



IIT MANDI PROPOSAL FOR NEW COURSE

Course number	: CE518
Course Name	: Structural Reliability and Risk Assessment
Credit Distribution	: 3-0-0-3
Intended for	: UG/PG elective
Prerequisite	: CE 351 – Design of Reinforced Concrete Structures
Mutual Exclusion	: None

1. Preamble:

Uncertainty is ubiquitous in all sorts of modelling and experimental processes in science and engineering. The objective of this course is to develop an understanding of the reliability analysis of structural systems having uncertainty and exposed to random environment. The course will introduce the probabilistic bases of structural reliability, the techniques and methods of evaluating the reliability of structural components and systems, the methodology in the development of reliability-based design criteria and lifetime risk assessment of structures (buildings and bridges) under service loads and natural hazards. The course will help the students to develop their skills to take this subject for further research.

2. Course Modules with quantitative lecture hours:

Module 1: Review of Probability and Statistics - [Basic definition of probability](#), [Concept of random variables](#); [Concepts of probability functions - PDF, CDF, and PMF](#); [Types of probability distributions](#); [Correlations, Conditional probability, Bayes theorem](#) **[8 hours]**

Module 2: Structural Reliability Analysis 1 - Basic concepts, Exact solution, Mean value first-order second-moment (MVFOSM), First-order second-moment (FOSM), First-order reliability method (FORM), Sensitivity analysis. **[8 hours]**

Module 3: Probabilistic Simulations - Monte Carlo simulations, Stratified sampling, Importance sampling. **[5 hours]**

Module 4: Structural Reliability Analysis 2 – [Component and System reliability](#), Second-Order Reliability Method (SORM), Time-varying reliability, Response surface method, Introduction to machine learning tools. **[8 hours]**

Module 5: Reliability-based design codes – Introduction, LRFD, Calibration of safety

factors. [6 hours]

Module 6: Advanced Topics and Applications - Risk assessment of civil structure and infrastructure systems under service loads and natural hazards; Reliability-based Optimization Problems; Bayesian Inference Techniques; Application in structural health monitoring - Concept of Value of Information. [7 hours]

3. Text book:

- Nowak, A.S. & Collins K.R., Reliability of Structures, 2nd ed., CRC Press, 2012.
- Ranganathan R, Structural Reliability: Analysis and Design, Jaico Publishing, 2006.

4. References:

- Melchers RE, Structural Reliability Analysis and Prediction, 2nd ed., Wiley, 1999.
- Haldar, A & Mahadevan, S, Probability, Reliability, and Statistical Methods in Engineering Design, Wiley, 1999.
- Wang, C. Structural Reliability and Time-dependent Reliability. Cham, Switzerland: Springer, 2021.
- Ditlevsen, O., & Madsen, H. O., Structural Reliability Methods (Vol. 178). New York: Wiley, 1996.
- Chandrasekaran, S, Reliability and Risk Assessment, CRC Press, 2016
- Thoft-Christensen, P. , & Murotsu, Y., Application of Structural Systems Reliability Theory, Springer Verlag, 1986.

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S.No	Course Code	Similarity Content	Approx. % of Content
1	CE555 – Advanced Design of Structures	Probability distributions and modeling for loading and material strength; Reliability of Structures	< 5%
2	MA 524- Probability and Statistics	Probability distributions and statistics basics	< 5%

6. Justification of new course proposal if cumulative similarity content is >30%:

NA