ENU4145/ENU5142 – Risk Assessment for Radiation Systems (Spring 2012)

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 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.
3. 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 l: An ability to apply advanced mathematics, science, and engineering sciences, including atomic and nuclear physics, to nuclear and radiological systems and processes

• 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

Kelly Jordan, Ast. Professor
106 UFTR
kjordan@ufl.edu
Office hours: TBD

7 Teaching Assistant

TBD

8 Course Meetings

NSC 227, MWF 09:35 am – 10:25 am (UF Period 3)

9 Final Exam Period

Exam Group 3A, Friday May 2, 7:30 am – 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

• Risk Analysis in Engineering: Techniques, Tools, and Trends, Mohammad Modarres, CRC Press (January 13, 2006), ISBN: 9781574447941

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. Some assignments should be submitted electronically via SAKAI by the deadline assigned. This will indicated 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 will 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. Basic Probability Theory (5 Lectures)
    - Review of Concepts in Probability • Laws of Probability
    - Failure Analysis

3.Probability Distributions in Reliability Evaluation (5 Lectures)
    - Discrete Distributions
    - Continuous Distributions
    - Nuclear Applications
    - Data Manipulation Concepts

4. Fault Tree Analysis (5 Lectures)
    - Tree Component Symbolism

- Generic Construction and Evaluation
- Examples Including Tree Reduction to Equivalent Trees

5. Event Tree Analysis (3 Lectures)
   - Event Tree Construction and Sequencing
   - Generic Evaluation with Radiation System Examples
   - Interactive Role of Fault and Event Trees

6. Failure Data Analysis (6 Lectures)
   - Sources and Examples of Failure Data
   - Incorporation of Common-Cause/Common-ModeFailures
   - Examples/Effects on Reliability
   - Human Factors Effects With Nuclear Industry Examples

7. System Network Reliability/Availability (6 Lectures)
   - Network Reliability Evaluation Without Repair
   - Reliability of Simple Systems
   - Use of Signal Flow Graphs and Use of Cut Set Methodology

15 Examinations

There will be 2 semester exams in this class and a final cumulative exam. The mid-semester exams will be evening exams to accommodate a 1.5 – 2 hour period and will be arranged by taking into account students' availability for evening scheduling. The final written examination will be held in the UF scheduled exam period – Group 3A (See item 9).

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

Since evening exams are to be held in the UF-designated time slot (2020-2210, E2/E3), only those excuses for which UF officially requires accommodation will be accommodated via make-up 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 fra- ternity/sorority), regularly-scheduled evening courses, 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 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.

Addendum: Any academic dishonesty, including unauthorized collaborations on projects, copying homework, and/or cheating on exams will be reported through appropriate official channels. If this is your first documented offense at UF, you should expect to receive, at minimum, a failing grade in this course. If you have prior offenses, I will recommend suspension or expulsion from UF, as appropriate.

20 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.

21 UF Counseling Services

Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

University Counseling Center, 301 Peabody Hall, (352) 392-1575, Personal and Career Counseling

SHCC mental Health, Student Health Care Center, (352) 392-1171, Personal and Counseling

Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, (352) 392-1161, sexual assault counseling

Career Resource Center, Reitz Union, (352) 392-1601, career development assistance and counseling.

22 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.