The University of Arizona
College of Engineering

Course Title: Reliability Engineering. Fall 2022 Start: August 23, 2022

Course: **SIE 408/508, T-Th 2PM – 3:15PM Chavez room 308**

Instructor: **Allan T. Mense, Ph.D., PE, CRE**
Systems and Industrial Engineering Department
University of Arizona
Class: August 23 - Dec. 6, 2022.
Office hour: Using Zoom Wednesday 4pm to 5pm by Zoom
Phone Number: (520) 907-7786. E-mail: atmense@arizona.edu

GTA: Lang Wu (langwu@arizona.edu)
Office: ENGR 159
Office hours: Tuesday & Thursday 3:30pm to 4:30pm in office

Text: Ebeling, Charles E., "An Introduction to Reliability and Maintainability Engineering, 3rd Ed.", Waveland Press, Inc., 2019 (ISBN 978-1-4786-3734-9)

Software: **Minitab 18** (Available on SIE department server); MS Excel

Course Description and Goals:
This is a three-credit course offered for well-qualified seniors, graduate students, and engineering professionals and practitioners. This is an introductory text and will be supplemented with material on many everyday reliability engineering problems e.g. root cause analysis. The course will make use of Minitab™ software. The scope of this course includes: (1) failure distributions, (2) failure rate models & reliability concepts, (3) reliability systems & state-space models, (4) accelerated testing. (5) Repair process & Availability, (6) Bayesian reliability estimates, (7) Case studies.
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 some types of complex systems. This course will introduce probability for continuous and discrete random variables, statistical failure time models, estimation of model parameters, model comparison and prediction of future failures. Students will practice application of the theoretical techniques with data sets from different engineering disciplines using the commercial software provided in this class.

There will be 3 or 4 quizzes during the semester that will account for grad students 40% of semester grade and undergrads 50% of semester grade.

Undergraduates will be graded separately from grad students.

Graduate students will perform a term project and present results as a paper (10 pages) and a set of ppt slides (10 slides). Grad students will have a fgew additional homework problems.

The project will be a report on the subject "Using prognostics to improve reliability and maintainability." This involves combing the internet, reading of published technical papers, summarizing the information, and adding in your own ideas.. See welcome announcement.

Prerequisite:
For undergraduate students: SIE 305 or equivalent; For graduate students: SIE 430/530 or its equivalent would be useful but not required. Students should review stats including hypothesis tests: t-test, Chi square test, F-test, and simple linear regression. A good text is Mathematical Statistics by Lawrence M. Leemis as well as others listed in Lecture #1.

Topics to be covered:

Basic concepts in Reliability Engineering
Statistical reliability models
Accelerated testing.
System reliability analysis
Lifetime data analysis & model parameter estimation
Repairable systems and Availability
Basic Bayesian reliability analyses

Proctor Information:
This course will have 3 or 4 quizzes taken on D2L; DRC students will be accommodated.

Grading (different criteria will be used for Under Grad and Grad students):

SIE 408	
Homework	50%
3 or 4 Quizzes	50%
Total	**100%**

SIE 508	
Homework	40%
3 or 4 Quizzes	40%
Project (Required)	20%
Total	**100%**

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%**. Instructor may curve final course grades but that is not guaranteed. Homework will have due dates assigned on each homework **LATE HOMEWORK WILL BE ACCEPTED only with permission of instructor or TA.** Late homework w/o prior notification to TA will have a 10% deduction. **If you want an A or B you must turn in all the homework!**

Suggested References for reliability

1. E.A. Elsayed, *Reliability Engineering, 3nd Ed*, Addison Wesley, 2021. (Very good but very expensive)
2. Tobias & Trindade, *Applied Reliability* 3rd Ed., (2011),Wiley Pub. Best Grad-level text
3. Meeker, W.Q., and L.A. Escobar, & F.G. Pascual, *Statistical Methods for Reliability Data*, 3rd Edition. John Wiley & Sons, 2021. Classic grad level textbook now in new edition. (Use in SIE 608)
4. O'Connor, Patrick, and Kleyner, Andre. *Practical Reliability Engineering*, 5th Ed., John Wiley & Sons, 2012. A lot of good practical advice and wisdom (paperback)

5. Leemis, L., *Reliability,* 2nd Ed., , (2009) more mathematical but well written (paperback)

6. Kapur, K.C. & Pecht, M. , Reliability Engineering 2nd Edition, (2014) Wiley & Sons,