

ENRE 670
Probabilistic Risk Assessment
Fall 2021

Instructor: Prof. Mohammad Modarres (modarres@umd.edu; 301-405-5226; Room 0151 Glenn Martin Hall), modarres@umd.edu.

Office Hours; TBD

No Teaching Assistant

Key Dates:

One Midterm Exam (October 28, 2021): 25%

One Final Exam (December 16, 2021): 30%

One Term Paper (Due December 9, 2021): 30%

Three Comprehensive Homework Sets: 15%

Required Textbook: Risk Analysis in Engineering; M. Modarres, CRC-Taylor & Francis (2006).

PREREQUISIT FOR THIS COURSE IS ENRE602: If you have taken the ENRE602 or ENRE447 or are taking it this semester you are ok. For those taking the ENRE602 concurrently, please note that the delivery of prerequisite topics in this course is NOT coordinated with ENRE602. So, you may need some topics in this course that might be covered in a later date in ENRE602. In those cases, you may need to do some self-studies. The main topics of interest from ENRE 602 are: Probability and Statistics, Component Reliability, Even Tree Analysis, Fault Tree Analysis.

TOPICS EXPECTED

Review of Risk Assessment Basics and Metrics

Importance of Risk Analysis

Complexity and Characteristics of Engineering Systems and Their Models

Demand for Risk Analysis

Emergence of Formal Risk Analysis

Categories of Risk

Safety vs. Security

Quantitative Risk Assessment

Quantitative vs. Qualitative Risk Analysis

Identification of Hazards

Identification of Barriers

Estimation of Frequency or Probability of a Hazard Exposure and Barrier Failure

Consequences Evaluation

Risk Assessment, Management, and Communication

Elements and Types of Risk Assessment

Risk, Hazard, Performance and Engineering Risk Assessment

Qualitative Risk Assessment

Probabilistic Risk Assessment

Steps in Conducting a Probabilistic Risk Assessment (PRA)

Strength of PRA
Risk Scenario development and Logic Modeling, Development and Quantification
Fault Tree Method
Evaluation of Logic Trees
Event Trees Method
Common Cause Failures
Modeling of Dependent Failures in Risk Assessment
A Simple Example of PRA

Uncertainty Analysis

Types of Uncertainty Measures of Uncertainty
Uncertainty Propagation Methods
Classical Methods Probabilistic Methods
Interpretation of Classical and Bayesian Intervals
Comparison of Uncertainty Propagation Methods Graphic Representation of
Uncertainty

Identifying, Ranking and Predicting Contributors to Risk

Importance Ranking in Probabilistic Risk Assessment
Importance Measure and Consideration of Uncertainties
Risk-Based Ranking
Ranking Order Uncertainty
Uncertainty Importance Measures

Risk Acceptance Criteria

Representation of Risk Results
Human Health and Safety Risk Acceptance Criteria
Individual Risk Acceptance Criteria
Economic Risk and Performance Acceptance Criteria
Other Risk Acceptance Criteria in Form of Figures of Merit Acceptable Risk Levels
Risk Acceptance Based on Life Valuation

Decision Making Techniques

Economic Methods in Risk Analysis
Benefit-Cost Analysis
Cost-Effectiveness Analysis Risk-Effectiveness Analysis
Non-Economic Techniques
Probability of Exceedance Method Structured Value Analysis
Analytical Hierarchy Process Decision Tree Analysis

Risk Communication

Forms of Communication
The Basic Rules of Risk Communication
Elements of Effective Risk Communication Characteristics of an Effective Risk
Communication Risk Perception