



# LINCOLN UNIVERSITY

## DI 10 – Physical Principles of Ultrasound

### Course Syllabus

#### Spring 2023

- Instructor:** Dr. Guillermo Paredes, MD, RDMS (ABD, OB/GYN), RVT
- Lecture Schedule:** Tuesday, 6:30 PM – 9:15 PM
- Credits:** 3 units / 45 hours of lectures
- Level:** Introductory (I)
- Office Hours:** By appointment  
E-mail: [gparedes@lincolnuca.edu](mailto:gparedes@lincolnuca.edu)
- Textbooks:**
- ***Diagnostic Ultrasound: Principles and Instruments*** by Frederick W. Kremkau, Saunders Publishing, 8th edition (Sonography Principles and Instruments, 2010), ISBN-10: 143770980X, ISBN-13: 978-1437709803  
7th edition (2005), ISBN-10: 0721631924, ISBN-13: 9780721631929
  - ***ARDMS Physics*** Test samples from different sources Ultrasonography Examination by Odwin & Fleischer, Lange Review Series – McGraw-Hill, 4th edition (2012)  
ISBN10: 007163424X, ISBN-13: 978-0071634243
  - ***Ultrasound Physics Review*** by Davies Publishing (2009) ISBN-10: 0941022749, ISBN-13: 978-0941022743
  - Paredes, Guillermo. (2012). ***Workbook for ultrasound physics and instrumentations, volume I***. San Mateo, CA: Gurnick Academy of Medical Arts.
- Prerequisites:** *SCI 10 or equivalent*
- Last Revision:** January 12, 2023

#### CATALOG DESCRIPTION

This course introduces ultrasound physical principles and instrumentation. Topics include sound wave mechanics, transducers, ultrasound equipment, Doppler physics, imaging modes, artifacts, quality, bio-effects, and safety techniques. (3 units)

#### GOALS AND OBJECTIVES

1. To familiarize the Student with the fundamentals of ultrasound physics.
2. To familiarize the Student with transducers, printers, orientation, and planes of ultrasound images.
3. To familiarize the Student with basic knobology.
4. To familiarize the Student with ultrasound machines and screen data interpretation.
5. To familiarize the Student with 2-D instrumentation, interpretation of screen information, and the knobology applications.

6. To familiarize the Student with abdominal scanning through recognition and obtaining views of gross anatomy.
7. To familiarize the Student with small parts scanning through recognition and obtaining views of gross anatomy; and to familiarize the Student with obtaining a good quality image.
8. To familiarize the Student with the recording and recalling of stored images on the ultrasound machines.
9. To familiarize the Student with the basic and most common artifacts in B Mode.
10. To familiarize the Student with the instrumentation of Pulse Wave Doppler and Color Doppler.
11. To familiarize the Student with basic scanning of Common Carotid Arteries.

### STUDENT LEARNING OUTCOME ASSESSMENT

1. Four Quizzes
2. Eleven Homework
3. Class Open Discussions
4. Midterm Examination.
5. Final Examination.

#### **The two main objectives of this Course are:**

1. Prepare the students for the ARDMS Board Registration Test (120 Questions/2 hours). Actual Test with ARDMS serves as an OBJECTIVE ASSESSMENT of Students Learning Outcomes).
2. Show the students how to properly, effectively utilize ultrasound systems.

### COURSE LEARNING OUTCOMES<sup>1</sup>

Course LO	Program LO	Institution LO	Assessment activities
Understand the medical imaging. Analyze technologies designed to introduce energy into tissues. Learn the physics and technology of ultrasound design and the design parameters that determine image contrast, noise, and spatial resolution.	PLO 1, PLO 2	ILO 1a, ILO 2a, ILO 3a	In-class activities, quizzes, midterm, and final exams.
Describe the operation of an ultrasound scanner in 2-D and 3-D B-mode, Doppler and color flow mode, and elasticity modes. Choose a transducer type, plug in/activate any transducer, and select the fundamental or harmonic frequency operating range for a given imaging/performance testing task. Describe the role of principle operating controls on a scanner and adjust controls to scan phantoms and test objects.	PLO 2	ILO 1a	In-class activities.
Explain principles underlying ultrasound propagation and biological effects of ultrasound. Have knowledge of clinical uses and limitations/artifacts of ultrasound imaging. Understanding of the technical details of modern medical ultrasound devices and methods to measure acoustic parameters.	PLO 3	ILO 1a, ILO 4a	In-class activities, quizzes, midterm, and final exams

<sup>1</sup> Detailed description of learning outcomes and information about the assessment procedure are available at the [Center for Teaching and Learning](http://ctl.lincolnuca.edu) website (ctl.lincolnuca.edu).

## INSTRUCTIONAL METHODS

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.

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 [Center for Teaching and Learning](http://ctl.lincolnuca.edu) website (ctl.lincolnuca.edu).

## ASSESSMENT

- Homework 20%
  - Quizzes 20%
  - Mid-Term Exam 30%
  - Final 30%
- Maximum total score. 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.

## LECTURE SCHEDULE

Session #	Date	Home-work	Topic and Textbook Pages Covered	Exercise #
1	1/24	HW 1	Basic Physics (Sound Definition and Parameters): pp. 3-19	1-14
2	1/31	HW 2	Orientation and Description of Ultrasound Images: pp. 19-25	15-26
3	2/07	HW 3	Instrumentation (Basic Machine Knobology): pp. 25-27	27-34
4	2/14	HW 4	Screen Data Interpretation: pp. 27-29	35-46
5	2/21	HW 5	Steps to Start Patient Scanning: pp. 29-32	47-57
6	2/28		<b>Quiz 1</b>	
7	3/7	HW 6	Labeling and Input Data; Scanning of the Following Gross Anatomy I: Left-Lobe of the Liver, Gallbladder, Right Kidney, Inferior Vena Cava, Aorta, Urinary Bladder: pp. 32-36	58-71
	<b>3/14</b>		<b>No Class – Spring Break</b>	
8	3/21	HW 7	Settings for Ultrasound Image and Quality Adjustments; Scanning of the Following Gross Anatomy II: Thyroid Gland: pp. 36-37 <b>Midterm</b>	72-75
9	3/28	HW 8	Recording on and Recalling Stored Images from Ultrasound machines: pp. 37-39	76-83
10	4/4	HW 9	Recognizing and Identifying the Different Types of Artifacts: pp. 39-41 <b>Quiz 2</b>	84-86

11	4/11	HW 10	A Mode, B Mode, & M Mode; Doppler I: Continuous Wave Doppler, Color Doppler, & Pulse-Wave Doppler: pp. 42-56	87-100
12	4/18		Doppler II, Scanning of the Following Gross Anatomy III: Common Carotid Artery: pp. 56-60	101-114
13	4/25	HW 11	<b>Continuation:</b> Doppler II, Scanning of the Following Gross Anatomy III: Common Carotid Artery: pp. 56-60	101-114
14	5/2		<b>Review Final Exam</b>	
15	5/9		<b>Final Exam</b>	

### 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.

### HOMEWORK

I will give homework every class, as we move forward. I will review and collect homework on selected days only. Bring your current homework to every class.

### 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.

**Policy on electronic devices in classroom**

- Students are not allowed to use electronic devices in the classroom or lab at any time. If you have an emergency quietly step outside and take care of it.
- You can use laptops only if it is directly related to the task at hand.
- Tape-and video recording without the consent of the instructor is not allowed.