COURSE SYLLABUS

Course Number: **DI 10**

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

Course Title: **Physical Principles of Ultrasound**

Course Credit: **3 units**

COURSE DESCRIPTION

This course introduces ultrasound physical principles and instrumentation. Topics include sound wave mechanics, transducers, ultrasound equipment, Doppler physics and safety.

COURSE OBJECTIVES AND STUDENT LEARNING OUTCOMES

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

- Describe the characteristics of a sound wave.
- Explain the fundamental requirement for sound to travel.
- Describe three ways in which attenuation occurs.
- Explain how attenuation is calculated.
- Relate the importance of impedance in ultrasound propagation.
- Explain the different types of scattering.
- Explain the difference between pulsed wave and continuous wave.
- Compare frequency / period and pulse repetition frequency / period.
- Discuss bandwidth, quality factor. Duty factor.
- Identify elements of an ultrasonic transducer. Types of probes.
- Relate characteristics of transducer frequency.
- Describe the significance of crystal thickness and matching layers.
- Discus physical characteristics of the sound beam.
- Relate sound beam divergence and factors that affect beam geometry.
- Discuss attenuation, penetration, resolutions, line density, frame rate.
- Identify different components of the ultrasound system.
- Discuss transmit power, receiver gain, TGC, log compression, 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, Doppler tissue imaging, color M-mode.
- Discuss artifacts: mirror image, reverberations, comet tail, shadow, enhancement, speed error, registration error, section thickness.
- Discuss probe and system quality and reliability, bio-effect and safety, calibration and maintenance.
- Operate Ultrasound Systems and perform basic scanning.

INSTRUCTIONAL METHODS:

Instructional methods will include lectures by 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.

45 hours lecture = 3 units

EVALUATION

1. Weekly Quiz – Homework assignments will be given on a weekly basis Additionally, unannounced quizzes will be given in Class.
2. Final Examination

Grading Scale:

Class Participation	20%
Quiz	20%
Homework	20%
Final Exam	40%
	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 lectures, and pass quiz, homework and final exam portions with a 70% or better.

RESOURCE MATERIALS : Textbook

- Diagnostic ultrasound: Principles and Instruments
  by Frederick W Kremkau, Ph. D. (Edition 2006 or later)
- Physics Test samples from ARDMS

(*) 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)
- ISECG (International Society of Electrocardiography)
- Reviewer of a professional journal in Ultrasound.