The University of Arizona College of Engineering

Course Title: Reliability Engineering Spring 2015

Course: **SIE 408/508**

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Textbook: Ebeling, C. E., *An Introduction to Reliability and Maintainability Engineering,* Waveland Press, Inc., 2009 (ISBN 1-57766-625-9) second edition.

Course Description and Goals:

This is a three-credit course configured for well-qualified seniors, graduate students, and engineering professionals and practitioners. It is concerned with determining the probability that a component or system, whether simple or complex, will function as intended, and how to analyze a system for "reliability". The scope of this course includes: (1) root cause analysis of critical failures, (2) reliability models of components and systems, (3) development of statistical methods for estimating the reliability of a product, and (4) methodologies to influence system designs.

After successful completion of the course, the students will be able to analyze data related to reliability questions and use the analytical results to predict the reliability of simple and complex systems. This course will provide an introduction to probability calculus for continuous and discrete random variables, statistical failure time models, estimation of model parameters, model comparison and prediction of future failures. Reliability for simple and complex systems and the relationship to component reliability

will be discussed. Students will practice application of the theoretical techniques with data sets from different engineering disciplines.

Graduate-level requirements include undergraduate level requirements with the addition of a research project. This project focuses on surveying research in the field of reliability engineering and will be discussed the first week of class.

Prerequisite:

- For undergraduate students: SIE 305 or equivalent
- For graduate students: SIE 430/530

Topics to be covered:

- Basic concepts and analyses in Reliability Engineering
- Root cause analysis
- Statistical reliability models
- System reliability analysis (RBD, FTA, ETA, FMECA, etc.)

Contribution to Professional Component/Learning Outcomes:

1. Understand and gain the ability to apply concepts and methods of reliability analysis to failure data from different engineering disciplines.
2. Understand and be able to develop probability distribution models (exponential, Weibull, etc.) for failure time analysis.
3. Acquire ability to model system reliability.
4. Acquire ability to root cause, correct, and document system failures
5. Acquire ability to apply system reliability analyses

Proctor Information:

This course will have proctored exams for distance students. It is the student's responsibility to locate a proctor and report this information to the distance education department.

It is expected that grading will be based on a percentage of the total points possible with the following minimums required for each grade: **A = 90%**, **B = 80%**, **C = 70%**, and **D = 60%**.

Assignments will be assigned with a due date. **NO LATE ASSIGNMENT WILL BE ACCEPTED.** If you cannot attend class, make sure your homework is e-mailed to the GTA or delivered to my office (237 Engineering Building) before class on the day it is

due. Homework not turned in on time will be graded as zero, so please turn in what you have completed even if you have not fully completed an assignment.

Grading (different criteria will be used for undergraduate and graduate students):

SIE 408			SIE 508	
Design Project	70%		Design Project	50%
Research Project	N/A		Research Project	25%
Midterm Exam	30%		Midterm Exam	25%
Total	100%		Total	100%

Assignments

Assignments will be posted periodically to D2L. All assignment details will be reflected in the assignment itself. Announcements will be provided in class about when these will be posted and also about addition detail related to the assignment.

Research Project (RP) - Individual project

Research Topics (select one per team)
- Reliability for early engineering design
- Utility based decision making
- Uncertainty analysis
- Robust design
- *Other - you propose it*

Deliverables
- RP1: Topic proposal
- RP2: Initial list and summary of literature search
- RP3: Continuation of literature search
- RP4: Refinement of literature search
- RP5: Future work
- RP6: Final report

Design Project (DP) - Team project

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

- *Other - you propose it*

Deliverables:
- DP1: Design project proposal (and presentation)
- DP2: Reliability measures and reliability block diagrams
- DP3: List of potential failures, risks from published databases
- DP4: FMEA results
- DP5: FTA & ETA results
- DP6: FRACAS reports
- DP7: FFIP analysis results
- DP8: Summary report for case study putting all the results together (and presentation)

Suggested References:

Books:

1. Reliability toolkit: Commercial practices edition. Reliability Analysis Center, 1995.
2. Blischke, Wallace R., and DN Prabhakar Murthy. *Reliability: modeling, prediction, and optimization*. Vol. 767. John Wiley & Sons, 2011.
3. Leemis, Lawrence M. *Reliability: probabilistic models and statistical methods*. Prentice-Hall, Inc., 1995.
4. Modarres, Mohammad, Mark P. Kaminskiy, and Vasiliy Krivtsov. *Reliability engineering and risk analysis: a practical guide*. CRC press, 2009.
5. O'Connor, Patrick, and Andre Kleyner. *Practical reliability engineering*. John Wiley & Sons, 2011.

Databases:

1. *Will be posted with the course material throughout the term.*