

Reliability and Risk Analysis for Nuclear Facilities

ENU 5142, Section 106A, Spring 2019

T 1355-1445 (UF “Period” 6) in Weimer 1092, R 1250-1445 (UF “Periods” 8-9) in MAE-B 234

Final Exam: 1000-1200, Wednesday May 1 in Weimer 1092

Instructor

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352-294-7870

dlschubring@ufl.edu (This is the best way to reach me. The Canvas “conversations” feature *is not* e-mail. Messages sent via that system will not be acknowledged.)

Office hours: There is no open door policy. T 1500-1600, W 1230-1430, R (time TBD), F 1400-1600, and by appointment. Beginning and end times of office hours will be enforced strictly.

Description

Nuclear facilities safety systems including reliability and probabilistic risk assessment.

Prerequisites

ENU 4144 or 5005 and 4934 or ENU 6935

Text (Required)

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

Course Outline and Schedule

There are seven major topics for the course, with 8 HW and 3 exams. Correspondence is as follows:

1. Introduction to Reliability and Risk Analysis (HW 1, Exam 1)
2. Probability in Reliability Evaluation (HW 2, Exam 1)
3. Probability Distributions (HW 3 and HW 4, Exam 1 and Exam 2)
4. Fault Trees (HW 5 and Exam 2)
5. Event Trees (HW 6 and Exam 2)
6. Failure Data (HW 7 and Exam 3)
7. System/Network Reliability (HW 8 and Exam 3)

The day-by-day outline of lecture coverage is to be taken as a draft. HW deadlines will not be moved up, but may be moved back. Exam dates will not change, barring university closure.

Week	Day	Date	Due	Material
1	T	8 Jan		Syllabus and Course Policies
1	R	10 Jan		Introduction to Reliability and Risk Analysis
2	T	15 Jan		Introduction to Reliability and Risk Analysis
2	R	17 Jan		Introduction to Reliability and Risk Analysis
3	T	22 Jan		Introduction to Reliability and Risk Analysis
3	R	24 Jan	HW 1	Probability in Reliability Evaluation
4	T	29 Jan		Probability in Reliability Evaluation
4	R	31 Jan		Probability in Reliability Evaluation
5	T	5 Feb		Probability Distributions
5	R	7 Feb	HW 2	Probability Distributions
6	T	12 Feb		Probability Distributions
6	R	14 Feb		Probability Distributions
7	T	19 Feb	HW 3	Probability Distributions
7	R	21 Feb	Exam 1	Exam 1
8	T	26 Feb		Fault Trees
8	R	28 Feb		Fault Trees
9				No Class - Spring Break
10	T	12 Mar		Fault Trees
10	R	14 Feb	HW 4	Fault Trees
11	T	19 Mar		Event Trees
11	R	21 Mar	HW 5	Event Trees
12	T	26 Mar		Failure Data
12	R	28 Mar		Failure Data
13	T	2 Apr		Failure Data
13	R	4 Apr	HW 6	Failure Data
14	T	9 Apr		System/Network Reliability
14	R	11 Apr	Exam 2	Exam 2
15	T	16 Apr		System/Network Reliability
15	R	18 Apr	HW 7	System/Network Reliability
16	T	23 Apr		Course Review
17	W	1 May	Exam 3	Exam 3

Grading

There are 650 total, equally-valuable points in the course.

- Exam 1 – 150 points
- Exam 2 – 150 points
- Exam 3 – 150 points
- HW – 200 points (8 HW, 25 points each)

The final grades will be assigned based on:

- A: 85%+
- A-: 84-84.99%
- B+: 83-83.99%
- B: 75-81.99%
- C: 67-74.99%
- E: < 67%

I reserve the right to grant higher grades at the end of the course at my sole discretion, including the use of B-, and C+. Under no circumstances will grades of C- or any flavor of D be used.

Please note the following:

1. Each exam is individually curved. The details of this curve are included as part of the Exam Previews.
2. No single item exceeds 25% of your course grade. This emphasizes consistent performance in this course and limits the deleterious effect on your grade of a single poor exam.
3. Grading in this course is plus-based. That is, I award you points based on correct steps, rather than deducting points for errors. As a result, a question such as, “Dr. Schubring, why did you take off 2 points here?” is both presumptuous and nonsensical, since you didn’t have the points to begin with.
4. There is no general protection against double jeopardy. Points are often allocated, particularly on exams, to each specific step and to obtaining the final, correct answer in each problem – a single error will prevent you from earning points at that step and for the final answer.
5. The grade cut-offs for A, B, and C are somewhat lower than the “high-school scale” (90, 80, 70, etc.) under which many UF courses operate. This is not to grant inflated letter grades but rather to account for the inherently challenging nature of two-phase flow and to appropriately award genuinely excellent performances.
6. The gradebook on Canvas is used to enable you to look up grades quickly. Note that this gradebook is *not* official. I reserve the right to correct errors, including transcription errors, from the official (spreadsheet) gradebook, to which I alone have access, until finalization of grades with the registrar.

