

BME 6535 – RADIOLOGICAL PHYSICS, MEASUREMENTS, AND DOSIMETRY - FALL 2020

Course Description (3 Credits)

Interactions and measurement techniques for x-rays, gamma rays, neutrons and charged particles with matter; radioactive decay processes, ion chamber measurements, scintillation detectors, and dosimetry techniques. Applications of cavity theory and dosimetry measurement in medical physics.

Course Prerequisites: Upper level college physics.

Course Objectives:

Develop an in-depth understanding of the physics of ionizing radiations and their interactions with matter. Students will explore methods of the generation and detection of photons, charged particles, electrons, positrons, and neutrons. Students will become proficient in measurement applications for a variety of radiation sources and the subsequent evaluation of radiation dose.

Instructor:

Wesley Bolch, PhD, (352) 273-0303, wbolch@ufl.edu

Office Hours: By appointment

Email Correspondence: If emailing about class issues, please use the email facility within Canvas.

Student Assistants:

Camilo Correa, Medical Physics PhD Student, ccorreaalfonso@ufl.edu

Sean Domal, Medical Physics PhD Student, sdomal@ufl.edu

Bonnie President, Medical Physics PhD Student, bonnie.president@ufl.edu

Office Hours: By appointment

Meeting Times: MWF, Period 5, 11:45 am - 12:35 pm

Meeting Location: Zoom Meetings - <https://ufl.zoom.us/my/wesbolch> - Zoom Meeting ID: 424 551 4101

Textbooks:

Intro to Radiological Physics and Radiation Dosimetry
Frank H. Attix
Wiley-VCH Verlag GmbH & Company (2004)
ISBN-13: 978-0-471-01146-0

Radiation Detection & Measurement
Glenn F. Knoll
John Wiley & Sons, Inc. (2010) – 4th Edition
ISBN: 978-0-470-13148-0 (Hardback)

Attendance and Expectations:

Students are expected to attend all Zoom Meetings, must notify the instructor of expected absence in advance, and make arrangements to make up missed material. Attendance will be monitored through periodic and unannounced verification in class. During Zoom Meetings, all students must have their video links active. Late homework is subject to a 20% per day penalty deduction. Professionalism standards will be enforced on the review paper and homework sets. Review papers will be subject to plagiarism cross-checks.

Grading Policy:

Attendance and Participation	5%	
Lecture Quizzes	15%	
Homework Sets	15%	
Exam 1	15%	
Exam 2	15%	
Exam 3	15%	
Review Papers - Submitted	20%	November 22
Review Papers - Returned		November 29
Review Papers - Resubmitted		December 6

Grading Policy

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)
[Grades and Grading Policies](#)

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the [Disability Resource Center](#). It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing [online evaluations](#). Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students on the [Gator Evals page](#).

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." [The Honor Code](#) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see the [Notification to Students of FERPA Rights](#).

Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or police.ufl.edu.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling.

Library Support, Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.

