

## Discipline Specific Elective (DSE) Course 2d: Reliability Theory

Course Title & Code	Credits	Credit Distribution of the Course			Eligibility Criteria	Prerequisite of the course (if any)
		Lecture (45 Hours)	Tutorial (15 Hours)	Practical (00 Hours)		
DSE 2d: Reliability Theory	4	3	1	0	NIL	NIL

### Course Objectives:

- Introduces fundamental reliability concepts, including reliability, availability, and maintainability, and explores their interrelationships.
- Define reliability and explain its significance in engineering and systems.
- Learn key reliability measures such as failure rate, mean time to failure (MTTF), and mean time between failures (MTBF).
- Understand redundancy techniques and their applications in improving system reliability.
- Understand new better than used (NBU), decreasing mean residual life (DMRL), and new better than used in expectation (NBUE) properties.

### Course Learning Outcomes:

- To analyze the system reliability, including coherent systems and their reliability estimation.
- Investigate reliability in systems with imperfect switches and priority redundant systems.
- Explain the loss of memory property of the exponential distribution and its significance in failure modeling.
- Apply Markov models to reliability function analysis and use regenerative point techniques to analyze system reliability.

### Unit I (12 Hours)

Reliability concepts & measures, components and systems, coherent system, reliability of the coherent system. Availability, types of availability- point wise, interval, asymptotic. Failure rate and mean time to failure and their inter-relationships. Statistical failure models: exponential, gamma, Weibull, Pareto, normal, lognormal and related distributions.

### **Unit II (10 Hours)**

System components and configurations: series-parallel, parallel-series, and K-out of -N-system. Series- strength reliability and its estimation. Reliability Bounds- classical and Bayesian approach.

### **Unit III (11 Hours)**

Maintenance Policies, System with imperfect switch. Concept of redundancy, types of redundancy, priority redundant, repairable system, comparison of component, unit and standby redundancies.

### **Unit IV (12 Hours)**

Model Plotting techniques: Reliability function with Markov model. Two unit cold standby & parallel unit system with constant failure rate, Arbitrary Repair rates & Regenerative point Techniques. Stress strength reliability and its estimation. IFR, IFRA, NBU, DMRL and NBUE and their duals, loss of memory property of the exponential distribution.

### **Tutorial:**

Tutorial sessions will include at least one activity such as group discussion/presentation/ problem solving exercise based on the material covered in the lectures along with scholastic work related to the conceptual understanding of the subject.

### **Essential Readings:**

1. Balagurusamy, E. (2017). *Reliability Engineering*, McGraw Hill.
2. Bazovsky, I. (2013). *Reliability Theory and Practice*, Dover Publications.
3. Billinton, R. and Allan, R.N. (2013). *Reliability Evaluation of Engineering Systems: Concepts and Techniques*, Springer.
4. Cooper, R.B. (1981). *Introduction to Queuing Theory*, Elsevier.
5. Cox, D.R., and Miller, H.D. (1972). *The Theory of Stochastic Processes*, Chapman & Hall.

### **Suggested Readings:**

1. Gross, D. and Harris C.M. (2008). *Fundamentals of Queueing Theory*, John Wiley & Sons.
2. Lewis, E.E. (1996). *Introduction to Reliability Engineering*, John Wiley & Sons.
3. Medhi, J. (2022). *Stochastic processes*, New Age International Publications.
4. Meeker, W.Q. and Escobar, L.A. (1998). *Statistical Methods for Reliability Data*, John Wiley & Sons.
5. Satty, T.L. (1983). *Elements of Queuing Theory with Applications*, Dover Publications.