LINCOLN UNIVERSITY

DI 210 – Advanced Ultrasound Physics and Technology

Fall 2022 Course Syllabus

Class Hours: Thursday, 6:30 PM – 9:15 PM (Online)
Credit: 3 units (45 lecture hours)
Level: Advanced (A)
Instructor: **Guillermo Paredes** M.D., MS, RDMS (OB), (AB). RVT (VT)
Contact: **gparedes@lincolnuca.edu.** Cell Phone: (650) 784-8522. Office Hours: **Anytime.**

RESOURCE MATERIALS

- **Diagnostic Ultrasound: Principles and Instruments** by Understanding Ultrasound Physics. Sidney Edelman, PH.D. 4th edition ARDMS Physics Test Samples from different sources
- "Ultrasonography Examination" by Appleton & Lange
- "Ultrasound Physics Review" by Davies Publishing

COURSE DESCRIPTION

This course provides a quick review of "Physical Principles of Ultrasound" and then introduces advanced technologies, systems, probes, imaging modes, and applications in sonography. (3 units)
Prerequisite: Completion of all DI 100 series coursework

COURSE LEARNING OUTCOME[1]

	Course Learning Outcome	PLO	ILO	Assessment
1	Operate some widely used Ultrasound systems by GE, Philips, Siemens, and others. Understand and apply different imaging modes: Doppler, Tissue velocity, M-Mode, Color M-Mode, Contrast-Enhanced Imaging, Strain & Strain Rate Measurements, Sonoelastography, and Acoustic Radiation Force Impulse. Optimize system controls for optimal 2D-images, Doppler spectrum accuracy, Power Doppler sensitivity, Strain & Strain Rate measurement accuracy.	PLO1, PLO 2	ILO 1a, ILO 2a, ILO 3a	In-class activities, quizzes, midterm, and final exams.
2	Understand the theory, operation, and handling of different types of Probes: 3D, 4D, TEE, Endovaginal, Endorectal; Understand indications and contra-indications related to endo-cavity probe usage. Understand and recognize all artifacts, particularly the recently reported ones. Learn to avoid them or to utilize them to our advantage (2D-Imaging and Doppler).	PLO 2	ILO 1a,	In-class activities.
3	Understand Bio-Effects namely Thermal and Mechanical ones. Select suitable Thermal Index (TI) and Mechanical Index (MI) for applications (Imaging of bones, Contrast Imaging. Observe ALARA.	PLO 3	ILO 1a, ILO 4a	In-class activities, quizzes, midterm, and final exams
4	Properly maintain the systems, probes, and related equipment / materials for optimal Quality & Reliability and Safety. Understand different types of phantoms, targets. 1. Understand the principles of other commonly used imaging modalities (MRI, Mammography, CT scan, PET Scan…) for correlation with Ultrasound results. 2. Understand simple statistical calculations for the interpretation of Ultrasound results such as Distribution, Mean value, Standard Deviation (SD), Sensitivity, Specificity, Accuracy, Positive Predictive Value (PPV), Negative Predictive Value (NPV).	PLO 2	ILO 1a	In-class activities, quizzes, midterm, and final exams

The two main objectives of this Course are:

- **Review materials on "Ultrasound Principles and Instrumentation" to prepare the students for the ARDMS Board Registration Physics Test.**
- **Show the students how to perform US Systems properly, effectively & safely for best results in various Diagnostic Sonography studies.**

The students are strongly encouraged to join – The American Institute of Ultrasound in Medicine (AIUM), and – The American Society of Echocardiography (ASE), as "student members" to be exposed to the real world of Ultrasound in Medicine.

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 assist students with all tutorials and other assignments.

The Course consists of **15 lectures, weekly quizzes, Q and A Sessions, Class Open Discussions, Midterm and Final Examinations**, **several lab sessions** (30 min. each). **Attendance will be recorded at every class meeting.**

EVALUATION AND GRADING

Evaluation is based on attendance, lab participation, quizzes, midterm, and final exams. To successfully complete this course, the student should attend more than 80% of the lectures and have a total score of 70% or higher.

Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	F
Points	95-100	90-94	87-89	84-86	81-83	78-80	76-77	74-75	72-73	70-71	0-69

Class attendance	**2%**
Quizzes (two quizzes)	**18% (9% each)**
Midterm Exam	**35%**
Final exam	**45%**
Total	**100%**

Lecture Schedule

DI 210 – Advanced Ultrasound Physics and Technology Begins Thursday, August 25th, Ends: Thursday, December 8th. Holiday Thursday, November 24th. 15 sessions (lectures). 6:30PM to 9:15PM

Lecture #	Dates	Topics	Post-Class Exercises Understanding Ultrasound Physics. Sidney Edelman, PH.D. 4th edition	Reading for the Next Week Understanding Ultrasound Physics. Sidney Edelman, PH.D. 4th edition
1	Aug 25th	Basics, Sound	Chapters 1 The basics Chapter 2 Sound	Review pp 7 – 10 and 16 – 18
2	Sep 1st	Describing Sound Waves	Chapter 3 Describing Sound Waves	Review pp 41 – 46
3	Sep 8th	Describing Pulse Waves, Intensity	Chapters 4 Describing Pulse Waves Chapter 5 Intensities	Review pp 59, 62, 65 – 68, 74
4	Sep 15th	Quiz 1 Chapters 1-5 Interaction of the Sound and Media	Chapters 6 Interaction of Sound and Media, Chapter 7 Range Equation	Review pp 79, 89, 96, 98, 104, 105, 106, 111, 112.
5	Sep 22nd	Artifacts	Chapter 21 Artifacts	Review pp 376 – 378
6	Sep 29th	PZT, Sound Beam, Transducers I.	Chapter 9 Sound Beam Chapter 8 Transducer	Review pp 126 – 128, 133, 134, 138, 141,
7	Oct 6th	Transducers II, Resolution	Chapter 10 Resolution Chapter 12 Transducers pp 167 to 194	143, 144, 149, 150, 157, 158, 195, 196
8	Oct 13th	Midterm Exam Chapter 1-10, 12. Real time Imaging, Pulse Echo Instrumentation I	Chapter 13 Real Time Chapter 14 Pulse Echo Instrumentation	Review pp 210 – 214, 229, 236 – 238, 261 – 264, 267, 283, 284
9	Oct 20th	Pulse Echo Instrumentation II	Chapter 15 Displays and	
10	Oct 27th	Pulse Echo Instrumentation III	Image Processing Chapter 16 Dynamic Range	
11	Nov 3rd	Quiz 2 Chapters 13-16 Modes & Doppler I	Chapter 11 pp 161-162 Chapter 18 Hemodynamics Chapter 19 Doppler	Review pp 297, 299, 302, 327, 329 – 331, 338 – 340 Final Exam Review pp 423 to 552
12	Nov 10th	Doppler II		
13	Nov 17th	Doppler III & QA		
14	Dec 1st	General Review		
15	Dec 8th	Final Comprehensive Exam		