Student Complaints Campus

On-Line Students Complaints

Lecture Schedule

<i>Date</i>	<i>Lecture No. and Topic</i>	<i>Reading</i>	<i>Period 5 - Zoom Activity</i>
August	31 Course Introduction		Course Introduction
September	2 #1 – Review of Radiation Interactions	Notes	Live Lecture - #1
	4 #2 – Photon Interactions	Attix – Ch 7	Live Lecture - #2
	7 No Class – Labor Day Holiday		
	9 #3 – Charged Particle and Electron Interactions	Attix – Ch 8	Live Lecture - #3
	11 #4 – Radiation Fields – Quantities and Units	Attix – Ch 1	Review - HW Set #1
	14 #5 – Energy Transfer and Dose – Quantities and Units	Attix – Ch 2	Lecture Questions - #2 to #4
	16 #5 – Energy Transfer and Dose – Quantities and Units	Attix – Ch 2	Problem or Article Review
	18 #6A – Exponential Attenuation – Uncollided Fluence	Attix – Ch 3	Review - HW Set #2
	21 #6A – Exponential Attenuation – Uncollided Fluence	Attix – Ch 3	Lecture Questions - #5 to #6A
	23 #6B – Exponential Attenuation – Buildup Factors	Attix – Ch 3	Problem or Article Review
	25 #6B – Exponential Attenuation – Buildup Factors	Attix – Ch 3	Review - HW Set #3/4
	28 #7 – Charge-Particle and Radiation Equilibria	Attix – Ch 4	Lecture Questions - #6A to #6B
	30 #8 – Radioactive Disintegration Processes	Attix – Ch 5	Problem or Article Review
October	2 #8 – Radioactive Disintegration Processes	Attix – Ch 5	Review - HW Set #5/6
	5 #9 – Radioactive Decay Kinetics	Attix – Ch 6	Lecture Questions - #7 to #8
	7 #9 – Radioactive Decay Kinetics	Attix – Ch 6	Problem or Article Review
	9 #10 – X-Ray Production and Quality	Attix – Ch 9	Review - HW Set #7/8
	12 #10 – X-Ray Production and Quality	Attix – Ch 9	Library Resources - Buhler
	14 #11 – Cavity Theory	Attix – Ch 10	Lecture Questions - #9 to #10
	16 #11 – Cavity Theory	Attix – Ch 10	Review - HW Set #9
	19 Review of Review Paper Topics and Questions		
	21 #12 – Counting Statistics and Error Prediction	Knoll – Ch 3	Problem or Article Review
	23 #12 – Counting Statistics and Error Prediction	Knoll – Ch 3	Review - HW Set #10
	26 #13 – General Properties of Radiation Detection	Knoll – Ch 4	Lecture Questions - #11 to #12
	28 #13 – General Properties of Radiation Detection	Knoll – Ch 4	Problem or Article Review
	30 #14 – Ionization Chambers	Knoll – Ch 5	Review - HW Set #11
November	2 #14 – Ionization Chambers	Knoll – Ch 5	Lecture Questions - #13 to #14
	4 #15A – Scintillation Detector Design	Knoll – Ch 8 &10	Problem or Article Review
	6 #15B – Scintillation Detector Spectroscopy	Knoll – Ch 8 &10	Review - HW Set #12
	9 Review of Review Paper Topics and Questions		Lecture Questions - #15
	11 No Class – Veteran's Day Holiday		
	13 #16 – Semiconductor Diode Detectors	Knoll – Ch 11	Review - HW Set #13/14
	16 #17 – Solid-State Detectors	Knoll – Ch 12	Lecture Questions - #16
	18 #18 – Luminescent Dosimeters	Knoll – Ch 19	Problem or Article Review
	20 #19 – Neutron Interactions & Dosimetry	Notes	Review - HW Set #15/16
	23 #19 – Neutron Interactions & Dosimetry	Notes	Lecture Questions - #17 to #18
	25 No Class – Thanksgiving Holiday		
	27 No Class – Thanksgiving Holiday		
	30 #20 – Slow Neutron Detection	Knoll – Ch 14	Lecture Questions - #19 to #21
December	2 #21 – Fast Neutron Detection	Knoll – Ch 15	Review - HW Set #17/18
	4 Review Paper Presentations		Presentations
	7 Review Paper Presentations		Presentations
	9 Review Paper Presentations		Presentations

Homework: Problems will be assigned for each chapter covered in the course text. Problem sets will be due within one week. Grades will be reduced 20% per day late.