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Grade Appeal

All appeals of grades, including those from clerical/grade-calculation errors, must be made within 1 week of return. (This may be modified for specific assignments near the end of the term. I will announce this via e-mail as needed.)

Grade appeals must be provided in the following format:

- Include your entire assignment *unmodified*.
- Attach (paper clip preferred) a written summary of which problem(s) or part(s) you believe were graded inaccurately. Be as specific as possible.
- Turn in your appeal to me at class time or during office hours.
- I will review your grade appeal, contact you via your ufl.edu e-mail address, and return the assignment in class. Fairly simple appeals provided to me during office hours may be decided upon while you wait, at my discretion.

Appeals will be considered for clerical errors, addition errors, and inconsistent scoring. Grade appeals will not be entertained if you simply do not like that (for example) Part 1 was worth only 2 points with Part 2 worth 5.

On very rare occasions, if I believe the student is not acting in a good faith belief that more points are deserved, I will deem the appeal frivolous. Following two frivolous appeals, your grade appeal privilege through this method will be *revoked*. Further appeals must be done through the petitions process, which requires formal paperwork and department/program level involvement.

Attendance & Class Conduct

Skip at your peril. Attendance is not considered in the grade. Pursuant to HWCOE policy, the following statement is required: Excused absences are consistent with university policies in the undergraduate catalog

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>
and require appropriate documentation.

However, some materials in the course will not be covered in the textbook or in the notes provided online – 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.

If a student arrives late or leaves early, he/she is expected to do so with minimum level of disruption to the class in progress. 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*. The same principle applies to office hours or appointments – if you stop by my office and your phone rings, you will be told to leave the room for the duration of that day's office hours (or your appointment considered over).

I reserve the right to take attendance to prioritize e-mail assistance.

Make-Up Work Policies

Late-work excuses (extensions) can be grouped into the categories of *professional*, *medical*, and *personal*.

Professional: Reasonable extensions for job/internship interviews, technical conferences, or other professional/career development reasons should be requested. Requests are typically granted, at my discretion, unless they would grant a student an unfair advantage over their peers, cause significant disruption to the course or grading schedule, or violate some UF policy.

Medical: Extensions will also be granted for (your own) medical reasons – please do not come to class if you are ill. Per UF policy, in the case of medical absences that are frequent or suspiciously-timed (*e.g.*; you are repeatedly, suddenly ill at deadlines), I may request a signed note from a physician or similar professional practitioner.

Personal: In addition, UF policies require accommodation for several non-academic, non-medical reasons. *Extensions for these personal issues are strictly limited to those mandated by the letter of UF policies.* The list of UF-approved personal reasons changes from time to time. If you have a question regarding your personal issue and if it qualifies under one of the excused absence/late-work policies, contact me in advance.

The 12-day rule will be enforced strictly. Note that the count of days is based on a per-student, not per-approved-activity basis. All requests for extensions must be submitted in writing, preferably

via e-mail.

For the purposes of this course, in the above-referenced list of approved absence (extension) reasons, the word “family” shall be taken to mean your parents, grandparents, great-grandparents (etc.); children, grandchildren (etc.); siblings; aunts/uncles; nieces/nephews; your spouse and the spouse of any of the above; and half- or step- “versions” of the above categories. More distant relatives (cousins, etc.), partners (excluding spouses), and pets are not included. Minor illnesses (guideline: anything meriting home care only or care at a walk-in clinic, as opposed to an ER) of family members, including minor children, do not count as serious family emergencies, nor do events such as birthdays, anniversaries, weddings, etc.

Political activities, including protests, demonstrations, and the like are considered personal matters and not generally permitted as reasons for extensions. This includes activities related to nuclear engineering or nuclear power. Exceptions: (1) A student who is pursuing nuclear-related (whether pro- or anti-) politics as a career path may be granted extensions, at my discretion, on condition of providing evidence of *bona fide* efforts to secure a full-time position or to secure admission to a relevant, non-STEM degree-granting graduate program and (2) activities between November 8 and November 15, inclusive, that are connected to the 2018 ANS “Winter” Meeting will be taken as related to that professional activity and potentially grounds for extensions.

Further, be advised that any approved reasons for extensions do not reduce the amount of work you are expected to complete, but merely rearranges the timing.

