



# 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:** Medical Ultrasound Physics II

**COMMON COURSE NUMBER:** SON1212

**CREDIT HOURS:** 3

## CONTACT HOUR BREAKDOWN

*(per 16 week term)*

**CLOCK HOURS:**

*(Voc. Course ONLY)*

Lecture: 3

Lab:

Clinic:

Other:

**PREREQUISITE(S):** SON1100, SON1170, SON1111, SON1121, SON 1211, SON1214, SON1804

**COREQUISITE(S):** SON1112, SON1122, SON1215, SON1814

**PRE/COREQUISITE(S):**

**COURSE DESCRIPTION** *(750 character maximum)*: **A continuation of the study of the properties of diagnostic ultrasound stressing the operation of diagnostic equipment, the display systems, biological effects and quality assurance methods. Current developments in ultrasound are review, discussed, and evaluated.**

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. Pulse Echo System
2. Imaging and Doppler System
3. Biological Effects
4. Testing and Calibration Procedures
5. Artifacts
6. Continuity

### ASSESSMENT:

Please provide a brief description (250 characters maximum) that details how students will be assessed on the course outcomes. **Quizzes, Midterm and Final Exams – all comprehensive. Students must earn a C or better to complete.**

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

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

**Common Course Number: SON1212**

## **UNITS**

### **Unit 1** Pulse Echo System

#### **General Outcome:**

- 1.0 The student shall:** demonstrate an understanding of instrumentation and equipment operation.

#### **Specific Measurable Learning Outcomes:**

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

- 1.1 Describe basic pulse echo systems
- 1.2 Define dynamic range and explain its' significance
- 1.3 Illustrate the system layout of a pulse echo instrument
- 1.4 Explain the function of the following components of a pulse echo instrument:
  - a. transmitter
  - b. receiver
  - c. video amplifier
  - d. cathode ray tube (TV monitor)
- 1.5 Describe at least four methods of displaying ultrasound information
- 1.6 Describe A-Mode, B-Mode and M-Mode presentation of echo information
- 1.7 Explain the functions of the following controls of diagnostic ultrasound instruments:
  - a. output power
  - b. overall gain
  - c. time compensated gain
  - d. reject
  - e. preprocessing
  - f. postprocessing
- 1.8 Demonstrate knowledge of ultrasound instrumentation
- 1.9 Explain the various types of equipment and their selection in performing an ultrasound exam
- 1.10 Discuss basic unit construction in the form of block diagrams for imaging and Doppler instruments, including color Doppler and Amplitude Doppler
- 1.11 Describe the purpose and use of typical controls located on imaging and Doppler instruments

- 1.12 Demonstrate understanding of acoustical physics, Doppler ultrasound principles and medical ultrasound imaging principles and instrumentation
- 1.13 Identify resolution and controlling factors of resolution as applied to the field of ultrasound
  - a. detail (spatial)
  - b. contrast
  - c. temporal
- 1.14 Demonstrate knowledge of selecting the correct technique(s) for examination(s) being performed
- 1.15 Adjust instrument controls to optimize image quality
- 1.16 Explain the principles and proper use of Harmonics
- 1.17 Explain the principles and proper use of Compounding
- 1.18 Explain the principles utilized in 3 dimensional scanning
- 1.19 Explain the techniques of recording static and dynamic images
- 1.20 Utilize hard-copy devices to obtain pertinent documentation of exam findings

**Common Course Number: SON1212**

## **UNITS**

### **Unit 2** Imaging and Doppler Systems

#### **General Outcome:**

- 2.0 The student shall:** demonstrate an understanding of the principles of real-time imaging and Doppler applications.

