



## Master Course Syllabus

### Ultrasound Physics II – DMS 2002

#### Purpose of Document

This document contains important information for transfer. It may be helpful for you to retain a copy for your records, along with the class specific syllabus. This document will be especially helpful if you decide to later change your course of study.

Pikes Peak State College and the Colorado Department of Higher Education have determined that graduates should have a broad range of learning skills as well as discipline related skills. Both types of skills are detailed below.

#### Course Description

Covers a detailed study of ultrasound physics and its application within the clinical setting, including manipulation of ultrasound system controls to optimize image quality and Doppler signals. Emphasizes instrumentation, Doppler principles, hemodynamics, image artifacts, quality assurance, and bioeffects/safety.

Credit Hours: 2

Contact Hours: 30

#### Required Course Learning Outcomes

1. Explain Doppler physics and hemodynamics: Describe the Doppler effect and use the Doppler equation to relate frequency shift, velocity, angle, and propagation speed; explain basic blood flow hemodynamics (laminar vs. turbulent flow).
2. Optimize Doppler and B-mode imaging in the clinical setting: Identify and adjust key system controls (gain, PRF/scale, wall filter, sample volume) to optimize signals and manipulate imaging parameters to improve quality.
3. Describe and troubleshoot image artifacts: Define and identify common types (reverberation, mirror image, shadowing, aliasing) and explain strategies to minimize or exploit them.
4. Understand ultrasound instrumentation and system components: Describe major components such as the pulser, beam former, receiver, and display; explain differences between continuous and pulsed wave Doppler.
5. Apply principles of bioeffects, safety, and ALARA: Explain thermal and mechanical indices (TI, MI) and interpret key elements of safety statements and the ALARA principle.
6. Understand harmonics, contrast, and emerging technologies: Describe tissue harmonic imaging principles and discuss the basics of contrast agents and contrast-specific imaging.

7. Discuss quality assurance (QA) and system performance testing: Describe common QA procedures, phantoms, and performance metrics (resolution, sensitivity).

## Topical Outline

- I. Review of core ultrasound physics and system controls
  - a. Review of sound wave properties and attenuation
  - b. Axial and lateral resolution
  - c. Basic knobology review
- II. Advanced instrumentation and system components
  - a. Pulser and beam former functions
  - b. Receiver functions (amplification, TGC, compression, demodulation, rejection)
  - c. Display systems and digital signal processing
- III. Image display, processing, and harmonics
  - a. Gray-scale display formats and dynamic range
  - b. Pre- and post-processing concepts
  - c. Principles of harmonic imaging and contrast imaging
- IV. Hemodynamics and Doppler principles
  - a. Flow characteristics (Poiseuille's law, Reynolds number)
  - b. CW vs. PW Doppler: trade-offs and clinical indications
  - c. Color and power Doppler basics
- V. Doppler optimization and spectral analysis
  - a. Angle correction and sample volume placement
  - b. PRF/scale, baseline, and wall filter adjustments
  - c. Aliasing recognition and correction strategies
- VI. Image artifacts
  - a. Propagation and attenuation artifacts
  - b. Doppler-specific artifacts (aliasing, mirror image)
  - c. Clinical troubleshooting and artifact reduction
- VII. Quality assurance and quality control (QA/QC)
  - a. QA goals and regulatory context
  - b. Use of test objects and phantoms
  - c. Routine equipment checks and documentation
- VIII. Bioeffects and safety
  - a. Thermal and mechanical mechanisms
  - b. TI and MI indices and display conventions
  - c. ALARA and professional safety guidelines
- IX. Emerging technologies / integrative review
  - a. Introduction to elastography or strain imaging
  - b. Comprehensive review for registry preparation