20MD009 DESIGN FOR RELIABILITY

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Course Description and Objective:

The purpose of this course is to introduce at senior level graduate students and practicing engineers in Mechanical Engineering to the theories of reliability and quantifying reliability in product design.

Course Outcomes: Students will be able to

- Understand the concepts of reliability and statistical distributions
- Calculate the reliability of static and dynamic reliability models
- Evaluate reliability of components subjected to random stresses
- Analyze time dependent and general stress - strength interference models
- Perform reliability optimization and Bayesian approach.

UNIT – I **L - 12**

Introduction: Reliability function, Expected life, failure rate and hazard function, failure rate and hazard function for Exponential distribution, Normal distribution, Lognormal distribution, Weibull distribution, Gamma distribution, Hazard models, Reliability definitions.

UNIT – II **L - 12**

Static Reliability models: Series system, Parallel System, Series and Parallel Combinations, Complex systems, reliability considerations in design.

Probabilistic Engineering Design: Methodology, Strength and Stress distributions, Safety factors and reliability, reliability bounds in probabilistic design, transformation of random variables in design, expectation and variance of a function of random variables

UNIT – III **L – 12**

Interference Theory: General expression for reliability, Reliability computations for Normal distributed stress and strength, lognormally distributed stress and strength, exponentially distributed stress and strength, Graphical Approach.

Reliability Design Case-studies: Tension element, I – beam, shaft subjected to torsion.

UNIT – IV **L – 12**

Time dependent Stress - Strength models: Classification, reliability computations - Deterministic Cycle times, random cycle times, Aging, Cyclic damage and cumulative damage.

Dynamic Reliability Models: Series system, Parallel System, Stand – by redundant system, shared load parallel system.

UNIT – V **L – 12**

Bayesian reliability in Design: Bayesian approach, application of bayesian theorem in design for reliability, design for reliability of a component subjected to random stresses.

Reliability Optimization: Reliability Allocation, Dynamic programming, optimization in probabilistic design

Text Books:

1. Singiresu S. Rao, "Reliability Engineering", Pearson, 2016
2. K. C. Kapur and L R Lambersan, "Reliability in Engineering Design", Wiley, 2011.
3. Elsayed A. Elsayed, "Reliability Engineering", John Wiley & Sons, 2012.
4. L S Srinath, "Reliability Engineering", 4th Edition, East West Press, 2005.