



LINCOLN UNIVERSITY

DI 10 – Physical Principles of Ultrasound

Summer 2012 Course Syllabus

Credit: 3 units

Class Hours: Mondays & Wednesdays, 9:00-11:45 AM

Instructor: Chris T. Nguyen, Ph.D. (*)

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Office Hours: Contact Dr. Chris T. Nguyen for appointment.

RESOURCE MATERIALS

- “Diagnostic Ultrasound: Principles and Instruments” by Frederick W. Kremkau, ISBN-13: 978-0-7216-3192-9, Edition 2006 or later
- ARMDS Physics Test samples from different sources
- “Ultrasonography Examination” by Appleton & Lange
- “Ultrasound Physics Review” by Davies Publishing

COURSE DESCRIPTION

This Course introduces Ultrasound physical principles and instrumentation. Topics include sound wave mechanics, transducers, ultrasound equipment, Doppler physics, safety techniques, imaging modes, artifacts, quality, and bioeffects.

COURSE OBJECTIVES AND STUDENT LEARNING OUTCOMES

Upon satisfactory completion of this Course, the students will be able to:

1. Describe the characteristics of sound wave.
2. Explain the fundamental requirements for sound to travel.
3. Discuss medium stiffness, density.
4. Explain the difference between pulsed wave and continuous wave.
5. Relate frequency / period, pulse repetition frequency / pulse repetition period.
6. Discuss duty factor, pulse duration, and spatial pulse length.
7. Explain different modes of scatterings.
8. Explain the three processes in which attenuation occurs.
9. Explain how attenuation is calculated.
10. Identify elements of an ultrasound transducer and types of probes.
11. Relate single crystal, arrays, matrix, mechanical / electronic probes.
12. Explain characteristics of a transducer, frequency, crystal thickness, matching layers.
13. Relate frequencies, bandwidth, and quality factor.
14. Discuss echogenicity: hyperechoic, hypoechoic, and isoechoic.
15. Relate near zone, far zone, focal zone, beam width.
16. Discuss attenuation, penetration, resolutions, wavelength, line density, frame rate.
17. Relate impedance / reflection, velocity / refraction.

18. Identify different components of an ultrasound system.
19. Discuss transmit power, receiver gain, TGC, dynamic range, pre-processing, post-processing, persistence.
20. Learn 2D-imaging, 3D-imaging, M-mode, Doppler mode, color flow imaging, contrast imaging, harmonic imaging, PW Doppler, CW Doppler, tissue Doppler imaging, Color M-mode.
21. Discuss different types of flows: plug, laminar, parabolic, and turbulent; discuss Doppler effects.
22. Discuss artifacts: reverberation, mirror image, comet tail, ring-down, shadow, enhancement, edge shadow, speed error, registration error, section thickness, aliasing; discuss side lobe / grating lobe.
23. Discuss probe and system quality & reliability, safety, phantom, calibration, and maintenance.
24. Discuss ALARA, thermal bioeffect, mechanical bioeffect, cavitation, and temperature elevation.
25. Operate ultrasound system and perform basic scanning.

The two main objectives of this Course are:

- Prepare the students for the ARDMS Board Registration Test
- Show them how to properly, effectively perform US Systems

INSTRUCTIONAL METHOD

Instructional methods will include lectures by the instructor and lab sessions under his guidance. Classroom activities are collaborative – students should help one another in class as well as in lab. The instructor will be available to help students with all tutorials and other assignments.

The Course consists of **13 lectures, weekly quizzes, 1 Midterm, 1 Final and several lab sessions. Attendance will be recorded at every class meeting.**

EVALUATION AND GRADING

To successfully complete this course, the student should attend more than 80% of the lectures, and have a total score of 70% or higher.

95-100	A
90-94	A-
87-89	B+
84-86	B
81-83	B-
78-80	C+
76-77	C
74-75	C-
72-73	D+
70-71	D
69≤	F

Class attendance	10%
Quizzes	25%
Midterm Exam	25%
Final exam	40%
Total	100%

SCHEDULE

Lecture #1 covers items 1, 2 & 3

Lecture #2 covers items 3, 4 & 5. Quiz on Lecture #1

Lecture #3 covers items 7, 8 & 9. Quiz on Lecture #2

Lecture #4 covers items 10, 11 & 12. Quiz on Lecture #3

Lecture #5 covers items 13, 14 & 15. Quiz on Lecture #4

Lecture #6 covers items 16 & 17. Quiz on Lecture #5

Lecture #7 reviews items 1 to 17 to prepare for Mid-term. Quiz on Lecture #7

Lecture #8 **MIDTERM EXAM.** Lecture on item 18

Lecture #9 covers items 19 & 20. Quiz on Lecture #8

Lecture #10 covers items 21 & 22. Quiz on Lecture #9

Lecture #11 covers items 23 & 24. Quiz on Lecture 10

Lecture #12 reviews all items from 1 to 24. Quiz on Lecture #11
600+ ARDMS Physics Test Questions

Lecture #13 **FINAL EXAM**

(*) INSTRUCTOR AFFILIATIONS

- Member of AIUM (American Institute of Ultrasound in Medicine)
- ASE (American Society of Echocardiography)
- HMS-PGA (Harvard Medical School Postgraduate Association)
- SDMS (Society of Diagnostic Medical Sonography)
- ISEECG (International Society of Electrocardiography)
- Member of CFA (California Faculty Association)
- A Reviewer for the Journal "Ultrasound in Medicine"
- A Reviewer for the Journal "Ultrasound in Medicine and Biology"

STUDENT LEARNING FEEDBACK: Result of the actual **ARDMS Physics Test** is gauged as learning feedback of my students.

Updated: 5/1/2012