



LINCOLN UNIVERSITY

DI 210 – Advanced Ultrasound Physics and Technology

Spring 2024 Course Syllabus

Class Hours: Thursday, 6:30 PM – 9:15 PM

Credit: 3 units (45 lecture hours)

Level: Advanced (A)

Instructor: **Guillermo Paredes** M.D., MS, RDMS (OB), (AB). RVT (VT)

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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 OUTCOME¹

	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

¹ Detailed description of learning outcomes and information about the assessment procedure are available at the [Learning Outcomes Assessment](#) section of LU website.

4	Properly maintain the systems, probes, and related equipment / materials for optimal Quality & Reliability and Safety. Understand different types of phantoms, targets. <ol style="list-style-type: none"> 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
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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.

Assignments and projects require students to actively use resources of the library. Detailed guide to business resources of the library as well as the description of Lincoln University approach to information literacy are available at the LU Library website (lincolnuca.libguides.com).

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.**

ASSESSMENT / EVALUATION AND GRADING

Class Attendance	5%
Quizzes (two quizzes)	40% (20% each)
Midterm Exam	25%
Final exam	30%
Total	100%

GRADING SCALE

Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	F
Points	94-100	90-93	87-89	84-86	81-83	78-80	76-77	74-75	72-73	70-71	0-69

To successfully complete this course, the student should have a total score of 70% or higher.

CLASS WORK/CLASS PARTICIPATION

- Your goal should be to demonstrate the grasp of the concepts, ability to solve problems and critical thinking skills in analyzing them.
- You should strive to ask relevant questions, volunteer relevant answers, as well as volunteer to solve problems on the board, actively participate in class discussions.

ATTENDANCE

- Lincoln University uses the class method of teaching, which assumes that each student has something to contribute and something to gain by attending class. It further assumes that there is much more instruction absorbed in the classroom than can be tested on examinations.
- Therefore, students are expected to attend all regularly scheduled class meetings and should exhibit good faith in this regard.

Instructor's attendance policy

- Attendance is mandatory. If you are frequently late to class, please review your schedule and make the necessary adjustments.
- Late arrivals are disruptive to class, they adversely affect the performance of all.

University academic integrity statement

- Students are responsible for proper conduct and integrity in all their scholastic work. They must follow a professor's instructions when completing tests, homework, and laboratory reports, and must ask for clarification if the instructions are not clear.
- In general, students should not give or receive aid when taking exams or exceed the time limitations specified by the professor. In seeking the truth, in learning to think critically, and in preparing for a life of constructive service, honesty is imperative.
- Honesty in the classroom and in the preparation of papers is therefore expected of all students. Each student has the responsibility to submit work that is uniquely his or her own. All this work must be done in accordance with established principles of academic integrity.

Classroom environment

- The primary responsibility for managing the classroom environment rests with the faculty. Students who engage in acts that result in disruption of a class may be directed by the faculty member to leave the class for the remainder of the class period.
- The faculty member should, if such action is necessary, immediately report the incident to the chair of their department, the dean of the school, and the dean of students. Longer suspensions from class, or dismissal on disciplinary grounds, must be preceded by a hearing or administrative conference as set forth in the Code of Student Conduct.
- In cases where a student's continued presence in a class, following their initial removal, poses a substantial and immediate threat or disturbance, the vice president of student success or dean of students may suspend the student from attending the class on an interim basis, pending their hearing or administrative conference.
- Cell phones are not to be used in the classroom during instructional time. Cell phones that ring and/or are answered during classroom instruction are subject to confiscation by the professor. Confiscated cell phones will be turned over to the dean of students.

Lecture Schedule

DI 210 – Advanced Ultrasound Physics and Technology

Begins Thursday, January 25th, Ends: Thursday, May 9th 15 sessions (lectures).

6:30PM to 9:15PM

Lecture #	Date	Topics	Post-Class Exercises Understanding Ultrasound Physics. Sidney Edelman, PH.D. 4 th edition	Reading for Next Week Understanding Ultrasound Physics. Sidney Edelman, PH.D. 4 th edition
1	Jan 25 th	Basics, Sound	Chapters 1 The basics Chapter 2 Sound	Review pp 7 – 10 and 16 – 18
2	Feb 1 st	Describing Sound Waves	Chapter 3 Describing Sound Waves	Review pp 41 – 46
3	Feb 8 th	Describing Pulse Waves, Intensity	Chapters 4 Describing Pulse Waves. Chapter 5 Intensities	Review pp 59, 62, 65 – 68, 74
4	Feb 15 th	Quiz 1 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	Feb 22 nd	Artifacts	Chapter 21 Artifacts	Review pp 376 – 378
6	Feb 29 th	PZT, Sound Beam, Transducers I.	Chapter 9 Sound Beam Chapter 8 Transducer	Review pp 126 – 128, 133, 134, 138, 141
7	Mar 7 th	Transducers II, Resolution	Chapter 10 Resolution Chapter 12 Transducers pp 167 to 194	143, 144, 149, 150, 157, 158, 195, 196
	Mar 14 th	No Class – Spring Break		
8	Mar 21 st	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
9	Mar 28 th	Midterm		
10	Apr 4 th	Pulse Echo Instrumentation II	Chapter 15 Displays and Image Processing	236 – 238, 261 – 264
11	Apr 11 th	Pulse Echo Instrumentation III	Chapter 16 Dynamic Range	267, 283, 284
12	Apr 18 th	Quiz 2 Modes & Doppler I	Chapter 11 pp 161-162	Review pp 297, 299, 302, 327
13	Apr 25 th	Doppler II	Chapter 18 Hemodynamics	Review pp 329 – 331, 338 – 340
14	May 2 nd	Doppler III & QA	Chapter 19 Doppler	Final Exam Review pp 423 to 552
15	May 9 th	Final Comprehensive Exam		