



BROWARD COLLEGE COURSE OUTLINE

LAST REVIEW: 2008-2009 **NEXT REVIEW:** 2013-2014 **STATUS:** A
(i.e. 2003-2004) *(i.e. 2008-2009)* *(A, I, D)*

COURSE TITLE: Sonographic Physics I

COMMON COURSE NUMBER: 1211

CREDIT HOURS: 3

CONTACT HOUR BREAKDOWN
(per 16 week term)

CLOCK HOURS:
(Voc. Course ONLY)

Lecture: 48 Lab:
Clinic: Other:

PREREQUISITE(S): SON 1100, SON 1170

COREQUISITE(S): SON 1111, SON 1121, SON 1214, SON 1804

PRE/COREQUISITE(S):

COURSE DESCRIPTION *(750 character smaximum)*: A study of the principles of diagnostic ultrasound, the fundamental properties of ultrasonic physics, stressing tissue interactions, and interfaces. Focusing characteristics, methods, intensity, and power considerations are introduced along with system resolution considerations.

General Education Requirements – Associate of Arts Degree (AA), meets Area(s): Area
General Education Requirements – Associate in Science Degree (AS), meets Area(s): Area
General Education Requirements – Associate in Applied Science Degree (AAS), meets Area(s): Area

UNIT TITLES

1. Basic Physics of Ultrasound
2. The transducer
3. Ultrasonic Field

ASSESSMENT:

Please provide a brief description (250 characters maximum) that details how students will be assessed on the course outcomes. **Quizzes, midterm exam and final exam – all comprehensive. Assignment may be given**

**** Complete the following only if course is seeking general education status ****

GENERAL EDUCATION Competencies and Skills*:

Please highlight in green font all Competencies/Skills from the list below that apply to this course. In the box to the right of the Competency/Skill, enter all specific learning outcome numbers (i.e. 1.1, 2.7, 5.12) that apply.

1. Read with critical comprehension	
2. Speak and listen effectively	
3. Speak and listen effectively	
4. Think creatively, logically, critically, and reflectively (analyze, synthesize, apply, and evaluate)	
5. Demonstrate and apply literacy in its various forms: (highlight in green ALL that apply) (1. technological, 2. informational, 3. mathematical, 4. scientific, 5. cultural, 6. historical, 7. aesthetic and/or 8. environmental)	
6. Apply problem solving techniques to real-world experiences	
7. Apply methods of scientific inquiry	
8. Demonstrate an understanding of the physical and biological environment and how it is impacted by human beings	
9. Demonstrate an understanding of and appreciation for human diversities and commonalities	
10. Collaborate with others to achieve common goals.	
11. Research, synthesize and produce original work	
12. Practice ethical behavior	
13. Demonstrate self-direction and self motivation	
14. Assume responsibility for and understand the impact of personal behaviors on self and society	
15. Contribute to the welfare of the community	

** General Education Competencies and Skills endorsed by '05-'06 General Education Task Force*

Common Course Number: SON 1211

UNITS

Unit 1 Basic Physics of Ultrasound

General Outcome:

- 1.0 The student shall:** demonstrate an understanding of the parameters of sound waves and their interactions with tissue.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 1.1 Describe the concepts of fundamental mathematical functions and algebraic equations and perform appropriate mathematical and algebraic functions
- 1.2 Relate mathematical formulas to the action of sound at interfaces of various qualities
- 1.3 List and describe the physical units involved in sonography
- 1.4 Define acoustic wave and describe the types
- 1.5 Explain what sound is and describe its characteristics
- 1.6 Describe the main features of a sound wave disturbance
- 1.7 Distinguish between infrasound, audible sound and ultrasound
- 1.8 Compare the difference between pulsed and continuous wave
- 1.9 Describe factors controlling velocity of propagation and the relationship of velocity to frequency and wavelength
- 1.10 Describe the phases of a wave and how waves interfere with one another
- 1.11 Define spatial and temporal intensity
- 1.12 Outline the factors affecting amplitude
- 1.13 Define acoustic impedance
- 1.14 Define bel and decibel
- 1.15 Outline the processes involved in attenuation
- 1.16 Describe the causes and effects of attenuation and impedance on ultrasound