#### **Specific Measurable Learning Outcomes:**

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

- 2.1** Describe how data acquisition rates, line density, and the field of view affect the image formation of real-time systems
- 2.2** List at least five factors influencing line density in real-time imaging
- 2.3** Outline the difference between the advantages or disadvantages of the following types of real-time scanners:
  - a. mechanical
  - b. multielement array
  - c. phased array
  - d. sequential linear array
  - e. convex linear array
  - f. vector array
- 2.4** Illustrate the major components of a cathode ray tube/TV. monitor
- 2.5** Outline the purpose of video scan converters and the difference between analog and digital
- 2.6** Describe the construction of a digital scan converter
- 2.7** Explain the function of binary numbers in the scan converter
- 2.8** Describe the resolving difference between a 4-bit system and those with higher numbers., i.e., 5-bit, 6-bit, 7-bit, 8-bit, etc.
- 2.9** Define Doppler effect and explain how it applies in diagnostic ultrasound
- 2.10** Describe principles of Doppler techniques
- 2.11** Explain methods of Doppler flow analysis
- 2.12** Describe color Doppler and explain its uses and limitations
- 2.13** Describe Amplitude Doppler (Power, Angio-) and explain its uses and limitations
- 2.14** Distinguish between sector scanners, linear array scanners, convex linear arrays, vector array, and intracavitary scanners with varying sector angles, and identify the field of view format of each
- 2.15** Explain the uses of the various operator control options associated with obtaining an optimal image or Doppler presentation for specific exams

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## UNITS

## Unit 3 Biological Effects

## General Outcome:

**3.0 The student shall:** discuss the biological effects of ultrasound interaction with tissue

## Specific Measurable Learning Outcomes:

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

- 3.1 Describe the following mechanisms by which biological changes happen:
  - a. thermal
  - b. cavitation
  - c. shear forces (mechanical)
- 3.2 Discuss causes, detection and control of factors that may create biological effects in human tissue with insonation at the diagnostic medical exposure level
- 3.3 Demonstrate current knowledge related to biological effects, including methods of reducing patient exposure to acoustic energy
- 3.4 Describe the methods used to obtain biologic effect data to date., i.e., in Vivo, in Vitro, epidemiological, longitudinal studies, etc.
- 3.5 Relate the A.I.U.M. position on biologic effects of ultrasound
- 3.6 Explain the basic assumptions related to mechanical index and thermal index
- 3.7 Describe modern instrument options and transducer selection options to maximize exam quality and minimize patient exposure to acoustic energy

**Common Course Number: SON1212**

## **UNITS**

### **Unit 4** Testing and Calibration Procedures

#### **General Outcome:**

- 4.0 The student shall:** demonstrate an understanding of quality assurance procedures and measures associated with sonography equipment

#### **Specific Measurable Learning Outcomes:**

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

- 4.1** Name at least three intensity parameters when considering measurement of acoustic output
- 4.2** Describe at least two techniques to measure the intensity
- 4.3** Identify a testing and calibration procedure for each of the following:
- a. sensitivity
  - b. resolution
    - i. axial
    - ii. lateral
    - iii. elevational
  - c. Doppler
  - d. dimensional calibration
  - e. dead zone
  - f. scan converter integrity
  - g. gray scale dynamic range
- 4.4** Identify methods of determining and assuring quality control both sonographically and photographically
- 4.5** Explain and use appropriate test objects
- 4.6** Explain and use a tissue-equivalent phantom
- 4.7** Distinguish between a phantom and a test object
- 4.8** Demonstrate knowledge and skills necessary to design and implement quality assurance programs, protocols, policies and procedures for general function and operation of the ultrasound department
- 4.9** Explain the importance of a routine quality assurance program as it relates to patient safety and to insuring optimal image quality

**Common Course Number: SON1212**

## **UNITS**

### **Unit 5 Artifacts**

#### **General Outcome:**

**5.0 The student shall:** demonstrate an understanding of the types and causes of artifacts and their effects on the sonogram

#### **Specific Measurable Learning Outcomes:**

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

- 5.1** Explain and recognize typical artifacts as found in sonographic imaging and photography, including:
- a. reverberation
  - b. shadowing
  - c. enhancement
  - d. slice thickness
  - e. mirror image
  - f. ring-down
  - g. beam width
  - h. speckle
  - i. side lobe/grating lobe
  - j. duplication
  - k. speed of sound artifacts
  - l. aliasing
  - m. artifacts associated with Doppler and color-flow imaging
- 5.2** Recognize and minimize and/or compensate for acoustic artifacts

**Common Course Number: SON1212**

## **UNITS**

### **Unit 6** Continuity

#### **General Outcome:**

- 6.0 The student shall:** demonstrate an understanding of the correlation of information gained in Term II with that gained in Term I.

#### **Specific Measurable Learning Outcomes:**

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

- 6.1** Recall the principles of physics and ultrasound physics from Term I.
- 6.2** Recall information regarding biological effects and instrumentation from Term I
- 6.3** Relate Term I material to knowledge gained in advanced physics, Term II.