EK 131/2, Section A4

Applications of Acoustics

SPRING 2013 INFO SHEET and SYLLABUS

Module Description: Acoustics is the science of sound. What we've learned about sound and its interaction with matter has led to many research programs and useful applications. For example, the scattering of sound waves is one of our most useful clinical tools for imaging tissue structure. This module offers an introduction to the physical principles and applications of sound waves in a unique format. Class will usually begin with a demonstration, the observation of which will lead us naturally to basic principles. Students will seek out research and industry applications, which they will present to the class to stimulate discussion, always leading back to basic principles. BU research applications will also be incorporated, including sonoluminescence, acoustic levitation, focused ultrasound surgery, lithotripsy, and others. The industry applications may include medical devices such as imaging ultrasound, lithotripters and thrombolysis transducers, other devices such as foggers and homogenizers, and products in which acoustics and vibrations play a role, such as golf club design. There will be a laboratory exercise.

Goals: The goals of this course are

1. To teach the fundamentals of acoustics as a wave phenomenon
2. To expose students to a variety of research, biomedical and industrial applications of acoustics
3. To expose students to a variety of active research areas within acoustics
4. To provide hands-on experience with acoustic transducers and acoustic wave phenomena in both a laboratory and demonstration setting.

Course Learning Outcomes: As an outcome of completing this course, students will:

i. Gain a basic understanding of sound phenomena as wave phenomena (A)
ii. Gain an appreciation of the variety of applications of acoustics in both research and industry (A,E, J,K)
iii. Gain experience in acoustic experimentation (B,D,E,K)
iv. Gain experience in reporting and documentation of experimental work through use of standardized lab reporting policies and requirements. (D, G, K)
v. Gain experience in the operating principles and uses of transducers and signal conditioning elements of measurement systems for acoustic pressure. (B, K)
vi. Gain experience and confidence in self-instruction on the use of data acquisition software and hardware systems, including standard multifunction analog-digital conversion boards, and LabVIEW GUI interface data acquisition control software. (B, I, K)
vii. Gain experience in efficient organization and teaming by performing a lab in self- organized groups. (D,G)

CLASS: M-W 10-12, **ME** 113: this is the lab on the first floor of 110 Cummington St., and we will meet there almost always. Class will be lively, informative, and PART OF YOUR ASSIGNED GRADED WORK. Don't expect to merely sit and be lectured to, you will participate. I will pass out an attendance signup sheet, it is your responsibility to sign it yourself (only for yourself).

TEXT: None.

LAB NOTEBOOKS: Just use any notebook, since we will only have 1 lab. If you want to buy one, National Brand #43-591 or Roaring Spring #77591, or equivalent are inexpensive and square-ruled.

PROFESSOR: Glynn Holt rgholt@bu
110 Cummington, Rm 417 353-9594 office
Office hours by appointment

TF's: none

GRADING:

40%	(Homework Assignments)
40%	(Labs and Lab Reports)
20%	Class attendance/participation

No exams if you participate in class!!

HOMEWORK: Homework assignments are given out as I generate them. They are due at the BEGINNING of class on the due date listed. LATE HOMEWORK WILL NOT BE ACCEPTED unless circumstances merit the exception.

EXAMS: I will not have an exam unless you do not participate in class. That should be a strong incentive!

LAB and TEAMING: There will be an in-class lab that will take 2 class periods. You will work in teams. You will measure acoustic standing waves. The lab report will also be a team effort, done OUTSIDE lab.

DROP DATES: Pay attention to the University's schedule of drop dates. FOR EK131 and 132 modules, drop dates are only 2 class periods after the beginning of that module, so think fast!

PREREQUISITES: None.

COLLABORATION: Homework: Do it individually. However, you are encouraged to consult with classmates on general concepts.

Lab reports: This is a group collaborative project, and I expect to see some division of labor here, and there will only be 1 report per group, so each group member will receive the same grade. Despite the division of labor, since this is a class, each member of the group must understand the other member's contributions.

Class	DATES	LECTURE TOPIC
1	1/16 and 3/18	Introduction. Sound as wave phenomenon – observations of spatial and temporal changes, wave nomenclature (speed, frequency, wavelength
2	1/23 and 3/20	Basics in classroom. Pitch and elucidation. Superposition. Sine representaion. Fourier., white noise
3	1/28 and 3/25	Hearing and levels; acoustic energy, intensity, pressure; (in)coherent addition, RMS; perceived loudness, threshold of hearing vs f, white pink; measure amplitude vs distance
4	1/30 and 3/27	Spreading and Attenuation; Waves at interfaces reflection and refraction;
5	2/4 and 4/1	resonance; normal modes
6	2/6 and 4/3	Standing wave tubes lab
7	2/11 and 4/8	FINISH Standing wave tubes lab, instruct uncertainty
8	2/13 and 4/10	Guest from industry: Biomedical ultrasound (TBD)
9	2/20 and 4/15	Faraday waves (3 demos)
10	2/25 and 4/17	Guest from faculty: Ultrasound Imaging and Lithotripsy (TBD)
11	2/27 and 4/22	Normal modes and Golf club acoustics
12	3/4 and 4/24	Drops and Bubbles and Levitation and Sonoluminescence
13	3/6 and 4/29	Guest from industry: Musical Acoustics (Chip Jones)
14	WORK in if time allows	