B.Tech III Year II Semester

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

19AEE65c- SYSTEM RELIABILITY CONCEPTS

(Open Elective-II)

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Course Objectives: The objectives of the course are to make the students learn about

- The Basic concepts, rules for combining probabilities of events, failure density and distribution functions.
- Evaluation of network Reliability / Unreliability and types of redundancies.
- Evaluation of network Reliability / Unreliability using conditional probability method.
- Expected value and standard deviation of Exponential distribution and Measures of reliability.
- Evaluation of Limiting State Probabilities of one, two component repairable models.

UNIT – I: Basic Probability Theory **09 Hrs**

Basic concepts – Rules for combining Probabilities of events – Failure Density and Distribution functions – Bernoulli's trials – Binomial distribution – Expected value and standard deviation for binomial distribution – Examples.

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about basic rules for probabilities of events **L1**
- Get detailed information about Probability of failure density and distribution Functions and obtain the expected value and standard deviation for binomial distribution. **L2**

UNIT – II: Network Modeling and Reliability Evaluation **09 Hrs**

Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cutset based approach – complete event tree and reduced event tree methods - Examples.

Learning Outcomes:

At the end of this unit, the student will be able to

- How to find the Probability of success and failures of network using different approaches for series-parallel configurations. **L1**
- To find reliability / unreliability of complex systems using different methods **L2**

UNIT – III: Time Dependent Probability **09 Hrs**

Basic concepts – Reliability functions f(t), Q(t), R(t), h(t) – Relationship between these functions – Bath tub curve – Exponential failure density and distribution functions - Expected value and standard deviation of Exponential distribution – Measures of reliability – MTTF, MTTR, MTBF – Evaluation of network reliability / Unreliability of simple Series, Parallel, Series-Parallel systems - Partially redundant systems - Evaluation of reliability measure – MTTF for series and parallel systems – Examples.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the concepts of time domain functions and relationship between them. and obtain the expected value and standard deviation for exponential distribution. **L1**
- To obtain probabilistic measures for fully redundant and partially redundant configurations **L2**

UNIT – IV: Discrete Markov Chains & Continuous Markov Processes **09 Hrs**

Markov Chains: Basic concepts – Stochastic transitional Probability matrix – time dependent probability evaluation – Limiting State Probability evaluation – Absorbing states.

Markov Processes: Modeling concepts – State space diagrams – time dependent reliability evaluation of single component repairable model – Evaluation of Limiting State Probabilities of one, two component repairable models – Frequency and duration concepts – Frequency balance approach - Examples.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the concepts of Stochastic Transitional Probability Matrix, Limiting State Probability **L1**
- Understand the concept of Frequency balance approach. And To distinguish between Markov chains and Markov processes **L2**

UNIT – V: Multi Component & Approximate System Reliability Evaluation **09 Hrs**

Recursive relation for evaluation of equivalent transitional rates– cumulative probability and cumulative frequency and 'n' component repairable model – Series systems, Parallel systems, Basic probability indices – Series, Parallel systems – Complex Systems– Cutset approach – Examples.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the concepts of recursive relation for evaluation of equivalent transitional rates. **L1**
- To know about computation of basic probability indices for series, parallel configurations **L2**

Text Books:

1. Reliability Evaluation of Engineering Systems by Roy Billinton and Ronald N. Allan, Reprinted in India B. S. Publications, 2007.
2. Reliability Engineering by E. Balagurusamy, Tata McGraw Hill, 2003.

Reference Books:

1. Introduction to Reliability Engineering by E. E. Lewis by Wiley Publications.
2. Reliability and Maintainability Engineering by Charles E. Ebeling, Tata McGraw Hill, 2000.
3. Reliability and Safety Engineering by Ajit Kumar Verma, SrividyaAjit and Durga Rao Karanki, Springer, Second Edition, 2016. System Reliability Theory Marvin Rausand and ArnljotHoyland, Wiley Publictions.

Course Outcomes:

At the end of this Course the student will be able to

- Understand the concepts for combining Probabilities of events, Bernoulli's trial, and Binomial distribution. **L1**
- Network Reliability/Unreliability using conditional probability, path and cutest based approach, complete event tree and reduced event tree methods. **L2**
- Understanding Reliability functions and to develop relationship between these functions, expected value and standard deviation of Exponential distribution and measures of reliabilities. **L3**
- Analyze the time dependent reliability evaluation of single component repairable model, frequency and duration concepts, Frequency balance approach. **L4**
- `Recursive relation for evaluation of equivalent transitional rates, cumulative probability and cumulative frequency and 'n' component repairable model. **L5**