New Course Request

School/Division: Radiologic Sciences/School of Medicine

Academic Subject Code: RADI

Course Number: RADI-R434 (must be cleared with University Enrollment Services)

Instructor: Golali Naziripour

Course Title: Ultrasound Physics I

Recommended Abbreviation (Optional): (Limited to 32 characters including spaces)

First time this course is to be offered (Semester/Year): Fall 2010

Credit Hours: Fixed at ________ or Variable from ___________ to ___________

Is this course to be graded S-F (only)? Yes [ ] No [X]

Is variable title approval being requested? Yes [ ] No [X]

Course description (not to exceed 50 words) for Bulletin publication:

In depth instruction into the physical principles of ultrasound production and image formation.

Lecture Contact Hours: Fixed at ________ or Variable from ___________ to ___________

Non-Lecture Contact Hours: Fixed at ___________ or Variable from ________ to _________

Estimated enrollment: _____ of which ______ percent are expected to be graduate students.

Frequency of scheduling: Once per year

Will this course be required for majors? [ ] Yes

Justification for new course: The course is currently under the R438 variable title listing course. The increase in number of credit hours better reflects effort and amount of time spent in the course.

Are the necessary reading materials currently available in the appropriate library? [ ] Yes

Please append a complete outline of the proposed course, and indicate instructor (if known), textbooks, and other materials.

If this course overlaps with existing courses, please explain with which courses it overlaps and whether this overlap is necessary, desirable, or unimportant.

A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of the new course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by:

[Signature] Date 11/19/09

Department Chairman/Division Director

[Signature] Date

Dean of Graduate School (when required)

Approved by:

[Signature] Date 12/10/09

Dean

[Signature] Date

Chancellor/Vice-President

[Signature] Date

University Enrollment Services

After School/Division approval, forward the last copy (without attachments) to University Enrollment Services for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.
Adjunct Lecturer:
Ali Naziripour, M.Sc, Ph.D
This is on course based class
Lecture: Friday, 12.30 pm to 1.45pm, 2.00pm-3.30pm

Email: gonaziri@iupui.edu

Phone: (317) 278-2406 or (317) 274-5091

Office hours: My "official" office hours - IUPUI main Library building - Room 7911

Friday: 11am to 12.00pm

Feel free to schedule a time to meet if the above time does not fit you - my time is your time!

"unofficial" office hours: Could be arranged by e-mail

Please read the entire syllabus carefully; you are responsible for all of the requirements and procedures described here. You are also responsible for all announcements, assignments, changes, etc., whether or not you are in class.

Class Etiquette:
The lecture period is a time for learning. Inappropriate talking, eating, or working on other coursework during the class session is not acceptable. If the instructor notices behavior that is not conducive to the proper functioning of the class, the involved student(s) will be asked to leave. Cell phones must be turned off. Personal pagers must be on vibrating, not audible. Use of laptops with wireless internet connection should be restricted to note taking or searching for course-related information. Inappropriate use of laptops will result in loss of privilege during class session.
**Objective:**
Ultrasound Review designed for the junior or the senior Advanced Medical Imaging student. This course will provide an exciting opportunity for the participant to become better acquainted with the physics of ultrasound production and its practical application to sonography. Instrumentation will be linked to the ultrasound machine through experiments on the program’s ultrasound machine. This course was designed with the content outline provided by the American Registry of Diagnostic Medical Sonographers in Physics. Participants will integrate course material with practical aspects of sonography in their clinical experiences. At the conclusion of this course the Diagnostic Medical Sonography (DMS) student will be better prepared to enter advanced level course work and also be better prepared for clinical rotations.

**COURSE GOALS**
Upon completion of Physics of Ultrasound, the participant will be able to:
1. Discuss the sound wave production and its application to clinical examination.
2. Discuss sound wave propagation and reflection through the human body.
3. Communicate both verbally and in writing some of the concepts of sound production through creative projects conducted in the Research Lab or in the field.
4. Discuss resolution and attenuation and how it is demonstrated on the tissue-mimicking phantom.
5. Discuss the difference in beam pattern for some of the common transducers used clinically.
6. Describe the different intensity measurements for ultrasound and their relationship to bio effects.
7. Be able to explain the parts of the pulse-echo system from sound production to the video image.
8. Discuss the importance of the use of the tissue-mimicking phantom to insure optimum ultrasound equipment performance.
9. Correctly use the wave equation to solve for different variables.

10. Understand the interrelationship between frequency, wavelength, and amplitude

**LEARNING RESOURCES**

**REQUIRED READING MATERIALS:**

1. *Textbook*

2. *SUGGESTED Other RESOURCES*
   Additional handouts from the instructor
   Review all lectures notes that are stored on *Oncourse*


   Bushburg, JT, Seibert JA, Boone JM The Essential Physics of Medical Imaging 2nd ed. Lippincott Williams & Wilkins Co 2001


**ASSESSMENT AND EVALUATION**

Each participant is expected to attend all lectures that are provided and to participate in the demonstrations that are provided.

Each participant is expected to inform the instructor about any accommodations that need to be made in order to fulfill course requirements.

Each participant is expected to inform the instructor about any accommodations that need to be made in regards to testing.

