology for Cell Manipulation and Sorting*. Springer.

Recommended texts:

Pierce, A. D. (2019). *Acoustics: An Introduction to Its Physical Principles and Applications*. Springer International Publishing AG.

Beranek, L. L., & Mellow, T. J. (2019). *Acoustics: Sound fields, transducers and vibration* (Second edition.). Academic Press.

Howard, C., & Cazzolato, B. (2015). *Acoustic Analyses Using Matlab and Ansys*. CRC Press, Taylor & Francis Group. <https://doi.org/10.1201/b17825>

All these texts are freely and electronically available from the University of Waterloo library.

Note

We are facing unusual and challenging times. The instructor reserves the right to modify course topics and/or assessments with due notice. In the event of further challenges, the instructor will work with the Department to find reasonable and fair solutions.



3 Course description

The objective of this course is to introduce students to fundamentals of vibration, general acoustics and physiological acoustics. This course covers fundamentals of wave propagation in solid and fluid media, basic acoustic elements such as waveguides, cavities and resonators, acoustic transducers and human auditory system as well as interactions of acoustic field with cells.

4 Learning Objectives

By the end of this course, students should be able to:

- Describe wave equation in solid and fluid media
- Describe acoustic elements and analyze acoustic circuits
- Describe the relationship between sound intensity and human perceived loudness
- Explain human auditory sound processing
- Explain, analyze and select acoustic transducers
- Improve their communication and critical thinking skills

5 Evaluation

The grade distribution is as follows:

Component	Weight %
First presentation (seminar and leading the discussions)	20
Deliverables: first presentation & its supplementary materials	20
Second presentation (seminar and leading the discussions)	20
Deliverables: second presentation & its supplementary materials	20
Participation in class discussions (2% for each session)	20
Total	100

6 Course format:

Each student will be assigned few topics during the term and read about them, prepare presentation and written materials at the senior undergraduate level and present them to the class and lead discussions about them.

7 Assessment method:

Assessment will be done based on presentations, participating in class discussions, and submitted written materials, presentation file and supplementary materials.

Responsibilities of the Lead of each topic:

1. Sending the presentation file on Wednesday by 10 PM (the night before the class) to the instructor and students in class in one email (Subject: SYDE 750 Week #X presentation). If possible sending the presentation by Tuesday at 10 PM is preferred and appreciated.
2. Finding supplementary materials such as videos and/or Matlab (preferably) programs to demonstrate the subject to help understanding the subject. Please incorporate these materials in your presentation. Please see <https://www.mathworks.com/matlabcentral/fileexchange/> or similar resources.
3. Presenting in class and leading the discussions.



4. The last week of the class is dedicated to presenting a project proposal directed at the senior undergraduate level. Instead leading discussion on a textbook topic. One student can lead that effort to define a project or a series of projects that can work as the backbone of the learning in the undergraduate course.

8 Missed presentation and deliverables

Please see Guiding Principles for our SYDE-BME Community (faculty, staff, and students).

9 Late submission rules

The success of this class depends on responsible conduct of the students and especially the Lead of each specific session. Late submission of each deliverable causes a late penalty of 20% of the grade of that deliverable if submitted to the instructor before the scheduled class and 50% of the grade of that deliverable if submitted to the instructor after the scheduled class. Absence from leading a session when scheduled costs the grade for that seminar (20% of the course grade). If you need accommodation due to illness or other justified reasons, please contact the instructor as soon as you learn about the situation but not later than the 5 hours before the class. Any change in the schedule will make considerable problems for future sessions and the learning outcome of the course and therefore rescheduling should be avoided as much as possible.

10 Matlab Access

<https://wiki.uwaterloo.ca/display/ISTKB/Download+or+use+MATLAB+online> or use <https://englab.uwaterloo.ca/> which needs VPN connection: <https://uwaterloo.ca/information-systems-technology/services/virtual-private-network-vpn>

11 Course schedule

Week	Class date	Class meets	Topic	Reference
1	2021-01-14	Y	Introduction to the course	
2	2021-01-21	N	Fundamentals of vibration and oscillation	K (1-1 to 1-13)
3	2021-01-28	Y	2-D wave equation for membrane vibration	K (4-1 to 4-6)
4	2021-02-04	Y	Basic 3-D acoustic wave equation and plane wave, spherical wave	5-1 to 5-7 and 5-11
5	2021-02-11	Y	Energy density, intensity, specific acoustic impedance, Decibel scale, point source	5-8 to 5-10, 5-12 and 5-15 to 5-16
6	2021-02-18	N	READING WEEK	
7	2021-02-25	Y	Radiation and reception of acoustic waves	7-1 to 7-5
8	2021-03-04	Y	Fundamental properties of transducers, microphones & Speakers	k7-6 and M&M 2-1 to 2-2 (optional further reading: ch 24 Rossing handbook)
9	2021-03-11	Y	Cavities, waveguides and pipes	9-1, 9-2 and 9-5 10-1 to 10.4



