BME 6535 – RADIOLOGICAL PHYSICS, MEASUREMENTS, AND DOSIMETRY - FALL 2025

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:
Andrew Sforza, Medical Physics PhD Student, andrewsforza@ufl.edu
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Office Hours: By appointment

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.

Meeting Times: Tuesdays, Periods 8-9, 3:00 to 5:00 pm
Thursdays, Period 8, 3:00 to 4:00 pm
Meeting Location: UF Health Communicore, Room C2-33

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 classes in person. Students must notify the instructor of expected absence in advance and make arrangements for completing missed material. Excused absences must be consistent with university policies in the graduate catalog (https://catalog.ufl.edu/graduate/regulations) and require appropriate documentation. Attendance will be monitored through periodic verification in class. During class, all students must put away all cell phones. Students are encouraged to bring laptops to class for class note taking. Professionalism standards will be enforced on reviewer papers and are subject to plagiarism checks.

Grading Policy	Total Points	Percentage of Final Grade	Exam / Due Dates
Homework Assignments	Variable	25%	
Lecture Quizzes	10	10%	
Exam 1 – 6 to 9 pm	100	15%	**Thursday – October 2**
Exam 2 – 6 to 9 pm	100	15%	**Thursday – November 6**
Exam 3 – 6 to 6 pm	100	15%	**Tuesday - December 9**
Review Papers – Submitted	85	20%	**Sunday - November 16**
Review Papers – Returned			**Sunday - November 23**
Review Papers – Resubmitted	15		**Sunday - November 30**

Lecture Schedule

Week	Date		Lecture No. and Topic (L – Live, R – Recorded)	Reading	Class Activity
1	**Aug**	21	Course Introduction		
2		26	#1 – Review of Radiation Interactions (L)	Notes	Live Lecture - #1
		26	#2 – Photon Interactions (L)	Attix – Ch 7	Live Lecture - #2
		28	#3 – Charged Particle and Electron Interactions (L)	Attix – Ch 8	Live Lecture - #3
3	**Sep**	2	#4 – Radiation Fields – Quantities and Units (R)	Attix – Ch 1	Problem Session
		2	#5 – Energy Transfer and Dose – Quantities and Units (R)	Attix – Ch 2	Problem Session
		4			**Review - HW Set #1**
4		9	#6A – Exponential Attenuation – Uncollided Fluence (R)	Attix – Ch 3	Lecture Q&A – #4/5
		9	#6B – Exponential Attenuation – Buildup Factors (R)	Attix – Ch 3	Problem Session
		11			**Review - HW Set #2**
5		16	#7 – Charge-Particle and Radiation Equilibria (R)	Attix – Ch 4	**Amy Buhler – UF Libraries**
		16	#8 – Radioactive Disintegration Processes (R)	Attix – Ch 5	Lecture Q&A – #6A/B
		18			**Review - HW Set #3 / #4**
6		23	#9 – Radioactive Decay Kinetics (R)	Attix – Ch 6	Lecture Q&A – #7/8
		23	#10 – X-Ray Production and Quality (R)	Attix – Ch 9	Problem Session
		25			**Review - HW Set #5 / #6**
7		30	#11 – Cavity Theory (R)	Attix – Ch 10	Lecture Q&A – #9/10
		30	#12 – Counting Statistics and Error Prediction (R)	Knoll – Ch 3	Problem Session
	Oct	2	**E1**		**Review - HW Set #7 / #8**
8		7	#13 – General Properties of Radiation Detection (R)	Knoll – Ch 4	Lecture Q&A – #11/12
		7	#14 – Ionization Chambers (R)	Knoll – Ch 5	Problem Session
		9			**Review - HW Set #9**
9		14	#15A – Scintillation Detector Design (R)	Knoll – Ch 8	Lecture Q&A – #13/14
		14	#15B – Scintillation Detector Spectroscopy (R)	Knoll – Ch 8	Problem Session
		16			**Review - HW Set #10**
10		21	**Review Paper Proposals** (L)		Lecture Q&A – #15A/B
		21	**Review Paper Proposals** (L)		Problem Session
		23			**Review - HW Set #11**
11		28	#16 – Semiconductor Diode Detectors (R)	Knoll – Ch 11	Free Discussion
		28	#17 – Solid-State Detectors (R)	Knoll – Ch 12	Problem Session
		30			**Review - HW Set #12**
12	**Nov**	4	#18 – Luminescent Dosimeters (R)	Knoll – Ch 19	Lecture Q&A – #16/17
		4	#19 – Neutron Interactions & Dosimetry (R)	Notes	Problem Session
		6	**E2**		**Review - HW Set #13/14**
13		11	#20 – Slow Neutron Detection (R)	Knoll – Ch 14	Lecture Q&A – #18/19
		11	#21 – Fast Neutron Detection (R)	Knoll – Ch 15	Problem Session
		13			**Review - HW Set #15/16**
14		18	#22 – Review of Detectors in Medical Imaging (L)		
		18	#23 – Review of Detectors in Radiotherapy (L)		
		20			**Review - HW Set #17/18**
15		25	***No Class – Thanksgiving Holiday***		
		25	***No Class – Thanksgiving Holiday***		
		27	***No Class – Thanksgiving Holiday***		
16	**Dec**	2	**Review Paper Presentations** (L)		
		2	**Review Paper Presentations** (L)		**E3 – Dec 9**