Final Grades will be based on the following percentages:
Homework 15%
Quiz 15%
Class Participation 25%
Mid-term exams 20%
Comprehensive Final Exam 25%
Total 100%

Grading Scale - letter grades will be awarded on the following scale:

100 to 94 A
93 to 87 B
86 to 80 C
79 to 73 D

**Tentative Schedule**

I. Elementary Principles:

Principles of waves, longitudinal and transverse wave, Frequency range and their name,
Units and parameters of waves, changes of propagation speed with frequency,
dependence of propagation speed with media, positive and negative decibel changes

II. Propagation of ultrasound through Tissues:

Two criterias for reflection, normal and oblique reflection, Propagation speed in different
media, Snell’s law, IRC and ITC with formulas, specular and non-specular reflectors,
contrast media in the body to enhance the image, improvement due to harmonics imaging,
factors depends on attenuation, attenuation properties of a high frequency to a low
frequency transducer, determination the useful frequency range and how it is determine
Image characterization: echogenic, hypogenic, isoechoic, anechoic

III. Diagnostic Ultrasound Transducer:

How a transducer works? Basic Piezoelectric, function of the crystal in transducer,
factors determining the frequency of transducer, Quality factor and bandwidth (pulse and
continues), damping and matching layer, anatomy of sound wave, Interference, ways to
increase the length of the near zero, resolution by the size and shape of sound waves array, how an array transducer works, Four ways to overcome shortcoming of the array transducers and to improve image quality, the proper care of transducer.

IV. Wave and pulse Echo

Basic principles of waves echoes
<table>
<thead>
<tr>
<th>Week/day</th>
<th>Lesson</th>
<th>Topics</th>
<th>Sections to read</th>
<th>Assignment</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1 August 28</td>
<td>Lesson 1</td>
<td>Introduction to Imaging Technology The basic of ultrasound</td>
<td>Presentation Posted on on course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 2 September 4</td>
<td>Lesson 1</td>
<td>The basics Of ultrasounds</td>
<td>Chapter 1 and 2 Edelman Hand out on on course</td>
<td>HW1 due</td>
<td>Preparation For Quiz 1</td>
</tr>
<tr>
<td>Week 3 September 11</td>
<td>Lesson 2</td>
<td>Sound</td>
<td>Chapter 3 Edelman</td>
<td>HW2 due</td>
<td>Quiz 1</td>
</tr>
<tr>
<td>Week 4 September 18</td>
<td>Lesson 3</td>
<td>Describing sound</td>
<td>Chapter 4 Edelman</td>
<td>HW3</td>
<td>Quiz 2 preparation</td>
</tr>
<tr>
<td>Week 5 September 25</td>
<td>Lesson 4</td>
<td>Pulsed Waves</td>
<td>Chapter 5 Edelman</td>
<td>HW4</td>
<td>Quiz 2</td>
</tr>
<tr>
<td>Week 6 October 2</td>
<td>Exam Review</td>
<td>Mid-term</td>
<td>Less &amp; Edelman 1, 2, 3, 4 &amp; 5</td>
<td>HW5</td>
<td>Mid-term I</td>
</tr>
<tr>
<td>Week 7 October 9</td>
<td>Lesson 5</td>
<td>Intensities</td>
<td>Chapter 6 Edelman Handout</td>
<td>HW6</td>
<td>Mid-term I Review</td>
</tr>
<tr>
<td>Week 8 October 16</td>
<td>Lesson 6 Guest Lecturer</td>
<td>Interaction of sound and media</td>
<td>Chapter 7 Edelman Handout</td>
<td>HW7 Dr. Lauren Christopher</td>
<td>Quiz 3 preparation</td>
</tr>
<tr>
<td>Week 9 October 23</td>
<td>Lesson 7</td>
<td>Range Equation</td>
<td>Chapter 8 Edelman</td>
<td>HW8</td>
<td>Quiz 3</td>
</tr>
<tr>
<td>Week 10 October 30</td>
<td>Lesson 8</td>
<td>Axial Resolution</td>
<td>Chapter 9 Edelman</td>
<td>HW9</td>
<td>Mid-term II practice</td>
</tr>
<tr>
<td>Week 11 November 6</td>
<td>Mid-term Review</td>
<td>Mid-term II</td>
<td>Lesson 5, 6, 7, 8 and 9</td>
<td>HW10</td>
<td>Mid-term II</td>
</tr>
<tr>
<td>Week 12 November 13</td>
<td>Lesson 9</td>
<td>Transducer</td>
<td>Chapter 10 of text</td>
<td>HW11</td>
<td>Mid-term</td>
</tr>
<tr>
<td>Week 13 November 20</td>
<td>Lesson 10</td>
<td>Sound Beams</td>
<td>Chapter 11 of text</td>
<td>HW12</td>
<td>Quiz 4 practice</td>
</tr>
<tr>
<td>Week 14 November 27</td>
<td><strong>Happy</strong></td>
<td>Thanks</td>
<td><strong>Giving</strong></td>
<td><strong>No</strong></td>
<td><strong>Class</strong></td>
</tr>
<tr>
<td>Week 15 December 4</td>
<td>Lesson 11</td>
<td>Chapter 1 to 17</td>
<td>Chapter 12 and 13</td>
<td>HW14</td>
<td>Quiz 4</td>
</tr>
<tr>
<td>Week 16 December 11</td>
<td>Review for</td>
<td>Final</td>
<td>Chapter 14</td>
<td>Final review</td>
<td></td>
</tr>
</tbody>
</table>
Final Exam: December 14, 2009 11.00am to 12.30pm