

**PD683**  
**Probabilistic Structural Analysis, Design, and Reliability-Risk Assessment**

**Day One**

- Module 1 – Refresher of Probability and Statistics
- Module 2 – Introduction to Probabilistic Structural Methods
  - Random variabilities in material properties
  - Random variabilities in loads
  - How these variabilities are handled in deterministic methods?
  - How these variabilities are handled in probabilistic methods?
  - Is there a general one-to-one relationship between factor of safety and reliability?
  - Where used? Benefits? Typical applications (detailed discussion of applications will be provided in later session.)
- Module 3 – Analysis Methods
  - Emphasis of the discussion is on assumptions, strengths and weaknesses, relative advantages and disadvantages, and computational requirements
  - Stress-Strength Interference Method
  - Simulation Methods
    - Direct simulation technique
    - Advanced simulation techniques
      - ❑ Importance sampling method
      - ❑ Adaptive sampling method
      - ❑ Stratified sampling method
      - ❑ Conditional expectation method
      - ❑ Generalized conditional expectation method
      - ❑ Response surface method
  - First-Order/Second-Order Methods

**Day Two**

- Module 4 – Probabilistic Fracture Mechanics
  - Random scatter in fracture properties
  - Methods of analysis
  - Example applications
- Module 5 – Probabilistic Fatigue Analysis
  - Random scatter in fatigue properties

- Probability-based S-N curves
- Methods of analysis
- Example applications
- Module 6 – Reliability-Based Design
  - Deterministic versus probabilistic methods
  - Factor of safety versus reliability
  - Design for specified reliability
  - Example applications

### Day Three

- Module 7 – Seismic Risk Assessment
- Module 8 – Reliability-Based Inservice Inspection (ISI)
  - Nondestructive examination reliability
  - Prioritization of components and equipment for ISI
    - ASME method
    - Pacific Northwest Laboratories method
    - Method of risk measure comparison
  - Example applications
- Module 9 – Reliability-Based Life Prediction and Life Extension
  - Deterministic versus probabilistic approach
  - Probability of failure as a function of time
  - Probability distribution of life
  - Methods of analysis
  - Example applications

### ***Please take note...***

- Discussions in the above topics include:
  - Applications in Aircraft Industry
  - Applications in Ships
  - Applications in Offshore Structures
  - Applications in Pressure Vessels and Piping
  - Applications in Nuclear Power Plants
  - Applications in Fossil Power and Process Plants