ME 515: RISK AND RELIABILITY BASED DESIGN

Fall 2010 Term
Mondays and Wednesdays 2:00-3:50pm
ROG 332
Course Web Site: http://classes.engr.oregonstate.edu/mime/fall2010/me515/

Instructor:

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Office Hours: Wednesdays 4-6pm (*available by email all the time!*)

Learning Outcomes:

By the completion of this course, students will be able to:

- Understand and articulate risk and reliability concepts
- Apply standard risk & reliability analysis methods to large engineering systems
- Explore failure and risk databases
- Formulate a research problem and present findings and research approach

Textbook:

No textbook is assigned. ***Reading assignments (RA)*** will be handed out for selected topics either from published articles or books. Suggested books for reading include:

Probabilistic Risk Assessment: Reliability Engineering, Design, and Analysis
By Henley and Kumamoto, IEEE Press, 1992.

Reliability engineering: Modeling, Prediction, and Optimization
By Blischke and Murthy, John Wiley & Sons, 2000.

Grading:

Design Project	40% (Proposal, RBD, Failure Databases, FMECA, FTA, FFIP, Report)
Exam	30% (Individual)
Research Project	30% (Research proposal 5%, interim progress report 5%, oral presentation 10%, final report 10%)

Reading Assignments (*RA1-RA6*):

Weekly reading assignments will be posted on the web site. You are required to read the assignments every week, as it'll help follow the lecture content. Note that material in the reading assignment may be included in the exam.

Design Project (*DP*):

Deliverables (Due Wednesdays):

- DP1: Proposal with case study and system description (and presentation)
- DP2: Reliability measures and reliability block diagrams
- DP3: List of potential failures, risks from published databases
- DP4: FMEA results
- DP5: FTA results
- DP6: FFIP analysis results
- DP7: Summary report for case study putting all the results together

Case Studies:

- Oil industry: e.g., Deepwater Horizon accident
- Automotive industry: e.g., Toyota accident
- Nuclear industry: e.g., Three mile island accident
- Space industry: e.g., Challenger shuttle accident

Summary Report Expectations: The final report will describe the case study and system, and will combine all the assignments and compare results/findings from each analysis method.

Research Project (*RP*):

Research Topics (select one per team)

- Reliability based design optimization
- Utility based decision making
- Uncertainty analysis
- Robust design

Deliverables (Due Wednesdays):

- RP1: Proposal (team assignment)
- RP2: In-class paper discussion forum (team assignment: 1 seminal paper per topic, per team)
- RP3: Initial list and summary of literature search (individual assignment)
- RP4: Interim progress report (team assignment)
- RP5: Oral presentation (team assignment---each team member must participate)
- RP6: Final report (team assignment)

Final Report Expectations: The final report will summarize the research findings to answer the following question: Could the research methods you've discovered been used to design the system in your case study (by taking failure and risk information into account early in the design process?) Is so, how? The final report should include the following:

- Background and literature search on selected topic
- A thorough discussion and analysis of the state-of-the-art and existing gaps/needs
- A discussion of how system used for the selected design project case study could be improved using research ideas (or selected approach)
- A plan of research approach to implement the method(s)

In-Class Paper Discussion Forums: Each team will be responsible for conducting a round-table discussion of a seminal journal paper for their selected research topic. This will require each team to reach a consensus on a paper to read and analyze thoroughly, distribute to the rest of the team, present findings, and prepare points of discussion during the round-table session.

Exam: There will be one exam on Wednesday, Week 7, that will take up the entire 2 hour time slot on that day (2-3:50pm). The exam will be composed of exercises and examples covered in the lectures, as well as the material contained in the DP assignments, up to the end of Week 6.

Special Needs:

Students with documented disabilities who may need accommodations, who have any emergency medical information the instructor should know of, or who need special arrangements in the event of evacuation, should make an appointment with the instructor as early as possible, no later then the first week of the term. Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098.

Academic Integrity:

Academic dishonesty is prohibited and considered a violation of the OSU Student Conduct Regulations. It includes cheating, the intentional use of unauthorized materials, information, or study aids); fabrication, assisting in dishonesty or tampering (intentionally or knowingly helping or attempting to help another commit an act of dishonesty or tampering with evaluation instruments and documents); and plagiarism, intentionally or knowingly representing the words or ideas of another person's as ones' own. If you have a question regarding academic integrity, please talk to the instructor or refer to the OSU student conduct homepage at http://osu.orst.edu/admin/stucon/index.htm.

Topics and Approximate Schedule:

Week 1: LECTURE 1-2: 9/27-29: Introduction to Risk
Introductions, Syllabus, Library Use; Teaming; Basic concepts and definitions
Risk vs. Uncertainty; Qualitative vs. quantitative risk; Risk analysis process
DP1 *due next week: Brief proposal and presentation of selected case study and system(s)*
RA1*: Reading Assignment for next week: Risk analysis and assessment*

Week 2: LECTURE 3-4: 10/4-6: Introduction to Reliability
Risk vs. Reliability; Reliability engineering; Discussion of case studies
RP1 *due next week: Research proposal and research meeting*
RA2*: Reading Assignment for next week: Reliability measures & reliability block diagrams*

Week 3: LECTURE 5-6: 10/11-13: Reliability Analysis
Reliability measures; Reliability block diagrams
DP2 *due next week: Reliability measures and reliability block diagrams*
RP2 *due next week: In-class paper discussion forum*
RA3*: Reading Assignment for next week: Failures mechanisms and reliability databases*

Week 4: LECTURE 7-8: 10/18-20: Failure Modeling and Failure Databases
Failure: definitions and modeling (HW vs. SW failures; component vs. system-level failures)
Failure and Reliability Databases
DP3 *due next week: List of failures modes & a failure or reliability data for system/case study*
RP3 *due next week: Initial literature survey summary (individual)*
RA4*: Reading Assignment for next week: Failures modes and effects analysis*

Week 5: LECTURE 9-10: 10/25-27: Risk Analysis Methods
Failure modes and effects analysis (FMEA), Criticality analysis (CA)
Introduction to Item Software
DP4 *due next week: FMECA for selected system and case study*
RA5*: Reading Assignment for next week: Fault tree analysis & event tree analysis*

Week 6: LECTURE 11-12: 11/1-3: Risk Analysis Methods
Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Probabilistic Risk Assessment (PRA)
DP5 *due Week 8: FTA for selected system and case study*
RP4 *due next week: Interim progress report*

Week 7: LECTURE 13-14: 11/8-10: Risk Analysis Methods
Risk based design: risk considerations in early design stages; Exam review
Midterm Exam *(Wednesday): Basic concepts and definitions in risk based design, failures, uncertainty, probabilistic design, reliability measures, and exercises in FMECA, FTA, databases, reliability block diagrams*
RA6*: Reading Assignment for next week: Functional failure identification and propagation analysis*

Week 8: LECTURE 15-16: 11/15-17: Risk Based Design Methods
Risk based design: risk considerations in early design stages
Functional failure identification and propagation (FFIP)
DP6 *due Week 10: FFIP analysis for selected system and case study*
RA7*: Reading Assignment for next week: Additional risk based design methods*

Week 9: LECTURE 17-18: 11/22-24: Risk Based Design Methods *(Thanksgiving week)*
Functional failure identification and propagation (FFIP)
DP7 *due Finals Week (Monday): Case study and system analysis summary report*
RP5 *due next week: Project presentations (20 minutes)*

Week 10: LECTURE 19-20: 11/29-12/1: Project Presentations
RP6 *due Finals Week (Monday): Final research project report*