

# ECE 607: FUNDAMENTALS OF ULTRASONICS

## Fall 2023

### Objectives

This course gives an in-depth coverage of technical concepts that are fundamental to the use of ultrasound in imaging and therapy. Concepts to be addressed include: principles of ultrasound imaging, field profile analysis, and essential ultrasound physics. The pedagogical aim of this course is to equip students with deep, foundational knowledge in ultrasonics. The course contents have been designed to include: 1) coverage of various fundamental principles in ultrasound wave physics, and 2) hands-on practice in various theoretical derivations and numerical computations related to ultrasonics.

### Course Learning Outcomes

By the end of this course, students should be able to demonstrate a threshold level of mastery of the following learning outcomes:

1. Explain how ultrasound imaging and beamforming work, and perform related calculations
2. Analyse ultrasound field profiles generated from different transducer geometries
3. Derive the fundamental laws that govern ultrasound wave propagation and acoustic cavitation

### Course Schedule



**Course Prerequisites:** ECE 207 (Signals and Systems), ECE 375 (Electromagnetic Fields and Waves), or equivalent courses. For prospective students who did not complete their undergraduate degree at UW ECE, please feel free to contact the instructor to seek permission to enroll.

*\*\* Students who are interested in the biomedical applications of ultrasonics may also take BME 581 in the Winter 2024 term. \*\**

**Other Essential Skills:** Proficiency in Matlab programming is expected. Knowledge in various branches of applied mathematics, including Fourier transform, matrix algebra, multivariable calculus, vector calculus, and partial differential equations will also be helpful. If you have received undergraduate training in an accredited engineering program (electrical, mechanical, biomedical, etc.), you should be familiar with the relevant math concepts and skills. If you have not learned these concepts previously, you should still be able to follow along as we typically do on-the-fly derivations during lectures. There will also be pre-class assignments to help you learn essential concepts.

### Instructor

Alfred C. H. Yu  
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Professor, NSERC Steacie Fellow  
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### Grading Scheme

Pre-Class / In-Class Exercises	35%
Formal Assignments	65%

### Learning Resources

**Required text:** RSC Cobbold. *Foundations of Biomedical Ultrasound*. Oxford University Press, 2007.  
(An electronic copy of this book will be provided to enrolled students)

**Reference Articles:** To be provided by the instructor on LEARN.