- 1.17 Describe scattering
- 1.18 Identify the causes and effects of incidence, scattering and refraction on ultrasound
- 1.19 Describe perpendicular reflection and transmission at a plane boundary
- 1.20 Discuss oblique incidence at a plane boundary and the consequent reflection and refraction
- 1.21 Describe the factors of attenuation versus depth penetration of ultrasound in human tissue
- 1.22 Describe the modes of reflection and refraction and the laws governing this phenomenon.
- 1.23 Explain amplitude and intensity of sound as it applies to the field of ultrasound
- 1.24 Discuss and demonstrate the basic principles governing sound and sound interaction in various types of tissue
- 1.25 Describe and demonstrate the conditions affecting sound transmission such as the attenuation factors
- 1.26 Explain the quantification of attenuation in tissues and its frequency dependence
- 1.27 Describe the principle of pulse echo ranging
- 1.28 Explain the importance of knowing the average speed of propagation in echo ranging
- 1.29 Explain and use the various types of scanning movements required to produce diagnostic quality sonograms
- 1.30 perform linear, area, circumference and other related measurements from sonographic images or data
- 1.31 Utilize archiving devices to obtain pertinent documentation of examination findings

Common Course Number: SON 1211

UNITS

Unit 2 The Transducer

General Outcome:

- 2.0 The student shall:** demonstrate an understanding of the construction and function of transducers.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 2.1 Describe piezoelectric effect and materials possessing this property
- 2.2 Describe resonance and factors that affect it
- 2.3 List situations that contribute to crystal variations
- 2.4 Name factors that contribute to changes in frequency and describe how these changes in frequency affect diagnostic ultrasound imaging
- 2.5 Define transducer Q and bandwidth and discuss their effects
- 2.6 Illustrate the construction of a transducer
- 2.7 Discuss historical perspective of scanner development
- 2.8 Describe single element and array transducer construction
- 2.9 Discuss the roles of half-wavelength resonance, damping and quarter-wavelength matching in the operation of a piezoelectric transducer
- 2.10 Describe how a transducer may be operated in continuous wave mode
- 2.11 Show the ways that a transducer may be driven in pulsed mode and discuss the factors that affect pulse duration/length
- 2.12 Discuss the role of the piezoelectric transducer as a receiver/detector of ultrasound
- 2.13 Appreciate the need for measures to take care of the transducer probe
- 2.14 Define transducer bandwidth and discuss its effect
- 2.15 Demonstrate ability to select transducer(s) most appropriate for exam(s)

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UNITS

Unit 3 Ultrasonic Field

General Outcome:

3.0 The student shall: demonstrate an understanding of the sound field and factors affecting it

Specific Measurable Learning Outcomes: Upon successful completion of this unit, the student shall be able to

- 3.1 Describe the regions of a sound beam and the parameters affecting them
- 3.2 Describe methods used to focus a sound beam
- 3.3 Name at least 6 factors which affect resolution
- 3.4 Describe diffraction patterns
- 3.5 Identify resolution and controlling factors of resolution as applied to the field of ultrasound
- 3.6 Describe spatial resolution and its effect on the final image
- 3.7 Describe and demonstrate the factors that control and determine axial, lateral and elevational (slice thickness) resolution
- 3.8 Draw the beam, with near field and far field, produced by a circular transducer
- 3.9 Explain interference, both constructive and destructive, and relate how the intensity of the beam is affected by these factors
- 3.10 Define Huygen's principle
- 3.11 Explain sensitivity of a transducer
- 3.12 Explain operator controls as they relate to ultrasonic field