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

Homework Schedule by Date

Week	*Date*		*HW Set - Assigned*	*HW Set - Due*
3	**September**	1	**HW Set #1** – Attix Chapter 7	
4		8	**HW Set #2** – Attix Chapter 8	**HW Set #1** – Attix Chapter 7
5		15	**HW Set #3** – Attix Chapter 1 **HW Set #4** – Attix Chapter 2	**HW Set #2** – Attix Chapter 8
6		22	**HW Set #5** – Attix Chapter 3 **HW Set #6** – Attix Chapter 4	**HW Set #3** – Attix Chapter 1 **HW Set #4** – Attix Chapter 2
7		29	**HW Set #7** – Attix Chapter 5 **HW Set #8** – Attix Chapter 6	**HW Set #5** – Attix Chapter 3 **HW Set #6** – Attix Chapter 4
8	**October**	6	**HW Set #9** – Attix Chapter 9	**HW Set #7** – Attix Chapter 5 **HW Set #8** – Attix Chapter 6
9		13	**HW Set #10** – Attix Chapter 10	**HW Set #9** – Attix Chapter 9
10		20	**HW Set #11** – Knoll Chapter 3	**HW Set #10** – Attix Chapter 10
11		27	**HW Set #12** – Knoll Chapter 4	**HW Set #11** – Knoll Chapter 3
12	**November**	3	**HW Set #13** – Knoll Chapter 5 **HW Set #14** – Knoll Chapter 8	**HW Set #12** – Knoll Chapter 4
13		10	**HW Set #15** – Knoll Chapter 10 **HW Set #16** – Knoll Chapter 11	**HW Set #13** – Knoll Chapter 5 **HW Set #14** – Knoll Chapter 8
14		17	**HW Set #17** – Knoll Chapter 14 **HW Set #18** – Knoll Chapter 15	**HW Set #15** – Knoll Chapter 10 **HW Set #16** – Knoll Chapter 11
15		24		
16	**December**	1		**HW Set #17** – Knoll Chapter 14 **HW Set #18** – Knoll Chapter 15

Exams: Three non-cumulative exams will be given during the semester on the following dates: **October 2** (6 to 9 pm), **November 6** (6 to 9 pm), and **December 9** (6 to 9 pm). 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 will include embedded figures and tables.
- Submit your Cover Letter and 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 10 peer-reviewed journal article citations (beyond textbooks or conference proceedings) and should have no more than 3 website citations.

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 on Sunday, **November 16**. Reviewed manuscripts will be returned by Sunday, **November 23**. A resubmitted manuscript with Response to Comments will be due by Sunday, **November 30**. **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.

Grading Policy

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

Required Computer

Recommended Computer Specifications: https://it.ufl.edu/get-help/student-computer-recommendations/
HWCOE Computer Requirements: https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/

Academic Policies & Resources

To support consistent and accessible communication of university-wide student resources, instructors must include this link to academic policies and campus resources: https://go.ufl.edu/syllabuspolicies. Instructor-specific guidelines for courses must accommodate these policies.

Commitment to a Positive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu