

# GS02-1093 - Introduction to Medical Physics I Basic Interactions

Schedule - Fall 2018

*last revised 11/05/2018*

## Objectives:

The purpose of this course is to provide the medical physics student with an introduction to ionizing radiation and its use in medicine. Topics covered include production of radiation, interactions of radiation with matter, and measurement of radiation. This course is a prerequisite for subsequent courses in medical physics.

## Lectures:

Mondays, Wednesdays, and occasional Fridays 1:30 - 2:30 pm  
Radiation Physics Classroom (FCT8.6091)

## Faculty:

Dr Kent Gifford, course coordinator  
FCT8.5076  
(713) 563-2596  
[kagifford@mdanderson.org](mailto:kagifford@mdanderson.org)

## Required texts:

The required text for the course is *The Physics of Radiology, 4th edition*, by H.E. Johns and J.R. Cunningham. A discussion of texts for this course can be found in a handout written by Dr William Hanson for a previous incarnation of this course. [\[link\]](#)

## Grading:

Grading will be based on the following formula:

40% - in-class quizzes  
40% - final examination  
10% - classroom participation  
10% - homework

Grading is done on an absolute basis; I do not grade on a curve. Please look at the following link for an argument against curve grading. [\[link\]](#)

## The need for care:

Medical physics is a discipline in which care and meticulousness is essential, with dire consequences for sloppy work. In order to provide you with some feel for the consequences that may arise when one is not careful, the following link is provided. Please view these presentations at your earliest convenience. [\[link\]](#) In addition a series of articles in the New York Times is a resource for finding out about what can go wrong with radiation. [\[link\]](#)

## Before each class:

In order to make most effective use of class time, it is essential for you to come to class prepared to discuss the class material. Before class, please download the lecture notes and listen to the recorded class lecture. In addition, please read the reading assignment. Before 9 am the day of each class take the online pre-test. The purpose of the pre-test is to ascertain whether or not you have prepared for class on that day. It is an open-book, open-notes examination. Be sure to include your name on the pre-test so you can get credit for doing it. Doing and submitting the pre-tests will count toward your classroom participation credit. If any points presented in the lecture are unclear to you, please submit your questions on the pre-test and we will address the questions in class. Before you do, however, please check the link to unclear points for that class.

## During class:

This class is going to be somewhat different from most classes you have experienced previously. It is taught using a method called "Peer Instruction," developed by Dr Eric Mazur, a physics professor at Harvard University. Using this technique, I present a multiple-choice question to the class. The question generally illustrates a concept presented in the lecture. Hence it is called a "ConcepTest question." You will have a few minutes to determine the answer to the question. Generally the answer to a ConcepTest question will require neither memorization of facts nor extensive computation, but rather understanding of a concept. When you have determined the answer, you will hold up a card with the correct answer (A, B, C, or D) in such a way that only I can see your answer. Everybody must vote for an answer, even if you have to guess. If everyone has the correct answer, we will briefly discuss the answer, and then we will go on to the next concept. More often than not, some of you will understand the concept and get the correct answer, while others will not have the correct answer. When this occurs, you will gather into groups of 4-5, and each one of you will be charged with convincing the others in the group that your answer is correct. After several minutes of discussion, you will be asked to vote again on the correct answer. We will then discuss the answer and the concept that has been presented. Participation in these discussions will count toward classroom participation credit.

Follow this link to see an example of a ConcepTest question (in another branch of physics): [\[link to ConcepTest question\]](#)

If you are interested in finding out more about Peer Instruction, here is a link to a YouTube video of a presentation given by Dr Mazur: [\[link to Peer Instruction presentation\]](#)

### End of class:

At the end of class, you will be asked to answer a short questionnaire that asks you to identify the key points of the class and any points that remain unclear. Be sure to bring a WiFi-enabled mobile device (smart phone, iPad, laptop, etc.) to class, as the questionnaire is online. The questionnaire is to be completed by 5 pm on the day of class.

To access WiFi in the classroom, you might try uthsc-guest or mdaguest.

### After each class:

Most lessons are associated with problem sets. These problem sets will be due at 3:30 pm one week after assignment. They should be emailed to me on the day they are due. Solutions to problem sets will be posted after they are due. Problem sets will be graded counting towards your final grade.

Feel free to work in groups to present an answer to this problem. Remember that the methodology in solving this problem is what is important, and not the actual number you get.

Hint: A great deal of the specific information you need can be found by doing a web search (Google it).

### Course Evaluation:

After the orientation lecture, I would like to know something about your expectations regarding this course. Please access this evaluation form [\[link\]](#) and fill it out. We may discuss your expectations in class.

