

**Spring 2018**

**CE 5310**

**RISK AND RELIABILITY ANALYSIS OF ENGINEERING SYSTEMS**

Instructor: Dr. Carlos Ferregut

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Office Hours: You can drop any time and, if I am available, I will talk to you. You can also make an appointment with my assistant Miss Luisa Ruiz Mendoza (X8151) or with Ms. Concha Ruiz, Administrative Assistant of the Department of Civil Engineering (X5464).

Text Book: See list of reference books.

Course Objectives: Familiarize the student with the process of modeling engineering problems containing uncertainties in the control (design) variables; and train the student in the application of analytical and numerical methods to quantify the effect of those uncertainties on the performance of an engineering system. The student will also become familiar with the principles of design and decision making under uncertain conditions.

**COURSE OUTLINE**

1. Review of Basic Probability Concepts
  - 1.1 Data analysis
  - 1.2 Set theory
  - 1.3 Probability distribution of a random variable
  - 1.4 Parameter estimation from data
  - 1.5 Empirical determination of distribution models
  - 1.6 Probability distributions of multiple random variables
  - 1.7 Functions of random variables
  - 1.8 Rosenblueth’s point mass distribution and applications
  
2. Monte Carlo Simulation Techniques
  - 2.1 Random numbers with standard uniform distribution
  - 2.2 Continuous random variables (Normal, Exponential, Lognormal, etc.)
  - 2.3 Functions of random variables
  
3. Extreme Value Statistics

- 3.1 Probability distribution of extremes
- 3.2 The tree asymptotic forms
- 3.3 Extremal probability paper
- 3.4 Estimation of extremal parameters
  
- 4. Reliability and reliability based design
  - 4.1 Analysis and assessment of reliability
  - 4.2 First order second moment formulation
  
- 5. Modeling and Analysis of Uncertainty
- 7. Systems Reliability
- 8. Fault Tree and Event Tree Analysis
- 9. Decision Analysis

Grading Policy:

First exam:.....	20%
Homework.....	30%
Projects .....	50%

## Reference Books

Alfredo H-S Ang and Wilson H. Tang, Probability Concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering, 2nd Edition, John Wiley & Sons, 2007.  
(NOTE: I like the first edition better but it is out of print)

Probability Concepts in Engineering Planning and Design, Volume II, Decision, Risk and Probability  
Alfredo H-S Ang and Wilson H. Tang  
John Wiley & Sons  
1984

Structural Reliability Theory and Its Applications  
Palle Thoft-Christensen and Michael J. Baker  
Springer-Verlag  
Berlin Heidelberg, New York  
1982.

Reliability Based Design in Engineering  
Milton E. Harr.  
Dover Publications, Inc.  
Mineola, New York  
1987.

Methods of Structural Safety  
H. Madsen, S. Krenk, N.C. Lind  
Dover (originally published by Prentice-Hall)

Probability, Statistics and Decision for Civil Engineers  
Jack R. Benjamin and C. Allin Cornell  
Dover

Probability and Statistics for Engineering and the Science  
Jay L. Devore  
Duxbury Press  
1995

Probability, Reliability and Statistical Methods in Engineering and Design  
Achintya Haldar and Sankaran Mahadevan  
John Wiley and Sons, Inc  
2000

Structural Reliability Analysis and Prediction  
Robert E. Melchers  
John Wiley  
Second or third editions

Reliability of Structures  
Andrzej S. Nowak & Kevin R. Collins  
CRC Press