



Course Description

SON2614C | Acoustical Physics and Instrumentation 1 | 2.00 credits

The course will present a review of fundamental physics and in-depth study of the physical principles of diagnostic ultrasound. Topics discussed include properties of sound waves, the interaction of sound waves with the matter, generation of ultrasound, and principles of Doppler ultrasound. Prerequisite: SON1005L.

Course Competencies

Competency 1: The student will demonstrate knowledge and comprehension of the properties of sound by:

1. Listing, defining, and differentiating different acoustic variables
2. Reviewing and discussing competencies of basic sonography
3. Discussing sound production
4. Discussing the interaction of sound and matter
5. Discussing the different kinds of waves
6. Identifying that sound is a mechanical wave
7. Defining acoustical propagation properties
8. Defining biological effects
9. Identifying acoustical parameters (frequency, period, amplitude, power, intensity, wavelength, propagation speed)
10. Discussing how acoustical parameters are related and not related
11. Defining transverse and longitudinal waves
12. Discussing interference (constructive, destructive)

Competency 2: The student will demonstrate knowledge and comprehension of pulsed sound by:

1. Defining pulse duration
2. Discussing what determines pulse duration
3. Identifying which pulse wave ultrasound imaging parameters the operator determines
4. Identify the formulas describing pulse duration, spatial pulse length, and pulse repetition period
5. Identifying how the parameters of pulsed sound are related
6. Identifying what the sonographer can change pulsed wave parameters
7. Identifying which knob controls the listening time portion of the pulse repetition period
8. Defining duty factor and discussing its calculation (formula for duty factor)

Competency 3: The student will demonstrate knowledge and comprehension of Intensity by:

1. Defining and discussing the importance of ALARA (as low as reasonably achievable)
2. Defining intensity
3. Defining spatial peak intensity
4. Defining temporal peak intensity
5. Combining spatial and temporal factors

Competency 4: The student will demonstrate knowledge and comprehension of the interaction of sound and media by:

1. Defining decibels and attenuation. Describing attenuation coefficient
2. Discussing the risk- benefit relationship. Discussing reflection and transmission
3. Discussing impedance
4. Discussing examples of specular reflectors
5. Discuss specular reflection and diffuse reflection
6. Discussing scattering and Rayleigh scattering
7. Discuss the attenuation of media types (water, fluid, soft tissue, air, bone, lung)
8. Discuss the half-value layer
9. Defining normal incidence and oblique incidence
10. Identifying the effect of normal and oblique incidence

11. Discussing the Intensity Reflection Coefficient and Intensity Transmission Coefficient
12. Defining refraction
13. Discussing the physics of refraction defined by Snell's law
14. Identifying Snell's law

Competency 5: The student will demonstrate knowledge and comprehension of sound beams by:

1. Identifying and describing the components of a sound beam
2. Differentiating between Near Zone and Far zone
3. Discussing Focal Depth
4. Explaining sound beam divergence
5. Defining types of waves
6. Explaining Huygens Principle
7. Explaining lateral resolution, its units, and by what it is determined
8. Discussing focusing
9. Differentiating types of focusing

Competency 6: The student will demonstrate knowledge and comprehension about resolution by:

1. Explaining axial resolution and lateral resolution
2. Demonstrating how the controls can improve axial resolution
3. Explaining the association with frequency, pulse duration, pulse length, and resolution
4. Explaining the measurement methods of intensity
5. Explain the intensity and relate this to the bioeffects of diagnostic ultrasound

Competency 7: The student will demonstrate knowledge and comprehension about display modes by:

1. Defining A-mode, B-mode, and M-mode
2. Discuss the difference between each mode
3. Discussing the application of each mode

Learning Outcomes:

- Communicate effectively using listening, speaking, reading, and writing skills
- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning