LINCOLN UNIVERSITY

DI 10 – Physical Principles of Ultrasound

Course Syllabus

Summer 2022

Instructor: Dr. Olesya Smolyarchuk, MD, RDMS (ABD, OB/GYN), RVT
Lecture Schedule: Tuesday 12:30 PM – 3:15 PM
Wednesday 9:00 AM – 11:45 AM
Credits: 3 units / 45 hours of lectures
Level: Introductory (I)
Office Hours: By appointment
E-mail: osmolyarchuk@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
- ***Examination review for Ultrasound, Sonographic Principles and Instrumentation***, second edition by Steven M. Penny, Traci B. Fox.
ISBN-13: 978-1-4963-7732-6

Prerequisites: *SCI 10 or equivalent*
Last Revision: June, 2022

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. Quizzes
2. Class Open Discussions
3. Midterm Examination.
4. 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 utilize ultrasound systems properly and effectively.

COURSE LEARNING OUTCOMES[1]

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.	PLO 2	ILO 1a	In-class activities.

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

Describe the role of principle operating controls on a scanner and adjust controls to scan phantoms and test objects.			
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

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 website (ctl.lincolnuca.edu).

ASSESSMENT

- Attendance 10%
- Quizzes 20%
- Mid-Term Exam 35%
- Final 35%
  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

Date	Topic and Textbook Pages Covered	Quiz
06/14 06/15	Basic Physics. Fundamentals and units of measurements. Sound Definition and Parameters	#1
06/21 06/22	The sound source and the medium. Interactions of sound with the tissue	#2-3
06/28 06/29	Ultrasound Transducers. Instrumentation (Basic Machine Knobology)	#4-5
07/05	**Midterm Exam**	
07/06	Display modes. Transmission and reception of ultrasound	

07/12	Imaging Artifacts. Recognizing and Identifying the Different Types of Artifacts	#6
07/13	Hemodynamics	#7
07/19	Doppler Principles	#8
07/20	Quality Assurance. Tissue equivalent phantom	#9
07/26	Patient care, Safety, and Communication. Bioeffects. Ergonomics.	#10
07/27	**Final Exam**	

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.

CLASSROOM PROTOCOL

- All students are expected to display professionalism, in preparation for hospital work. That means arriving on time, remaining quiet when others are speaking, and paying attention to whoever has the floor in the classroom.
- Students are expected to attend and be prepared for all regularly scheduled classes. If a student knows in advance that he or she will need to leave early, he or she should notify the instructor before the class period begins.
- Students are expected to treat faculty and fellow students with respect. For example, students must not disrupt class by leaving and reentering during class, must not distract class by making noise, and must be attentive to comments being made by the instructor and by peers.
- Never speak while the instructor is speaking.
- **Disruptive behavior will not be tolerated.**
- Students engaging in disruptive behavior in class will be asked to leave and may be subject to other penalties if the behavior continues.
- **No eating, sleeping or personal grooming is permitted during lecture and ultrasound laboratory classes.**
- **Drinks only in closed container in classroom and not in the laboratory.**
- Please turn off your cell phones.
- If you use a computer in class, please use it only to take notes, to access course materials from the course webpage, or to locate information relevant to the class discussion.
- Do not use your computer to surf the web, check emails, or send/receive text messages, as these activities are distracting to those around you (and decrease your chances of getting the most out of your time in class).

- To encourage the free flow of conversation, no part of any class may be recorded on audio or video media without the permission of the instructor. You may record notes by hand or by typing into a mobile computer.
- The presence of guests to listen to any part of a class requires the consent of the instructor.

ATTENDANCE

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.

COURSE GUIDELINES

To successfully complete this course, students must pass the quizzes, midterm and final exam portions with a 70% or better. Students should attend all the class meetings. However, considering possible urgent situations, students may be absent from maximum two class meetings with prior notice to the instructor. Three late arrivals will affect the grade.

- **Students who are tardy, who arrive after roll is taken will consider absent.**
- **Students are not allowed to be more than 10 minutes late.**
- **If you are late or absent, a valid excuse such as illness, family emergency, unforeseen heavy traffic or natural disaster is expected.**
- **If you are late because of unforeseen heavy traffic more than 3 times during the semester it will consider as absence.**
- **If a student arrives twice late for a one session (at the begging of the class and after break more than 5 minutes late) would consider as absent.**

The term grade is based on attendance, class activity, midterm and/or sum of quizzes, final examination.

If a student misses a class without a valid reason, no make-up for quizzes and presentations is allowed. With a valid document, a student is allowed to take missed tests within one week. The valid document must be provided as soon as possible after the student returns from the illness and as determined by the instructor. There is no make-up for missed or failed midterm. The final examination, if failed, can be retaken only once. If failed second time, the subject is considered failed. Dictionaries can be used during the class time. No electronic devices during the test time.

Exams must be taken during the scheduled time period. A student missing an exam because of an illness or legitimate emergency may take a make-up exam as soon as possible after the student returns from the illness and as determined by the instructor. In such a circumstance, the student should make every reasonable attempt to contact the instructor before the exam period is over (or as soon as possible). While make-up exams will cover the same content area as a missed exam, the exam format and specific questions may be different.

During the written exam, any student observed in a situation that could be considered suspicious (e.g., an open book within his/her field of vision, looking around or checking a cell phone or other wireless device (a smart watch, etc.) but no cheating is observed, will be warned. Once warned, any applicant found cheating on written exam will be failed for the exam and prohibited from retaking the written exam without permission from the dean.

Students cannot leave the room during the test/exam. As soon as a student leaves, his/her exam is considered finished.

Lecture is not a substitute for textbooks. Students should read textbooks and use other sources to be prepared for the tests. Lecture is to guide the students to prepare for the course subjects.

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.