Later in the semester, I would like to know how you perceive the course is coming along. Please access this second evaluation form [\[link\]](#) and fill it out.

At the end of the semester, you will be asked to fill out an evaluation form provided by the GSBS.

Course Schedule		
Date	Topic	Instructor
Monday, 8/27	<b>Part 0 - Introduction to the course</b>	Gifford
Wednesday, 8/29	<b>Part 1 - Introductory Material</b> 1.1 - Basic quantities and units reading assignment: Johns & Cunningham, ch 1, pp 1-10 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to You Tube video on standard deviations]</a> <a href="#">[link to a second YouTube video on standard deviations]</a> <a href="#">[link to Problem Set 1.1]</a> <a href="#">[link to additional problems]</a>	Gifford
Monday, 9/3	Labor Day, NO CLASS	
Wednesday, 9/05	1.2 - Radiation quantities and units reading assignment: Johns & Cunningham, ch 1, pp 10-12 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to video]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 1.2]</a> <a href="#">[link to additional problems]</a>	Gifford
Monday, 9/10	1.3 - Atomic and nuclear structure reading assignment: Johns & Cunningham, ch 1, pp 12-21 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a>	Gifford

	<a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 1.3]</a>	
Wednesday, 09/12	1.4 - Tying up some loose ends reading assignment: Johns & Cunningham, ch 1, pp 21-34 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 1.4]</a> <a href="#">[link to additional problems]</a> Problem Set 1.1 due @ 3:30 pm <a href="#">[link to Problem Set 1.1 Solutions]</a>	Gifford
Monday, 9/17	<b>Part 2 - Production of Radiation</b> 2.1 - Radioactivity reading assignment: Johns & Cunningham, ch 3, pp 71-92 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 2.1]</a> Problem Set 1.2 due @ 3:30 pm <a href="#">[link to Problem Set 1.2 Solutions]</a> <a href="#">[link to additional problems]</a>	Gifford
Wednesday, 9/19	2.2 - Radioactive Processes reading assignment: Johns & Cunningham, ch 3, pp 92-100 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to neat article about medical use of radon]</a> <a href="#">[link to critical mass calculation]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 2.2]</a> Problem Set 1.3 due @ 3:30 pm <a href="#">[link to Problem Set 1.3 Solutions]</a> <a href="#">[link to additional problems]</a>	Gifford
Friday, 9/22	No class Problem Set 1.4 due @ 3:30 pm <a href="#">[link to Problem Set 1.4 Solutions]</a>	
Monday, 9/24	2.3a - Production of X-rays - Part 1 reading assignment: Johns & Cunningham, ch 2, pp 37-70 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 2.3a]</a> Problem Set 2.1 due @ 3:30 pm <a href="#">[link to Problem Set 2.1 Solutions]</a> <a href="#">[link to additional problems]</a>	Gifford
Wednesday, 9/26	2.3b - Production of X-rays - Part 2 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 2.3b]</a> Problem Set 2.2 due @ 3:30 pm <a href="#">[link to Problem Set 2.2 Solutions]</a>	Gifford
Monday, 10/1	<b>Part 3 - Interactions of Radiation</b> 3.1a - Photon Interactions: Basic Principles (part 1) reading assignment: Johns & Cunningham, ch 5, pp 133-146 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a>	Gifford

	<a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a>	
Wednesday, 10/3	3.1a - Photon Interactions: Basic Principles (part 2) <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 3.1a]</a> <a href="#">[link to additional problems]</a> Problem Set 2.3a due @ 3:30 pm <a href="#">[link to Problem Set 2.3a Solutions]</a>	Gifford
Monday, 10/8	3.1b - Photon Interactions: Photoelectric Effect reading assignment: Johns & Cunningham, ch 5, pp 146-149; ch 6, pp 167-168 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 3.1b]</a> <a href="#">[link to additional problems]</a>  3.1c - Photon Interactions: Coherent Scatter (part 1) reading assignment: Johns & Cunningham, ch 5, pp 149-150; ch 6, pp 168-173 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to ConcepTest questions]</a> Problem Set 2.3b due @ 3:30 pm <a href="#">[link to Problem Set 2.3b Solutions]</a>	Gifford
Wednesday, 10/10	Quiz #1 <a href="#">[link to Quiz #1 Solutions]</a>	
Monday, 10/15	3.1c - Photon Interactions: Coherent Scatter (part 2) <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 3.1c]</a> Problem Set 3.1a due @ 3:30 pm <a href="#">[link to Problem Set 3.1a Solutions]</a>	Gifford
Wednesday, 10/17	3.1d - Photon Interactions: Compton Scatter (Part 1) reading assignment: Johns & Cunningham, ch 5, pp 151-155; ch 6, pp 173-184 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> Problem Set 3.1b due @ 3:30 pm <a href="#">[link to Problem Set 3.1b Solutions]</a>	Gifford
Monday, 10/22	3.1d - Photon Interactions: Compton Scatter (Part 2) <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to Problem Set 3.1d]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> Problem Set 3.1c due @ 3:30 pm <a href="#">[link to Problem Set 3.1c Solutions]</a> <a href="#">[link to additional problems]</a>	Gifford
Wednesday, 10/24	3.1e - Photon Interactions: Pair Production reading assignment: Johns & Cunningham, ch 5, pp 155-158; ch 6, pp 184-186 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a>	Gifford