Homework

Excluding the make-up work policies, above, no late homework will be accepted.

Homework may be submitted electronically (via Canvas) or as hard copy; some may have required electronic submissions indicated on the assignment sheets. The following restrictions apply for electronic submissions:

- Submissions may include multiple files, but only files with the following extensions will be accepted: pdf, xls, xlsx, and .txt.
- If a hard copy and electronic submission are provided, the hard copy will take precedence. (Only it will be read, reviewed, and graded.) You may not submit parts of the homework electronically and parts in hard copy, unless explicitly allowed on that assignment sheet.

Examinations

For each exam, you will receive an Exam Preview, intended to prepare you for taking the exam (both technically and procedurally). Detailed policies (including grading/curving) are included on this document. The preview will also include the specific topics addressed by the problem (for most problems), the way points are distributed among problems, and a brief list of topics within the scope of the exam.

Examinations are due at the end of the examination period. No collaboration is permitted during examinations, although you may prepare for these however you choose. Use of any unauthorized materials or any communication (including mobile phones, laptops, or face-to-face with classmates in the room) is grounds for *immediate and final* collection of your exam with no more

work permitted and any work already completed that, in my judgement, was aided by said materials/communication not considered in grading. Examinations consist of two stages: a closed-note conceptual and open-note problem solving.

The criteria for make-up exams are the same as for extensions to other assignments. All make-up exams will be held after the regular exam, as organized with me. Note that conflicts in my proposed make-up times with your personal business will not, in general, be accommodated.

UF policy restricts make-up finals to Friday, May 3, 1500-1700, barring a conflict at that time with another make-up in a course of higher number. This rule applies regardless of your personal business, such as travel times. I strongly discourage you from making hard-to-change travel plans such as flight reservations before Friday evening.

In the unlikely event you (1) are unable to complete the exam at the time originally scheduled for allowed reasons, (2) are unable to make the UF-appointed make-up exam time for allowed reasons, (3) do not make-up the exam at some other time prior to the finalization of grades on May 3, and (4) are on pace to pass the course, you will receive a grade of I (Incomplete). In the (also unlikely) case that the first three of these conditions apply but you were on pace to fail the course, UF policy requires that I assign a failing grade with the notation that you stopped participating before the end of the term. This may have implications on financial aid beyond a simple “E” grade.

Other Course Policies

Electronic Communication

The primary means of communication with the class outside of class time will be e-mail listserv. These listservs will send to your @ufl.edu address only. Any inquiries regarding grading will be directed towards your @ufl.edu address only, per FERPA.

Technical and procedural questions will be answered as a reply to whatever e-mail address you used to send them. If the entire class will benefit from the answer, I may send to the class list (either in lieu of or in addition to a direct reply to you, at my discretion). If you do not wish to have a specific e-mail to me regarding technical content or course procedures replied to through the class list, you must explicitly state this in that e-mail. In such a case, I will reply directly to you and send a general-purpose announcement to the class list, not indicating who caused me to send it.

When sending questions via e-mail, please make sure you provide all the information needed for me to produce an answer or solution. This includes any files on which you are working. (Note: I will not open files from students in the following formats: .ppt, .pptx, .doc, .docx; make a PDF and send that if needed.)

The primary use of the Canvas website is for file storage, as all assignments, lecture notes, etc. will be provided there. I take no responsibility for downtime of this service, nor for actions of University of Florida staff that affect the website (including Canvas upgrades).

ENU 4145 vs. 5142

The undergraduate (ENU 4145) and graduate (ENU 5142) courses share common lectures and a fraction of common coursework.

Letters of Recommendation/Evaluation Policy

To request a letter of recommendation/evaluation (for graduate school or otherwise), you must provide:

- A hard copy of your UF transcript.
- A hard copy of a résumé (or CV).
- A hard copy of the following form: <http://www.registrar.ufl.edu/pdf/ferparelease.pdf>. You *must* check all four circles.

Letters are typically filed once per week. For students whom I know only through coursework, my letter typically focuses on an estimate of their rank-in-class and on their performance on projects (from other courses) and challenging problems.

I will only file *one batch* of letters per student during the term, for any student currently enrolled in a class with me. (This policy is designed to keep me from looking up slight changes in your rank/performance multiple times for multiple batches of letters.) I recommend that this batch occur as late as possible in the term to allow me sufficient information (sample size) on your performance to write a useful letter.

I reserve the right to refuse provide a letter for any student and am not obligated to provide a reason for such refusal.

Syllabus Boilerplate

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 me when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluations

UF expects students 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/>.

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.

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:

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

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 (392-1575) and

<http://www.counseling.ufl.edu/cwc>

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, 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>