CVT A220: ULTRASOUND SONOGRAPHIC PHYSICS AND INSTRUMENTATION

Item	Value
Curriculum Committee Approval Date	12/02/2020
Top Code	121300 - Cardiovascular Technician
Units	3.5 Total Units
Hours	81 Total Hours (Lecture Hours 54; Lab Hours 27)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)

Course Description

The study of physical principles and instrumentation of diagnostic medical sonography, echocardiography, vascular ultrasound and peripheral vascular ultrasound. It includes sonographic equipment design, instrumentation and sonographic imaging application. PREREQUISITE: CVT A150. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Understand the physical principles of Ultrasound Physics relating to Sonographic imaging.
2. Understand clinical safety relating to Sonographic imaging.
3. Select the proper Ultrasound transducer for Sonographic imaging.
4. Understand pulsed echo instrumentation.
5. Understand Doppler instrumentation and hemodynamics.
6. Conduct quality assurance performance evaluations.
7. Understand and demonstrate applicable knowledge of new technologies.

Course Objectives

- I 1. Apply basic principles of physics as related to sonography. 2. Identify sonographic equipment design and parts. 3. Perform exercises related to instrumentation, and critiquing of proper TGC settings and other need imaging adjustments. 4. Analyze maintenance of equipment, trouble shooting, and quality control. 5. Apply principles of scientific notation, conversion, simple math, and terminology. 6. Perform scanning exercises in laboratory using Tissue Phantom and student models. 7. Select correct transducers to adequately scan patients. 8. Identify artifacts which occur while scanning. 9. Analyze safety and bio-effects of ultrasound on patients.

Lecture Content

A. Ultrasound Principles 1. Nature of Ultrasound 2. Frequency, Wavelength, Propagation Speed 3. Properties of Ultrasound Waves 4. Decibels 5. Physical Units B. Propagation of Ultrasound Through Tissue 1. Speed of sound 2. Reflection 3. Refraction 4. Attenuation 5. Useful Diagnostic Frequency Range C. Ultrasound Transducers 1. The Piezoelectric Effect 2. Transducer Construction and Characteristics 3. Sound Beam Formation 4. Focusing 5. Beam Width and Lateral Resolution 6. Pulse Duration and Axial Resolution 7. Transducer Arrays D. Pulse Echo Instrumentation 1. Range Equation 2. Pulsing Characteristics 3. Output Power Control 4. Receiver Overall Gain 5. Time-gain-compensation (TGC) 6. Reject 7. Signal Processing E. Principles of Pulse Echo Imaging 1. Principal Display Modes 2. Harmonics Imaging 3. Imaging Speed Limitations F. Image Storage and Display 1. Scan Converters and Digital Memories 2. Concepts of Digital Systems 3. Image Storage and Retreival nb 4. Display Devices and Controls 5. Post Processing 6. Recording Techniques- digital clips/ PACS G. Doppler 1. Physical Principles and hemodynamics 2. Instrumentation H. Principles of Color Flow Imaging 1. Sample size- Region on Interest (ROI) 2. Display of Color Doppler Information 3. Advantages and Limitations 4. Artifacts COURSE CONTENT AND SCOPE/TOPIC OUTLINE, continued I. Image Features and Artifacts 1. Definition of Artifacts 2. Reverberations, Refraction and Other Artifacts 3. Shadowing and Enhancement 4. Measurements of Dimension from Images J. Quality Assurance of Ultrasound Instruments 1. General Concepts of a Quality Assurance Program 2. Parameters to be evaluated 3. Preventive Maintenance 4. Record Keeping K. Bioeffects and Safety 1. Dosimetric Quantities 2. Typical Values for Diagnostic Equipment 3. Experimental Biological Effects Studies

Lab Content

A. Ultrasound Lab Safety Protocols.B. Instrumentation Use and Safety Requirements.C. Imaging equipment components: Electrical cables/ plugs/ On-off switch Tranducers/ cables - care and safety Monitor/Imaging Screen Keyboard Input (Patient data) Trac ball controls Equipment positioning/ ErgonomicsD. Physical principles and imaging equipment adjustments: Gains Depth Time-Gain-Compensation (TGC) Axial/Lateral/Temporal/ Azimuthal resolutionE. Clinical safety: Adjustments to output power Ergonomics Cleaning and disinfecting transducers (Manufacturers guidelines) Quality Assurance for imaging equipment specificationsF. s p; Pulsed Echo Instrumentation Adjustments Gains Dynamic range Gray scale Depth Pulse Repetition Frequency Harmonics Digital clip storageG. Doppler Instrumentation and hemodynamics Adjustments Spectral Acquisition and Display Color Doppler Acquisition and Display Doppler gains Color Doppler Maps Doppler ArtifactsH. Artifacts Imaging angle errors Reverberation/Ring down/Comet tail/GhostingI. New Technologies Contrast imaging 3- Dimensional Imaging 4- Dimensional Imaging b

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- Lab (04)
- DE Live Online Lab (04S)

Instructional Techniques

Lecture, PowerPoint prresentations, printed handouts, projected examples, hands-on demonstration and class discussion.

Reading Assignments

Minimum of six (6) hours assigned reading weekly of subject content or chapters.Complete end of chapter practice quizzes.Lab Requirement: Complete weekly image exercises and save to digital media. Submit these saved exercises for evaluation and lab grade.

Writing Assignments

Written lab reports

Out-of-class Assignments

Complete computer generated practice exams.Complete computer generated mock Sonographic Physics and Instrumentation Registry Examinations.

Demonstration of Critical Thinking

Objective exams.

Required Writing, Problem Solving, Skills Demonstration

Written lab reports and skills demonstration.

Eligible Disciplines

Cardiovascular technology: Any bachelors degree and two years of professional experience, or any associate degree and six years of professional experience.

Textbooks Resources

1. Required Edelman, S, K.. Understanding Ultrasound Physics, Latest ed. Woodlands, Texas: Esp, Inc., 2012