

Standardized Syllabus for the College of Engineering

ENU-4605 Radiation Interactions and Sources

1. Catalog Description (4 credit hours) – Three one-hour lectures discussing interaction of ionizing radiation with matter; cross sections and radiation fields with emphasis on photons, heavy charged particles and electrons.
2. Pre-requisites and Co-requisites: ENU-4001 (co-requisite)
3. Course Objectives:
 - a. Provide students with the ability to apply advanced mathematics, computational skills, science and engineering science, including atomic and nuclear physics, to identify, formulate, analyze, and solve nuclear and radiological engineering problems.
 - b. Provide students with knowledge of the fundamentals of radiation transport, interactions, and detection and with the principles required for the analysis, design, and safe operation of radiation producing devices and using equipment and systems.
4. Contribution of course to meeting the professional component
 - a. Graduates will have successful careers in Nuclear Engineering and related disciplines.
 - b. Graduates will pursue advanced degrees or continuing education.
5. Instructor: Katherin Goluoglu
 - a. Office location: Nuclear Sciences Building, Rm 232
 - b. Telephone: (865) 719-0521
 - c. E-mail address: klgoluoglu@mse.ufl.edu
 - d. Class Web site: Available on e-Learning
 - e. Office hours: TTH 10:30-12:00. Problem sessions Th 10:30-12, Hauck Library (214 NSC)
6. Teaching Assistant- none
7. Meeting Times: Tuesday/Thursday, 2nd & 3rd Periods (8:30-10:25 a.m)
8. Class/laboratory schedule: Class consists of four 50-minute lectures a week, with a problem session to be held as needed on Thursdays after class)
9. Meeting Location: Room 227 NSC for lectures. Problem sessions to be held in Hauck Library (214 NSC)
10. Material and Supply Fees- None
11. Textbooks and Software Required:
 - Text:
 - James E. Turner, *Atoms, Radiation, and Radiation Protection*, 3rd Edition, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2007, [ISBN 9783-527-40606-7]
 - References:
 - Herman Cember, *Introduction to Health Physics*, McGraw-Hill, Inc, New York, 1992. [ISBN 0-07-105256]
 - Serway, Moses, Moyer, *Modern Physics*, Saunders College Publishing, New York, 1989. [ISBN 0-03-096029-0]

12. Recommended Reading (see 12 above)
13. Course Outline: (Four 50 minute class periods each week)
- I. **Basic Concepts, Units, and Quantities (~5 class periods)**
Special units, historical perspective
 - II. **Special Theory of Relativity (~2 class periods)**
Time Dilation, Mass Increase, Length Contraction, Mass-Energy Relationship
 - III. **Atomic Theory (~4 class periods)**
Electronic Structure, Electron Binding Energies, Orbitals
 - IV. **Nuclear Structure (~4 class periods)**
Liquid Drop Model, Shell Model, Energetics Concepts
 - V. **Types of Radiation (~4 class periods)**
Alpha, Beta, Gamma, X-ray, Neutrons, Fission Fragments
 - VI. **Nuclear Reactions and Decay (~8 class periods)**
Binary Reactions, Q-Values, Kinematic and Coulombic Thresholds, Decay Types, Decay Energetics, Branching Ratios
 - VII. **Heavy Charged Particle Interactions (~4 class periods)**
Collisional Stopping Power, Semi-classical Formula, Bethe Formula, Maximum Energy Transferrable
 - VIII. **Electron Interactions (~8 class periods)**
Radiative Stopping Power and Calculations, Radiation Yield
 - IX. **Photon Interactions (~5 class periods)**
Photoelectric, Compton Scattering, Raleigh Scattering, Pair Production, Triplet Production, Cross-Sections, Attenuation Coefficients
 - XI. **Characterization of Radiation Fields and Neutron Interactions (~7 class periods)**
Flux, Fluence, Solid Angle, Cross-Sections. Absorption and scattering reactions, macroscopic and microscopic cross section, interaction rates
 - XII. **Reactor Interactions (~3 class periods)**
Six factor formula, fuel reactions
 - X. **X-ray Production (~1 class period)**
Projectiles, Targets, Bremsstrahlung, Fluorescence, Filters
 - XI. **Accelerators (~1 class period)**
Linacs, Cyclotrons, Synchrocyclotrons, Synchrotrons, Betatrons, Charged Particle Acceleration Physics
14. Attendance and Expectations:
- a. Attendance is expected but will not be specifically marked off. Missing classes will cause your grade to suffer because of missed material and/or quizzes. If you know that you will miss a class, have someone pick up handouts or take notes, and let me know beforehand. Otherwise, see me afterward to get any handout material. Or have a classmate pick up any handouts for you.
 - b. Assignments are to be written on only one side of assignment pages including examinations. Assignments will be due as indicated on each assignment sheet, usually one week or more after being assigned. Homework must be submitted in class on the due date to avoid assessment of a late penalty (5% per day). Weekends count two days. All late assignments are to be deposited in instructor's mailbox outside Room 232 NSC. Otherwise, they will not be counted. Assignments submitted after grading is completed may be graded but will receive no credit.
15. Grading – Homework and Other Assignments Including Quizzes: 10%
Midterm Exam 1 (evening): 30%

Midterm Exam 2 (evening):	30%
Final Exam as scheduled (Dec 10 at 5:30 p.m.):	30%

16. Grading Scale: 92.0%+: A; 90.0-91.9%: A-; 87.0-89.9%: B+; 83.0-86.9%: B; 80.0-82.9%: B-; 77.0-79.9%: C+; 73.0-76.9%: C; 70.0-72.0%: C-; 67.0-69.9%: D+; 63.0-66.9%: D; 60.0-62.9%: D-; 59.9% and lower: E.

Grades will not be curved, but bonus points may be earned throughout the semester.

A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement.

For more information on grades and grading policies, please visit:
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

17. Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at:
<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

18. Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

Note that failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures.
 See <http://www.dso.ufl.edu/sccr/procedures/honorcode.php>

19. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.
20. UF Counseling Services –Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
- UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
 - Career Resource Center, Reitz Union, 392-1601, career and job search services.
21. Software Use – All faculty, staff and student 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.