

LINCOLN UNIVERSITY
SPRING 2012 COURSE SYLLABUS

Course Number: **DI 10 / UT 10**
Course Units: **3 Units (45 lecture hours)**
Course Title: **Physical Principles of Ultrasound**
Instructor: **Chris T. Nguyen, Ph.D. (*)**

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. (3 units)

Prerequisite: SCI 10 or equivalent

COURSE OBJECTIVES AND STUDENT LEARNING OUTCOMES

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

- Describe the characteristics of sound wave
- Explain the fundamental requirement for sound to travel
- Discuss medium stiffness, density
- Explain the three processes in which attenuation occurs
- Explain how attenuation is calculated
- Explain the different types of scattering
- Discuss echogenicity, hyperechoic, hypoechoic, isoechoic
- Explain the difference between pulsed wave and continuous wave
- Relate frequency / period, pulse repetition frequency / pulse repetition period
- Discuss bandwidth, quality factor. Duty factor
- Identify elements of an ultrasound transducer. Types of probes
- Discuss characteristics of transducer, frequency, crystal thickness, matching layer
- Discuss attenuation, penetration, resolutions. Line density, frame rate
- Relate impedance / reflection, velocity / refraction
- Discuss near zone, far zone, focal zone, beam width
- Identify different components of an ultrasound system
- Discuss transmit power, receiver gain, TGC, dynamic range, pre-processing, post-processing, persistence
- 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-node
- Discuss different types of flows: plug, laminar, parabolic, turbulent
- Discuss artifacts: reverberation, mirror image, comet tail, ring-down, shadow, enhancement, edge shadow, speed error, registration error, section thickness, aliasing. Side lobe / grating lobe
- Discuss probe and system quality and reliability, bio-effect, safety, calibration, maintenance
- Discuss ALARA, thermal bioeffect, mechanical bioeffect, cavitation, temperature
- 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 and effectively operate Ultrasound systems**

INSTRUCTIONAL METHOD

Instructional methods will include lectures by the Instructor and Lab. 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.

EVALUATION

1. Homework and Quiz: Written homework assignments will be given on a weekly basis. Additionally, unannounced quizzes will be given in Class.
2. Final Examination

GRADING SCALE

Class attendance	20%
Quizzes	20%
Homework	20%
Final Exam	<u>40%</u>
	100%

90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
Below 60	F

To successfully complete this course, the student must attend the lecture regularly, and pass the quizzes, homework, and final exam portions with a total score of 70% or higher.

RESOURCE MATERIALS

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

(*) 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)
- A Reviewer for the Journal “Ultrasound in Medicine”
- A Reviewer for the Journal “Ultrasound in Medicine and Biology”

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OFFICE HOURS: Contact Dr. Chris T. Nguyen for appointment.

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