

COURSE CONTENT

STRUCTURAL RELIABILITY (Professional Elective – III)

II Semester: SE								
Course Code	Category	Hours/ Week			Credits	Maximum Marks		
2522048	Core	L	T	P	C	CIA	SEE	Total
		3	0	0		3	40	60
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			
Prerequisites: NIL								

Course Overview:

This course introduces structural safety and reliability concepts used in civil engineering design. Unit I covers basic statistics, probability theory, random variables, distributions, and data analysis for structural applications. Unit II focuses on resistance distributions of materials like concrete, steel, brick, and mortar, along with variability and reliability-based allowable stresses. Unit III explains structural reliability concepts and Monte Carlo simulation for safety evaluation. Unit IV introduces reliability methods including first-order second-moment (FOSM) techniques. Unit V deals with reliability-based design, partial safety factors, design formats, and development of reliability criteria for RCC structures and codes.

Course Objectives:

1. To introduce probabilistic concepts in engineering, including uncertainty modeling, failure theories, and statistical distributions.
2. To apply reliability-based design methods using probability of failure, reliability index, Monte-Carlo simulation, and stochastic modeling.
3. To analyze structural safety under variable loads, material variability, deterioration, and model uncertainty.
4. To integrate reliability assessment into performance-based structural design and risk-informed decision-making.
5. To develop advanced reasoning skills for applying reliability tools in research, optimization, and infrastructure resilience.

Course Outcomes: After completion of the course, students should be able to

1. Describe the concepts of structural safety, probability theory, and statistical distributions relevant to reliability analysis.
2. Assess reliability-based allowable stresses considering variations in material strengths.
3. Apply Monte Carlo simulation for estimating structural reliability.
4. Examine the reliability of structures using the first-order second-moment (FOSM) approach.
5. Develop reliability-based design formats and safety factors for reinforced concrete structures in accordance with Indian standards.

SYLLABUS:

UNIT - I

Concepts of Structural Safety: General - Design methods- Basic Statistics: Introduction -Data reduction – Histograms - Sample correlation - Probability Theory: Introduction, Random events - Random variables - Functions of random variables - Moments and expectation - common probability distribution - Extremal distribution.

UNIT - II

Resistance Distributions and Parameters: Introduction - Statistics of properties of concrete, steel, strength of bricks and mortar - dimensional variations - characterization of variables - Allowable stresses based on specified reliability.

UNIT - III

Basic Structural Reliability: Introduction - Computation of Structural reliability- Monte Carlo Study of Structural Safety: General- Monte Carlo method - Applications.

UNIT - IV

Reliability Methods: Introduction - Basic variables and failure surface - First-order second-moment methods (FOSM)

UNIT - V

Reliability Based Design: Introduction - Determination of partial safety factors - Safety checking formats - Development of reliability-based design criteria - Optimal safety factors -Summary of results of study for Indian standard – RCC Design.

TEXT BOOKS:

1. R. Ranganathan, Structural Reliability Analysis and Design, Jaico Publishing House, 2006.
2. R.E. Melchers, Structural Reliability – Analysis & Prediction, 2/e, Wiley – Blackwell, 1999.

REFERENCES:

1. Maurice Lemaire, Structural Reliability, Wiley (2009).
2. Dan M. Frangopol, Mitsuo Kawatani & Chul-Woo Kim, Reliability and Optimization of Structural Systems, Taylor & Francis (2006)



ELECTRONIC RESOURCES:

<https://nptel.ac.in/courses/105103140>

MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Definitions and terminology
4. Assignments
5. Model question paper–I
6. Model question paper–II
7. Lecture notes
8. E-Learning Readiness Videos(ELRV)