	<a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to Problem Set 3.1e]</a> <a href="#">[link to additional problems]</a> 3.1f - Photon Interactions: Photonuclear Disintegration <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a>	
Monday, 10/29	3.2a - Charged Particle Interactions: Stopping Power Reading assignment: Johns & Cunningham, ch 6, pp 190-197 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 3.2a]</a> <a href="#">[link to additional problems]</a> Problem Set 3.1d due @ 3:30 pm <a href="#">[link to Problem Set 3.1d Solutions]</a>	Gifford
Wednesday, 10/31	3.2b - Charged Particle Interactions: Range, Energy, Depth Dose Reading assignment: Johns & Cunningham, ch 6, pp 197-200 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 3.2b]</a> Problem Set 3.1e due @ 3:30 pm <a href="#">[link to Problem Set 3.1e Solutions]</a>	Gifford
Monday, 11/05	3.2c - Charged Particle Interactions: Mean Stopping Powers Reading assignment: Johns & Cunningham, ch 6, pp 200-214 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 3.2c]</a> Problem Set 3.2a due @ 3:30 pm <a href="#">[link to Problem Set 3.2a Solutions]</a>	Gifford
Wednesday, 11/07	3.3a - Neutron Interactions - Part 1 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 3.3a]</a> Problem Set 3.2b due @ 3:30 pm <a href="#">[link to Problem Set 3.2b Solutions]</a>	Gifford
Monday, 11/12	3.3b - Neutron Interactions - Part 2 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to supplementary reading 1]</a> <a href="#">[link to supplementary reading 2]</a> <a href="#">[link to supplementary reading 3]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a>	Gifford
Wednesday, 11/14	<b>Part 4 - Cavity Theory</b> 4.1a - Cavity Theory - Part 1 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <a href="#">[link to unclear points]</a> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a>	Gifford

	<a href="#">[link to Siebers Lecture - 2009 AAPM Summer School]</a> <a href="#">[link to Nahum Lecture - 2009 AAPM Summer School]</a> <a href="#">[link to Problem Set 4.1a]</a> Problem Set 3.2c due @ 3:30 pm <a href="#">[link to Problem Set 3.2c Solutions]</a>	
Monday, 11/19	<b>Quiz #2</b> <a href="#">[link to Quiz #2 Solutions]</a> Problem Set 3.3a due @ 3:30 pm <a href="#">[link to Problem Set 3.3a Solutions]</a>	Gifford
Wednesday, 11/21	Thanksgiving, NO CLASS	
Monday, 11/26	Thanksgiving, NO CLASS	
Wednesday, 11/28	<b>4.1b - Cavity Theory - Part 2</b> <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <b>[link to unclear points]</b> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 4.1b]</a> Problem Set 4.1a due @ 3:30 pm <a href="#">[link to Problem Set 4.1a Solutions]</a>	Gifford
Monday, 12/03	4.1c - Cavity Theory - Part 3 <a href="#">[link to notes]</a> <a href="#">[link to lecture]</a> <a href="#">[link to lecture transcript]</a> <a href="#">[link to pre-test]</a> <b>[link to unclear points]</b> <a href="#">[link to ConcepTest questions]</a> <a href="#">[link to end of class questions]</a> <a href="#">[link to Problem Set 4.1c]</a>	Gifford
Friday, 12/07	Problem Set 4.1b due @ 3:30 pm <a href="#">[link to Problem Set 4.1b Solutions]</a> Problem Set 4.1c due @ 3:30 pm <a href="#">[link to Problem Set 4.1c Solutions]</a>	
Wednesday, Dec 12: Final Exam 9am-12pm FCT8.6091 FCT14.5059		