El Paso Community College
Syllabus
Part II
Official Course Description

SUBJECT AREA	**Diagnostic Medical Sonography**
COURSE RUBRIC AND NUMBER	**DMSO 1302**
COURSE TITLE	**Basic Ultrasound Physics**
COURSE CREDIT HOURS	**3 3 : 1** **Credits Lec Lab**

I. Catalog Description

Provides basic acoustical physics and acoustical waves in human tissue. Emphasizes ultrasound transmission in soft tissues, attenuation of sound energy, parameters affecting sound transmission, and resolution of sound beams. A grade of "C" or better is required in this course to take the next course. **Prerequisites: MATH 1314. (3:1). Lab fee.**

II. Course Objectives

Upon satisfactory completion of this course, the student will be able to:

A. Unit I. Mathematics Review and History of Ultrasound

1. Manipulate basic algebraic equations, solving for given variables.
2. Perform algebraic calculations utilizing the algebraic hierarchy (i.e., the rules of addition/subtraction, multiplication/division and proper use and sequence of parentheses).
3. Solve algebraic equations with multiple units, carrying the correct unit(s) through to the end of the equation.
4. Convert between standard (American) and metric units.
5. Recognize and apply complementary metric units.
6. Write numbers in scientific notation.
7. Relate major milestones in the development of ultrasound as a diagnostic tool.
8. Identify pioneers in ultrasound research and development.

B. Unit II. Sound and Parameters of Continuous Wave Ultrasound

1. Define the term "wave."
2. Describe the characteristics of a wave.
3. Define the following sound parameters:
   a. Frequency
   b. Period
   c. Wavelength
   d. Propagation speed
   e. Amplitude
   f. Intensity
4. Provide the formula for the following continuous wave ultrasound parameters:
   a. Frequency
   b. Period

c. Wavelength
d. Propagation speed
e. Amplitude
f. Intensity

5. Explain the fundamental requirement for sound to travel.
6. Relate the difference between an acoustic variable and an ultrasound parameter.
7. Define the following acoustic variable terms:
   a. Pressure
   b. Density
   c. Temperature
   d. Particle Motion
8. Describe how acoustic variables relate to diagnostic ultrasound.
9. Identify which of the ultrasound parameters are determined primarily by the sound source.
10. Identify which of the ultrasound parameters are determined primarily by the medium.
11. Relate sound phases to interference.
12. Define power and its relation to amplitude.

C. Unit III. Attenuation

1. Define the following:
   a. Logarithm
   b. Decibel
   c. Attenuation
2. Describe three ways in which attenuation occurs:
3. Explain how attenuation is calculated.
4. Describe the significance of the half value layer thickness.
5. Relate the importance of impedance in ultrasonic reflections.
6. Explain the different types of scattering and inflections and give characteristics of each.
7. Relate sound beam angles of incidence as they may effect reflection and transmission.
8. Discuss the phenomenon of refraction and conditions under which it occurs.
9. Explain how an imaging system determines the depth of a reflecting surface.

D. Unit IV. Pulsed Wave

1. Define pulsed ultrasound.
2. Explain the differences between pulsed ultrasound and continuous wave ultrasound.
3. Give examples of how pulsed ultrasound and continuous wave ultrasound are applied in the field of diagnostic ultrasound.
4. Define the following pulsed ultrasound parameters:
   a. Pulse Repetition Frequency
   b. Pulse Repetition Period
   c. Duty Factor
   d. Spatial Pulse Length
5. Provide the formula for the following pulsed ultrasound parameters:
   a. Pulse Repetition Frequency
   b. Pulse Repetition Period
   c. Pulse Duration
   d. Duty Factor
   e. Spatial Pulse Length
6. Compare pulse repetition frequency with pulse repetition period.
7. Draw a sine-wave schematic for the following:
   a. Frequency
   b. Wavelength
   c. Period
   d. Pulse Repetition Period

e. Pulse Repetition Frequency
f. Pulse Duration

8. Compare period to pulse repetition period and explain the difference between the two.
9. Relate similarities between pulsed and continuous wave ultrasound.
10. Describe what the duty factor for continuous waves would be.
11. Compare pulse repetition frequency to pulse repetition period.
12. Relate the various intensities ascribed to ultrasound and their significance.

E. Unit V. Basic Transducer Design and Construction

1. Identify elements of an ultrasonic transducer.
2. Relate characteristics of transducer frequencies.
3. Discuss bandwidth, quality factor, and their implications on diagnostic ultrasound applications.
4. Discus physical characteristics of the sound beam.
5. Explain what is meant by diffraction and relate it to Huygen's Principle.
6. Relate sound beam divergence and factors that affect beam geometry.

