

# ECE 607: FUNDAMENTALS OF ULTRASONICS

## Spring 2022

### 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, acoustic wave propagation theory, and acoustic cavitation. 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) significant 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 Prerequisites:** ECE 207 (Signals and Systems), ECE 375 (Electromagnetic Fields and Waves), or equivalent courses. If you have the necessary prerequisites but did not complete your 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 Fall term. \*\**

**Other Essential Skills Required:** Proficiency in Matlab programming is required. Knowledge in various branches of applied mathematics, including Fourier transform, matrix algebra, multivariable calculus, vector calculus, and partial differential equations is also needed. 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. There will be pre-class assignments to help you refresh these concepts.

### Instructor

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### Grading Scheme

Pre-Class / In-Class Exercises	25%
Formal Assignments	50%
Term Writing Project	25%

### Learning Resources

**Required text:** RSC Cobbold. *Foundations of Biomedical Ultrasound*. Oxford University Press, 2007.

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