



# STRUCTURAL RELIABILITY

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Department of Civil Engineering

IITKGP

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 12 Weeks (26-Jul' 21 - 15-Oct'21)

**EXAM DATE** : 23 Oct 2021

**PRE-REQUISITES** : Must have completed at least 2nd year UG curriculum in engineering with course(s) in Engineering Mechanics must have taken courses in probability & statistics, linear algebra and basic calculus

**INTENDED AUDIENCE** : 4th year advanced UG students, 1st year MTech, 1st year PhD students

**INDUSTRIES APPLICABLE TO** : All companies with R&D facilities, all national labs including DAE, ISRO, DRDO labs

## **COURSE OUTLINE :**

The civil engineering community, and structural engineers in particular, have long recognized the important role played by variability and incomplete information in their profession: (i) random system properties, (ii) unpredictable future loads and strength deterioration, (iii) human errors, and (iv) imperfect mathematical models.

## **ABOUT INSTRUCTOR :**

Professor Bhattacharya works in the area of probabilistic mechanics and computational materials science. His research has involved material degradation, load modelling, damage detection, system identification, seismic reliability analysis and design guides for various structures including nuclear power plant shells, ships, offshore vessels and bridges.

## **COURSE PLAN :**

**Week-1:** Introduction and overview, Review of basic probability, Random variables, probability laws, common probability distributions – origins and interrelations, Simple one variable example problems

**Week-2:** Functions of random variables, Joint probability distributions, conditional distributions, Joint Normal distribution, Concepts of stochastic process, Simple two variable example problems.

**Week-3:** Reliability – historical development, applications, different measures of reliability, Component vs. system reliability, Probabilistic formulation of civil engineering problems, Concepts of performance requirements and definitions of failure.

Week-4:

Formulation of structural component reliability problems: limit states.

Simple example problems involving closed form solutions of limit state probabilities

**Week-5:** Approximate solutions to component reliability problems: FORM, SORM Examples: Solution of benchmark problems

**Week-6:** Approximate solutions to component reliability problems: Monte Carlo simulations

Variance reduction techniques Examples: simple coding problems

**Week-7:** System reliability - representation of failure, series and parallel systems, redundancy, fault trees.

**Week-8:** Approximate solutions to system reliability problems: FORM based and simulation based System reliability bounds

**Week-9:** Time dependent reliability. Hazard function. Component formulation, Concept of first passage problem

**Week-10:** Reliability-based maintenance. Perfect and imperfect repair.

**Week-11:** Probability-based design, Reliability-based design codes – partial factors of safety.

**Week-12:** Probability-based design (contd), Performance based design codes. Determination of target reliabilities, Concepts of robustness and resilience.