F. Unit VI. System Operation

1. Distinguish the five major components of a diagnostic ultrasound machine.
2. Define what factors determine the following parameters:
   a. Frequency
   b. Period
   c. Wavelength
   d. Propagation Speed
   e. Pulse Repetition Frequency
   f. Pulse Repetition Period
   g. Pulse Duration
   h. Duty Factor
   i. Spatial Pulse Length
   j. Axial Resolution
   k. Amplitude
   l. Intensity
   m. Attenuation
   n. Half-Intensity Depth
   o. Beam Diameter
   p. Lateral Resolution
3. Define dynamic apodization.
4. Define:
   a. Amplification
   b. Compensation
   c. Demodulation
   d. Compression
   e. Rejection
5. Identify which component of the ultrasound system performs the tasks in #4.
6. Explain the importance of system memory in an ultrasound machine.
7. Define the two types of memory available for ultrasound systems.
8. Define pixel and bit.
9. Perform binary equation conversions and computations.
10. Define pre- and post-processing.
11. Explain gray-scale resolution.
12. Explain the various methods in which information received from the transducer can be displayed.
13. Explain the purpose of the cathode-ray tube.
14. Define frame rate.

15. Describe why real-time imaging can operate without a means of memory storage.
16. Define the relationship between pulse repetition frequency and frame rate.
17. Describe the different types of scan formats and why they are necessary.
18. Define the maximum depth as it related to ultrasound.
19. Provide the formulas for the following:
    a. Pulse Repetition Frequency (for display)
    b. Line Density (for linear and sector)
    c. Maximum Depth
20. Discuss binary digits and bit depth as it relates to memory and display characteristics.

III. THECB Learning Outcomes (WECM)

1. Describe the interaction of sound and soft tissues.
2. Explain sound production and propagation.
3. Summarize the basic principles and techniques of ultrasound.

IV. Evaluation

A. Methods:

1. Homework and Quizzes – Written homework assignments will be given periodically; late assignments will not be accepted. Additionally, unannounced quizzes will be given during class time to assess comprehension and application of course objectives. Absence during a quiz can not be made up. A quiz missed or homework not turned in due to an unexcused absence will result in a grade of zero.
2. Unit Examinations – Unit examinations will be administered at the end of a specified unit or units to assess master of course objectives. All exams are written and consist of multiple choice, true/false, matching, essay, or a combination of the preceding. An exam missed because of an excused absence must be made up on the day that the student returns to class. An exam missed because of an unexcused absence can not be taken and the student will receive a grade of zero (0) for that exam.
3. Comprehensive Final Examination – This examination is given to assess your mastery of the course objectives.

B. Grading Scale:

100 – 92 = A
91 – 83 = B
82 – 75 = C
74 – 67 = D
66 – 0 = F

A total final course grade of below **C** (i.e., less than 75%) is **not** acceptable for completion of professional (DMSO) courses.

C. Final Grade Determination

Homework and Quizzes	15% toward final grade
Unit Examinations	65% toward final grade
Comprehensive Final Examination	20% toward final grade
TOTAL	100%

D. Remediation

Your progress in the class will be discussed with you periodically to review areas of concern or improvement. You should understand that failure to achieve a combined course average of at least 75% will prevent your continuation in the Ultrasound program; therefore, any problem regarding course content that you are concerned about should be addressed to me as soon as possible.

E. Attendance

Attendance in class is required to best assimilate the lecture and textbook material. Frequent absences are discouraged.

F. Tardiness

You are tardy when you are more than 10 minutes late from class. Consistent tardiness is disruptive to the class and you may not be allowed into the class should this continue.

V. Disability Statement (Americans with Disabilities Act [ADA])

EPCC offers a variety of services to persons with documented sensory, mental, physical, or temporary disabling conditions to promote success in classes. If you have a disability and believe you may need services, you are encouraged to contact the Center for Students with Disabilities to discuss your needs with a counselor. All discussions and documentation are kept confidential. Offices located: VV Rm C-112 (831-2426); TM Rm 1400 (831-5808); RG Rm B-201 (831-4198); NWC Rm M-54 (831-8815); and MDP Rm A-125 (831-7024).

VI. 6 Drop Rule

Students who began attending Texas public institutions of higher education for the first time during the Fall 2007 semester or later are subject to a 6-Drop limit for all undergraduate classes. Developmental, ESL, Dual Credit and Early College High School classes are exempt from this rule. All students should consult with their instructor before dropping a class. Academic assistance is available. Students are encouraged to see Counseling Services if dropping because exemptions may apply. Refer to the EPCC catalog and website for additional information.