10	2021-03-18	Y	Helmholtz resonator, acoustic impedance and lumped parameter models, reflection and transmission in pipes	10-7 to 10-10 and B&X Sections 2-6 to 2.7 and Chapter 3 (Optionally for a more thorough treatment read Chapter 3 of Beranek & Mellow.)
11	2021-03-25	Y	Physiological acoustics and Psychoacoustics	R Ch 12.1 to 12.2-1 R 13.1 and 13.3
12	2021-04-01	Y	Cell-acoustic interactions (suggestion: acoustophoresis)	L Ch 5 (Further reading R Ch 21)
13	2021-04-08	Y	Design of a course project (or a number of projects) that covers fundamental concepts of acoustics covered in the course or an application of the concepts to solve a problem, make a simulation or develop a device. Software projects are easier to handle for students rather than projects that require building/prototyping.	
14	2021-04-15	N		



12 Guiding Principles for our SYDE-BME Community (faculty, staff, and students)

1. Be compassionate. 2. Be accountable. 3. Be patient. 4. Be safe and healthy.

Compassionate and respectful communication: Most online communication between the Department and students will be done through LEARN and/or email. Students are reminded that they should now use their email account name@uwaterloo.ca. Include an academic signature with your full name, program, student ID. We encourage you to include your preferred pronouns (he/him; she/her; they/them).

Scheduling of Synchronous (live) online course events: Due to the COVID-19 pandemic, all University of Waterloo courses components will be delivered online, until further notice. To maintain build supportive teaching environments, instructors may use the time slots (EDT) scheduled “in-class” hours to hold “live-stream” events such as lectures, tutorial help sessions, group activities, and open office hours. To accommodate different time zones, different working/studying conditions and limitations in internet access, all critical course components, including lectures and student support must be made available in asynchronous formats. Any timed component (e.g. test/quiz) must take time zone and internet availability into account.

SYDE-BME comment on accommodation: We respect that our SYDE-BME students are independent adult decision-makers, with many opportunities to partake in activities that might be in time conflict with academic deadlines and deliverables. Along with the right to make adult decisions comes the responsibility and accountability for those decisions and any outcomes.

The University of Waterloo’s policy on accommodation for missed deliverables pertains to verifiable health matters, and highly unfortunate events (e.g. family tragedies). The Department of Systems Design Engineering follows UW’s general policy: students who self-elect to forgo a deliverable receive a “0” for that deliverable. It is preferred practice so that fairness is maintained for members of the same class/course by avoiding preferential treatment, and so that instructors are not burdened with having to create extra quizzes, deliverables, etc. It also reflects professional practice, as failing to show up to work and missing deadlines can be very costly to the company and individual (e.g. not submitting a contract proposal, or design review on time). **Please read the policy here:** [Accommodation due to illness.](#)

SYDE-BME Academic Priorities over Co-op Interviews: With asynchronous schedules, students should be able to arrange co-op interviews that do not conflict with major deliverables (i.e. timed course midterms, final exams). For deliverables with longer time windows (e.g. 24-48 hours or more), students must manage their time for deliverables and co-op interviews accordingly. If a co-op interview conflicts with a short deliverable time window (e.g. 1-3 hours), then students MUST follow the CECA procedure for rescheduling the interview: [CECA rescheduling co-op interviews.](#)

Compassionate Accommodation: If you are facing challenges that are affecting more than one course contact the Associate Chair Undergraduate (ACUG sydeunde@uwaterloo.ca) or the Director of BME (sdbmedir@uwaterloo.ca). They will review your case and coordinate a reasonable and fair plan in consultation with appropriate others (e.g. instructors, Department Undergraduate Studies Committee, Chair, AccessAbility Services, Engineering Counselling services, Registrar's Office).



13 Faculty of Engineering policies

Faculty of Engineering website: [Academic Support and Policies](#)

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 Academic Integrity website [Office of Academic Integrity](#) for more information.]

Online Academic Integrity: All students are expected to work individually and submit their own original work. Under Policy 71, the instructor may have follow-up conversations with individual students to ensure that the work submitted was completed on their own. Any follow up will be conducted remotely (e.g., MS Teams, Skype, phone), as the University of Waterloo has suspended all in-person meetings until further notice.

Discipline: A student is expected to know what constitutes academic integrity (see link above) to avoid committing an academic offence, and to take responsibility for their actions. 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 expectations for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. Relevant documents include:

- UW Policy 71 [Link [Policy 71 Student Discipline](#)].
- Academic Penalty Guidelines [Link [Policy 71 Penalty Guidelines](#)].
- Assessment of Unauthorized Collaboration: [Link [Assessment of Unauthorized Collaboration](#)].

Grievance: A student who believes that a decision affecting some aspect of their university life has been unfair or unreasonable may have grounds for initiating a grievance. Read *Policy 70, Student Petitions and Grievances, Section 4* When in doubt please be certain to contact the **Associate Chair Undergraduate or Academic Advisor** who will provide further assistance. [Link [Policy 70 Petitions & Grievance](#).]

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 they have a ground for an appeal should refer to Policy 72 (Student Appeals) [Link [Policy 72 Student Appeals](#).]

AccessAbility Services: AccessAbility Services (AAS) is the University's centralized office for the provision of academic accommodations for students with a known or unknown disability, illness, or condition. Even if students are unsure of whether they qualify for AAS support, an AAS consultant can talk them through next steps, and refer them elsewhere if appropriate.

[Link [AccessAbility Services](#)]

Turnitin.com: Text matching software (Turnitin®) may be used to screen assignments in this course. This would be done to verify that use of all material and sources in assignments is documented. Students will be given an option if they do not want to have their assignment screened by Turnitin®. Students will be provided about arrangements and alternatives for the use of Turnitin® in this course.