

ENU4145/5142 – Risk Assessment for Radiation Systems (Spring 2017)

1 Description:

This course addresses nuclear systems safety primarily via probabilistic risk assessment. Risk and its evaluation and measurement are addressed for a variety of technologies with emphasis on radiation producing nuclear facilities including nuclear power plants. Applicable probabilistic and statistical concepts and methodology are addressed to introduce safety system reliability and risk assessment analysis. In addition, human and system reliability factors are also considered along with related regulatory effects. The methods of probabilistic risk assessment using event trees and fault trees are developed and applied to various safety-related systems associated with nuclear technology to quantify and evaluate risk, especially those related to the uncontrolled release of radioactivity and potential over exposures of radiation workers or members of the public.

2 Prerequisite:

ENU 4103 & STA 3032

3 Program Educational Objectives Supported by Course:

1. Graduates will have successful careers in Nuclear Engineering or related disciplines.
2. Graduates will pursue advanced degrees or continuing education.
3. Graduates will communicate effectively and work collaboratively in Nuclear Engineering or related disciplines.
4. Graduates will use the knowledge and skills obtained in their undergraduate education to practice high ethical and professional standards in Nuclear Engineering or related disciplines.

4 Professional Components Supported by Course:

1. 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.
2. Provide students with the skills needed to communicate effectively, work collaboratively, and understand their professional and ethical responsibilities and the impact of engineering solutions in a societal and economic context so they can pursue successful, productive careers in nuclear and radiological engineering.

5 Program Outcomes Supported by Course:

- Outcome A: An ability to apply knowledge of mathematics, science and engineering
- Outcome E: An ability to identify, formulate and solve engineering problems
- Outcome F: An understanding of professional and ethical responsibility.
- Outcome G: An ability to communicate effectively, using both oral and written presentations, in engineering practice
- Outcome H: The broad education necessary to understand the impact of engineering.
- Outcome I: A recognition of the need for, and an ability to engage in life-long learning
- Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- Outcome N: An ability to work professionally in one or more of the areas of nuclear power systems, nuclear instrumentation and measurement, radiation protection and shielding, and radiation sources and applications

6 Instructor:

Erinc John, Lecturer
231 NSC
erincjb@ufl.edu
Office hours: TBD

7 Teaching Assistant:

TBD

8 Course Meetings:

NSC 227, T 01:55 PM – 02:45 PM (UF Period 7)
NSC 227, H 12:55 PM – 02:45 PM (UF Period 6 & 7)

9 Final Exam Period:

Wednesday April 26, 7:30-9:30 AM

10 Text (Recommended):

Reliability Engineering and Risk Analysis: A Practical Guide, Mohammad Modarres, CRC Press, 2nd edition (September 22, 2009), ISBN: 9780849392474

11 References:

None

12 Attendance:

Attendance is not considered in the grade. However, students are responsible for all materials and announcements presented in class. Some materials in the course may be covered only in class. Some example problems and complex figures (hard to digitize, easy to make on chalkboard) fall into this category. Students are responsible for these materials. There is NO tolerance for mobile phones or other electronic disruptions. Such disruptions will lead to the student being told to leave the room for the duration of the class period, including during examination periods. If a student must arrive late or leave early while class is in session, he/she is expected to do so with minimum level of disruption to the class in progress. This list is by no means complete; please try to be reasonable and considerate of others in all things.

13 Assignments:

The key to assignment presentation is professionalism; assignments are to be written on only one side of assignment pages including examinations. Answers must be legibly written or typed. If I cannot read your handwriting, I cannot grade it. Homework will be assigned approximately biweekly and due in class on the dates stated on the assignment. Submission in PDF format is preferred.

Late homework will be accepted up to 1 day after it is due and you will receive 50% of the score had you turned it in on time. Assignments submitted later than 1 day after it is due may be graded but will receive no credit.

Documenting your Sources: In your assignment, you will typically use information from sources such as your textbook, a reference book, and articles published in a science or engineering journal. When you use information from sources, it must be accompanied by proper references and citations. Failure to do so can result in a severe penalty in order to maintain scientific integrity and to discourage plagiarism.

14 Course Outline:

1. Introduction to Reliability and Risk Analysis (7 Lectures)
 - Definition of Risk
 - Measurement of Risk
 - Comparison/Perception of Risks
 - Probabilistic Risk Assessment and Overview of Risk Evaluation Methodologies
 - WASH-1400 Nuclear Safety Report
 - Status/Role of Safety Goals
 - Risk-Based Versus Risk-Informed Regulation
2. Biological Effects (2 Lectures)
 - a. Describe the effects of radiation

- b. Describe how cells can be damaged by radiation
 - c. Define absorbed and equivalent dose
 - d. Explain the concept of hormesis
3. Basic Probability Theory (5 Lectures)
- Review of Concepts in Probability • Laws of Probability
 - Failure Analysis
4. Event Tree Analysis (3 Lectures)
- Event Tree Construction and Sequencing
 - Generic Evaluation with Radiation System Examples
 - Interactive Role of Fault and Event Trees
5. Probability Distributions in Reliability Evaluation (5 Lectures)
- Discrete Distributions
 - Continuous Distributions
 - Data Manipulation Concepts
6. Fault Tree Analysis (5 Lectures)
- Tree Component Symbolism
 - Generic Construction and Evaluation
 - Examples Including Tree Reduction to Equivalent Trees
 - Use of Signal Flow Graphs and Use of Cut Set Methodology
7. Failure Data Analysis (6 Lectures)
- Sources and Examples of Failure Data
 - Incorporation of Common-Cause/Common-Mode Failures
 - Examples/Effects on Reliability
8. System Network Reliability/Availability (6 Lectures)
- Network Reliability Evaluation Without Repair
 - Reliability of Simple Systems

15 Examinations:

There will be 3 semester exams in this class. The mid-semester exams will be Thursday exams to accommodate a 1.5 – 2 hour period.

16 Grade Assignment:

Grades will depend on your homework performance, midterm and final exams. The grades will be distributed as follow:

- | | |
|----------------|-----|
| • Homework – | 25% |
| • Exam1 – | 25% |
| • Exam 2 – | 25% |
| • Final exam – | 25% |

17 Grading Scale:

This course will use the standard UF grading scale, shown below:

A: 94 –100
A-: 90 –93.99
B+: 87 – 89.99
B: 83– 86.99
B-: 80 – 82.99
C+: 77 – 79.99
C: 73 – 76.99
C-: 69 – 72.99
D+: 67– 68.99
D: 63 – 66.99
D-: 60 – 62.99
E below 60

UF Grade Policy: “ 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> ”

18 Make-up Exam Policy:

Only those excuses for which UF officially requires accommodation will be accommodated via makeup exams. These include: assembly exams for courses with higher numbers, religious holidays, UAA competitions, and sudden (documented) emergencies. In particular, the following activities are not grounds for a make-up exam: co-curricular activities/events (including ANS, intramurals, and fraternity/sorority), personal business (including family/childcare responsibilities), and long commutes to/from campus. All make-up exams will be held after the regular exam at a mutually agreed-upon time.

Exam dates will be finalized in the first week, with some effort to minimize personal conflicts; you are encouraged to make arrangements as soon as possible.

19 Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

20 Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. 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 at <https://evaluations.ufl.edu/results/>.

21 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.

22 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.

23 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: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

24 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: <http://www.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 <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, <http://cms.uflib.ufl.edu/ask>. 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. <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>.