

Doppler Physics (DMSO 2351)



Credit: 3 semester credit hours (3 hours lecture)

Prerequisite/Co-requisite: Passed all previous sonography courses.

Course Description

Doppler and hemodynamic principles relating to arterial and venous imaging and testing.

Required Textbook and Materials

1. Understanding Ultrasound Physics by Sidney K. Edelman, Ph. D
ISBN# 0-9626444-4-7

Course Objectives

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

1. Describe Doppler and hemodynamic principles and actions.
2. Identify instrument options and transducer selection.
3. Interpret methods of Doppler flow analysis.
4. Differentiate common image artifacts.
5. Describe potential bio-effects.

Course Outline

- A. Hemodynamics
 - a. Types of flow
 - i. Steady
 - ii. Pulsatile
 - iii. Phasic
 - iv. Laminar vs. turbulent
 - v. Parabolic
 - vi. Plug
- B. Energy gradient
 - a. Types of energy in the circulatory system
 - i. Potential (pressure)
 - ii. Kinetic
 - iii. Hydrostatic
- C. Reynold's number
 - a. Predicting turbulence
 - b. Reynold's formula
- D. Flow vs. velocity
 - a. Poiseuille's Law
 - b. Conservation of Energy
 - c. Ohm's Law

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- E. Stenosis profile
 - a. Bernoulli's Law
 - b. Proximal to a stenosis
 - c. Within a stenosis
 - d. Distal to a stenosis
- F. Transmural pressure
 - a. Pressure within a vessel
 - b. Pressure outside a vessel
- G. Venous hemodynamics
 - a. Respiration
 - i. Phasic flow
 - b. Calf pump
- H. Doppler
 - a. Doppler shift
 - i. Positive frequency shifts
 - ii. Negative frequency shifts
 - iii. Typical values
 - b. Doppler equation
 - c. Demodulation
 - i. Demodulator
 - d. Non directional vs. Bi-directional Doppler
 - i. Non-coherent processing
 - ii. Phase quadrature processing
 - e. Continuous wave Doppler
 - i. PZT crystals
 - ii. Range ambiguity
 - iii. Aliasing
 - f. Pulsed wave Doppler
 - i. PZT crystals
 - ii. Range resolution
 - iii. Aliasing
- I. Aliasing
 - i. Definition
 - ii. Nyquist limit
 - iii. Causes
 - iv. elimination
- J. Doppler Packets
 - a. Ensemble length
 - i. Advantage
 - ii. Disadvantage
- K. Power Doppler
 - a. Sensitivity
 - b. Limitations
- L. Spectral analysis

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- a. Fast Fourier Transform
 - b. Autocorrelation
- M. Color Flow Doppler
 - a. definition
 - b. Autocorrelation
- N. Color Maps
 - a. Variance mode
 - b. Velocity mode
- O. Predicting direction of Flow
 - a. Sector image
 - b. Linear image
- P. Doppler artifacts
 - a. Ghosting
 - b. Clutter
 - c. Cross talk
 - d. Mirror image
- Q. Quality Assurance
 - a. Requirements of a Quality Assurance program
 - b. Devices for measuring quality assurance for Doppler
 - i. Doppler Phantom
 - ii. Vibrating string

Grade Scale

- 93 – 100 A
- 85 – 92 B
- 75 – 84 C
- 68 - 74 D (not able to continue in sonography program)

Course Evaluation

Semester grades will be calculated from the following criteria:

- 1. Unit tests **100%**

Course Requirements

- 1. Unit tests
- 2. Class participation
- 3. Daily work assignments (worksheets, reading assignments, presentations)

Course Policies

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1. No food, drinks, or use of tobacco products in class.
2. Beepers, cell phones, head phones and any other electronic devices must be turned off while in class.
3. Do not bring children to class.
4. If a unit test is missed, arrangements will be made with the instructor to take the test in a timely manner.
5. Attendance Policy: Absences must be limited to serious illness and/or immediate family emergencies. Unexcused absences are not allowed. **Three (3) absences will result in a letter grade reduction. Excessive tardiness (more than 10 minutes/class or more than 2 consecutive classes)** will result in an absence being awarded. In the event that LIT is forced to cancel classes due to inclement weather, DMS classes and clinical rotation will also be canceled. Notification of closures will be made through local radio and TV stations. Students out of the immediate broadcast area should contact the Program Director for information. It is extremely important that students communicate with the faculty regarding absences by telephone and/or email at all times.
6. All assignments are due when stated. Late assignments will result in a drop of **10** points per late day, and more than five days past due will result in a grade of **0**. If a student has an excused absence with written documentation, assignments will be accepted at the beginning of class upon return. Missed in-class assignments receive a grade of **0**.
7. Cheating on any (lecture/lab) exam results in immediate dismissal from the program and an **F** for the course.
8. If you wish to drop a course, the student is responsible for initiating and completing the drop process. If you stop coming to class and fail to drop the course, you will earn an “**F**” in the course.

Disabilities Statement

The Americans with Disabilities Act of 1992 and Section 504 of the Rehabilitation Act of 1973 are federal anti-discrimination statutes that provide comprehensive civil rights for persons with disabilities. Among other things, these statutes require that all students with documented disabilities be guaranteed a learning environment that provides for reasonable accommodations for their disabilities. If you believe you have a disability requiring an accommodation, please contact the Special Populations Coordinator at (409) 880-1737 or visit the office in Student Services, Cecil Beeson Building.

Course Schedule

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Week of	Topic	Reference
Week 1	Hemodynamics : types of flow	Edelman: pgs. 275-278
Week 2	Energy gradient – types of energy	Edelman: pgs. 279-281
Week 3	Stenosis profile – Reynold's number–pressure flow relationship	Edelman: pgs. 282-283
Week 4	Venous hemodynamics	Edelman: pgs. 286-292
Week 5	Test I	
Week 6	Doppler – Doppler shift – Doppler equation	Edelman: pgs. 293-300
Week 7	Types of Doppler	Edelman: pgs. 301-310
Week 8	Aliasing	Edelman: pgs. 307-310
Week 9	Color Flow Doppler	Edelman: pgs. 311-319
Week 10	Doppler artifacts	Edelman: pgs. 320-324
Week 11	Quality Assurance	Edelman: pgs. 358-359
Week 12	Test II	

Contact Information:

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