Course Name:
Reliability, Risk, and Resilience

Credit:
3

Course Content (outline):

- **Introduction and background**
  - Motivation
  - Uncertainties
  - Set theory
  - Probability theory
- **Decision analysis**
  - Decision trees
  - Expected cost theory
  - Introduction to reliability-based design optimization
- **Probabilistic models**
  - Discrete distribution models
  - Continuous distribution models
  - Bayesian inference
  - Multivariate distribution models
- **Reliability**
  - Analysis of functions
  - Probability transformations
  - Basic reliability problem
  - Mean-value first-order second-moment method
  - Sampling methods
- **Risk**
  - Hazard
  - Infrastructure
  - Consequence
  - Disaster
  - Introduction to earthquake engineering
  - ATC-13 risk analysis framework
  - FEMA-NIBS risk analysis framework
  - Reliability-based risk analysis framework
- **Resilience**
  - Definition of resilience
  - Design philosophies
    - Allowable stress design
    - Load and resistance factor design

        - Performance-based design
        - Resilience-based design
    - Properties of resilience
        - Robustness
        - Rapidity
        - Resourcefulness
        - Redundancy
    - Robustness quantification via risk models
    - Recovery analysis via agent-based models
    - Resourcefulness via Bayesian network

References:

- Haldar and Mahadevan (1999), Probability, Reliability, and Statistical Methods in Engineering Design, Wiley
- Der Kiureghian (2005), First- and Second-order Reliability Methods. Chapter 14 in Engineering Design Reliability Handbook, Edited by Nikolaidis, Ghiocel, and Singhal, CRC Press
- ATC (1985). Earthquake Damage Evaluation for California. ATC-13, Applied Technology Council, Redwood City, CA
- FEMA-NIBS (2012). Earthquake Loss Estimation Methodology, HAZUS Technical Manual. Federal Emergency Management Agency and National Institute of Building Sciences, Washington, DC
- Cimellaro (2016), Urban Resilience for Emergency Response and Recovery. Springer International Publishing, Switzerland