Homework Schedule by Date

<i>Date</i>	<i>HW Set - Assigned</i>	<i>HW Set - Due</i>
September 7	HW Set #1 – Attix Chapter 7	
14	HW Set #2 – Attix Chapter 8	HW Set #1 – Attix Chapter 7
21	HW Set #3 – Attix Chapter 1 HW Set #4 – Attix Chapter 2	HW Set #2 – Attix Chapter 8
28	HW Set #5 – Attix Chapter 3 HW Set #6 – Attix Chapter 4	HW Set #3 – Attix Chapter 1 HW Set #4 – Attix Chapter 2
October 5	HW Set #7 – Attix Chapter 5 HW Set #8 – Attix Chapter 6	HW Set #5 – Attix Chapter 3 HW Set #6 – Attix Chapter 4
12	HW Set #9 – Attix Chapter 9	HW Set #7 – Attix Chapter 5 HW Set #8 – Attix Chapter 6
19	HW Set #10 – Attix Chapter 10	HW Set #9 – Attix Chapter 9
26	HW Set #11 – Knoll Chapter 3	HW Set #10 – Attix Chapter 10
November 2	HW Set #12 – Knoll Chapter 4	HW Set #11 – Knoll Chapter 3
9	HW Set #13 – Knoll Chapter 5 HW Set #14 – Knoll Chapter 8	HW Set #12 – Knoll Chapter 4
16	HW Set #15 – Knoll Chapter 10 HW Set #16 – Knoll Chapter 11	HW Set #13 – Knoll Chapter 5 HW Set #14 – Knoll Chapter 8
23		HW Set #15 – Knoll Chapter 10 HW Set #16 – Knoll Chapter 11
30	HW Set #17 – Knoll Chapter 14 HW Set #18 – Knoll Chapter 15	
December 7		HW Set #17 – Knoll Chapter 14 HW Set #18 – Knoll Chapter 15

Exams: Three non-cumulative exams will be given during the semester. Depending upon continuing circumstances regarding COVID-19 restrictions during the Fall 2020 semester, these exams will most likely be given as time-limited and open book/notes format on a date to be announced within a week of the exam distribution. If, however, arrangements can be made to safely give the exam in person and on campus under CDC guidelines, we will make those arrangements. Make-up exams will only be considered for exceptional circumstances and will be implemented by the instructor on a case-by-case basis. Notice of the absence must be given to the instructor prior to the start of each exam.

Review Papers: Students are asked to select a topic related to radiation detection or dosimetry, and perform a detailed literature review of that topic. The review article will follow the Instructions to Contributors for the journal *Medical Physics*. Grades for the final manuscripts will be based upon (1) technical content, (2) writing style, and (3) adherence to journal article submission guidelines.

Students are asked to follow the author instructions, except for the following:

- Limit your total number of pages of text (Abstract to Conclusions) to no more than 15 pages and no fewer than 10 pages. This page count does not include embedded figures and tables.
- Submit only one copy of the Cover Letter and one copy of the Manuscript (including all tables and figures) all in MS Word format
- Use the following file names:
 - Cover Letter – Last_Name.docx,
 - Paper – Last_Name.docx.
- Each paper must have at least two tables and two figures.
- Each paper must have cited at least 5 peer-reviewed journal article citations (beyond textbooks or conference proceedings).

Each manuscript will be submitted with a cover letter to the appropriate Editor-in-Chief noting why you think your work is worthy of publication. Final manuscripts are due by email on Sunday, **November 22**. Reviewed manuscripts will be returned by Sunday, **November 29**. A resubmitted manuscript with Response to Comments will be due by Sunday, **December 6**. **All papers will be subject to plagiarism review using Turnitin software.**

Homework Policy

Wesley E. Bolch

1. Homework sets will be assigned on Mondays as noted above. They will be due by upload to the Canvas course website on the date and time indicated. Grades will be decreased 20% for each day late (20% the following Monday, 40% the following Tuesday, etc.).
2. Homework to be turned in must be neat and legible, and submitted in PDF format of high-quality. As a general practice, work each homework problem on a scratch paper and recopy when thought to be correct and complete. All homework problems will be graded; however, **the instructor reserves the right to give zero credit for any problem that does not appear neat, legible, and easy to follow.**
3. For each problem...
 - a) Start each problem on a separate page.
 - b) Paraphrase the problem to be solved.
 - c) State all given and pertinent data, and specify the sources for each.
 - d) List all pertinent formulas or laws needed to solve the problem.
 - e) State clearly all assumptions made.
 - f) Solve the equations specified above with minimal calculation of intermediate values. When reporting intermediate values, carry 2-3 extra significant digits until the final answer is given.
 - g) Within each equation to be solved, show units for every numerical value substituted. Perform a unit analysis for both intermediate and final answers.
 - h) Label and box your final answer. Give no more than one significant digit beyond those of your input data.
 - i) **The instructor reserves the right to give zero credit to a problem if any one of these steps are not followed.**
4. Partial credit will be given for each worked problem.
5. Turn in each homework with the homework assignment as a cover page.