Radiation Interaction Basics and Applications I
ENU 1000, Class 13203/27420/27421/27422, Fall 2020
T 1250-1445 (UF Period 6-7) and R 1250-1340 (UF Period 6)
Online
Final Exam: Monday, December 14, 2020, 1000-1200

Instructor

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Office Hours: T 0930-1100, R 930-1100, F 1400-1500, and by appointment. Beginning and end times of office hours will be enforced strictly.

Course Description

Interaction of X-rays, gamma rays, neutrons, and charged particles with matter; radioactive decay, nuclear moments, and nuclear transitions. Application to basic problems in nuclear engineering sciences.

Course Prerequisites

None

Course Objectives

Following successful completion of this course, the student will have developed an understanding of ionizing radiation, atomic and nuclear structure, radioactive decay, and ionizing radiation interaction with matter including the concept of cross sections for charged particles (electrons and heavy charged particles) as well as uncharged particles (neutrons and photons). Specific objectives are as follows:

- Demonstrate an ability to apply knowledge of mathematics, science, and engineering for problem solving in engineering related to radiation interaction with matter.
- Demonstrate an ability to identify, formulate, and solve engineering problems related to radiation interaction with matter.
- Demonstrate an ability to apply advanced mathematics, science, atomic and nuclear physics and engineering to nuclear and radiological systems and processes.

Text

Course Pack for ENU 6051 available at `https://store.cognella.com/22509`.

References

- *Radiation and Radiation Protection*, James E. Turner, 3rd Edition, 2007, ISBN 9783-527-40606-7
- *Fundamentals of Nuclear Science and Engineering*, J. Kenneth Shultis and Richard E. Faw, 1986, 1st Edition, ISBN 0-8247-0834-2
- *Physics for Radiation Protection*, James E. Martin, 2000, ISBN 0-471-35373-6
- *Introduction to Radiological Physics and Radiation Dosimetry*, Frank H. Attix, 1992, ISBN 0-471-01146-0

Course Schedule

The course schedule is subject to change depending on the speed in which material is covered.

1. Characterization of Radiation: Introduction to Modern and Nuclear Physics (3 weeks)
    - Introduction
    - Forces and Energy in Atoms
    - Theory of Electromagnetic Radiation
    - Nuclear Models
    - The Nucleus and Nuclear Radiation
    - Kerma and Radiation Dose
2. Radioactive Decay (1 week)
    - Radioactive Series Decay
    - Radioactive Dating
3. Photon Interactions (3 weeks)
    - Exponential Attenuation
    - Photon Interactions with Matter
    - Gamma and X-ray Interactions with Matter
    - Radiation Shielding and Buildup Factors
4. Charged Particle Interactions (3 weeks)
    - Heavy Charged Particle Interactions
    - Electron Interactions
    - Charged Particle Track Phenomena
    - Charged Particle Interactions with Matter
5. X-Ray Generation (1 week)
6. Neutron Interactions (2 weeks)
    - Neutron Nuclear Reactions
    - Neutron Chain (Fission) Reactions
7. Accelerators and Medical Applications (1 week)
    - Accelerators
    - Medical Applications

Online Course Recording

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Grading

Grades will be assigned based on the following weighting

- Assignments (15%)
- Midterm Exam 1 (25%)
- Midterm Exam 2 (30%)
- Final Exam (30%)

& the following scale

- A: 87%+
- A-: 85-86.99%
- B+: 83-84.99%
- B: 75-82.99%
- C: 66-74.99%
- E: $< 66\%$

More information on the UF grading policy may be found at:
`http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades`

Course Policies

Attendance

Attendance is strongly recommended starting September 1 (first class). Attendance is not part of grade calculations.

Pursuant to HWCOE policy, the following statement is required: Excused absences are consistent with university policies in the graduate catalog. `http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance` and require appropriate documentation.

Class Conduct

There is no tolerance for mobile phones or other electronic disruptions. Changing your Zoom settings to mute yourself upon joining a meeting is strongly recommended.

Assignments

Assignments must be submitted electronically (via Canvas). The following restrictions apply for submission:

- Only files with the following extensions will be accepted: pdf, xls, xlsx, and txt.
- Assignments are not accepted past the due date, except for excused absences as defined by university policy.

Electronic Communication and Course Website

Canvas is used extensively for the course including, but not limited to:

- Distributing and storing the course syllabus, along with any syllabus updates
- Maintaining student grades
- Regular communication with students through announcements and messages (course email listserv may also be used)
- Providing access to course materials
- Scheduling Zoom meetings

Changes to Syllabus

Changes to this syllabus will be provided via the Canvas platform. Such changes may include those required by policy changes, changes in the speed of course coverage, university closure, errors in previous syllabus versions, and other reasons.

Standardized Syllabus Content

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting `https://disability.ufl.edu/students/get-started/`. 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 Evaluations

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at `https://gatorevals.aa.ufl.edu/`students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via `https://ufl.bluera.com/ufl/`. Summaries of course evaluation results are available to students at `https://gatorevals.aa.ufl.edu/public-results/`.

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:

`https://www.dso.ufl.edu/sccr/process/student-conduct-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.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

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 Undergraduate/Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, `rbielling@eng.ufl.edu`
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, `taylor@eng.ufl.edu`
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, `nishida@ufl.edu`

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:

`https://registrar.ufl.edu/ferpa.html`

Campus Resources

Health and Wellness

U Matter, We Care

Your well-being is important to the University of Florida. The U Matter, We Care initiative is

committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact `umatter@ufl.edu` so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

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

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the Office of Title IX Compliance, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, `title-ix@ufl.edu`

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or `http://www.police.ufl.edu/`

Academic Resources

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

`https://lss.at.ufl.edu/help.shtml`

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

`https://www.crc.ufl.edu/`

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

`http://cms.uflib.ufl.edu/ask`

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

`https://teachingcenter.ufl.edu/`

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

`https://writing.ufl.edu/writing-studio/`

Student Complaints Campus:

`https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf`

On-Line Students Complaints:

`http://www.distance.ufl.edu/student-complaint-process`