

# DMS-1071: CONCEPTS OF PHYSICS IN DIAGNOSTIC SONOGRAPHY

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## Cuyahoga Community College

**Viewing: DMS-1071 : Concepts of Physics in Diagnostic Sonography**

**Board of Trustees:**

January 2023

**Academic Term:**

Fall 2024

**Subject Code**

DMS - Diagnostic Medical Sonography

**Course Number:**

1071

**Title:**

Concepts of Physics in Diagnostic Sonography

**Catalog Description:**

Introduction to general physical concepts and related mathematics. Motion, major laws of physics, properties of matter, thermodynamics, basic electricity and electromagnetism, light properties, sound properties, and nuclear physics and their relationship to diagnostic ultrasound discussed.

**Credit Hour(s):**

2

**Lecture Hour(s):**

2

## Requisites

**Prerequisite and Corequisite**

MATH-1410 Elementary Probability and Statistics I or concurrent enrollment; and ENG-0995 Applied College Literacies, or appropriate score on English Placement Test.

Note: ENG-0990 Language Fundamentals II taken prior to Fall 2021 will also meet prerequisite requirements.

## Outcomes

**Course Outcome(s):**

Define the basic terminology as related to applied physics.

**Objective(s):**

1. Define types of energy.
2. Describe refraction.
3. Define the terms used to describe motion.
4. Define the terms used to describe waves.
5. Explain the difference between the various temperature scales.
6. Define boiling point.
7. Define conductor and insulator.
8. Define the terms volt and ampere.
9. State Ohm's law and use it to solve problems.
10. Define and state the relationship to each other: amplitude, frequency, period, wavelength, speed of propagation.

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**Course Outcome(s):**

Use algebra and the laws of physics to solve simple problems.

**Objective(s):**

1. Calculate problems involving work, power and energy.
2. Calculate problems involving pressure and density.
3. Demonstrate how the variables in Bernoulli's equation are related.
4. Calculate intensity using the inverse square law.
5. Express a sound intensity in decibels given its intensity in watts/cm<sup>2</sup> and a standard value.
6. Perform a calculation using the Doppler equation.

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**Course Outcome(s):**

Explain the basic principles of physics.

**Objective(s):**

1. Describe Newton's Laws of Motion.
2. Describe properties of solids, liquids, and gases.
3. Explain momentum.
4. Describe the properties of heat and light.
5. Explain the behavior of electric and electromagnetic charges.
6. Identify the characteristics and wave properties of sound.
7. Describe the atomic nature of matter.
8. Describe the internal structure of an atom.
9. Compare and contrast nuclear fission and fusion.

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**Methods of Evaluation:**

1. Quizzes
2. Assignments
3. Mid Term examination
4. Final examination

**Course Content Outline:**

1. Concepts
  - a. Critical thinking
  - b. Energy
  - c. Motion
  - d. Force
  - e. Temperature
  - f. Pressure
  - g. Electricity
  - h. Ultrasound production
  - i. Ultrasound interaction
  - j. Math principles
  - k. Parameters of ultrasound
2. Skills
  - a. Apply related mathematics to physics problems.
  - b. Using critical thinking to solve problems.
  - c. Correlating energy interaction with media.
3. Issues
  - a. Math application
  - b. Energy transformation
  - c. Intangible
  - d. Theories
  - e. Attenuation
  - f. Variables
  - g. Interference
  - h. Intensity

- i. Beam
- j. Frequency
- k. Amplitude
- l. Safety

#### Topical Outline

1. Review of basic math concepts
2. Motion
  - a. Position
  - b. Velocity
  - c. Acceleration
3. Newton's Laws
4. Energy and Conservation Laws
  - a. Momentum
  - b. Collisions
5. Physics of Matter
  - a. Solids
  - b. Liquids
  - c. Gases
  - d. Fluids
    - i. Static
      1. pressure
      2. density
      3. pressure at a depth in a fluid
    - ii. Dynamics
      1. continuity
      2. Bernoulli
      3. Poiseuille
      4. Reynolds
      5. Pascal
  6. Waves
    - a. Simple harmonic motion
    - b. Electromagnetic (transverse)
      - i. frequency
      - ii. wavelength
      - iii. media and effect on speed
      - iv. piezoelectric
      - v. infra-, ultra-
      - vi. velocity
      - vii. intensity
      - viii. Doppler effect
      - ix. dispersion
      - x. transmission
      - xi. absorption
      - xii. scattering
      - xiii. refraction
      - xiv. reflection
        1. specular
        2. diffuse
      - xv. interference
        1. in phase
        2. out of phase
      - xvi. diffraction
    - c. Sound (longitudinal)
      - i. compression
      - ii. rarefaction
      - iii. frequency
      - iv. wavelength
      - v. piezoelectric

- vi. velocity
- vii. intensity
  - 1. logarithms
  - 2. attenuation
- viii. Doppler effect
- ix. standing waves and resonance
- x. fundamentals and harmonics
- xi. sound quality
- xii. dispersion
- xiii. transmission
- xiv. absorption
- xv. scattering
- xvi. refraction
- xvii. reflection
  - 1. specular
  - 2. diffuse
- xviii. interference
  - 1. in phase
  - 2. out of phase

7. Electricity

- a. Static electricity
- b. Conductors and insulators
- c. Direct current (DC)
  - i. voltage (volts)
  - ii. current (amps)
  - iii. resistance (ohms)
  - iv. power (watts)
- d. Alternating current (AC)
  - i. amplitude
  - ii. frequency
  - iii. rms, peak values
  - iv. voltage
  - v. current
  - vi. resistance
  - vii. inductance
  - viii. capacitance + dielectrics
- e. Series circuits
- f. Parallel circuits
- g. Electrical safety

8. Thermodynamics

- a. Temperature scales
- b. Temperature measurement
- c. Thermal expansion
- d. Gas laws
  - i. ideal
  - ii. real
- e. Heat
  - i. convection
  - ii. radiation
  - iii. conduction
  - iv. internal energy
- f. Elementary atomic physics
  - i. Atomic structure
  - ii. Atomic phenomena
- g. Nuclear physics
  - i. types of radioactivity
  - ii. nuclear composition
  - iii. nuclear decay

- iv. fusion
- v. fission

## Resources

Edelman, Sidney K. *Understanding Ultrasound Physics*. 4th ed. Houston, TX: ESP, 2012.

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Hedrick, Wayne R. *Technology for Diagnostic Sonography*. 5th ed. St Louis: Elsevier Science, 2012.

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Kremkau, Frederick. *Diagnostic Ultrasound Principles and Instruments*. 10th ed. St. Louis: Saunders, 2020.

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Miele, Frank R. *Ultrasound Physics & Instrumentation*. 6th ed. Forney, TX: Pegasus Lectures, 2022.

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Hughes, Sheila. *National Certification Examination Review: Ultrasound Physics Instrumentation*. 4th ed. Dallas, TX: Society of Diagnostic Medical Sonography, 2010.

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Tillery, Bill W. *Physical Science*. 12th ed. New York: McGraw-Hill, 2020.

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Griffith, W. Thomas. *Physics of Everyday Phenomena: A Conceptual Introduction to Physics*. 10th ed. New York: McGraw-Hill, 2021.

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Urone, Peter Roger Hinrichs. *College Physics*. v1.3. Houston: OpenStax College, 2015.

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