



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

| POWER SYSTEM RELIABILITY | | | | | | | | |
|-----------------------------|-----------------------|------------------------|---|---|-------------------|---------------|-----|-------|
| III Semester: EPS | | | | | | | | |
| Course Code | Category | Hours / Week | | | Credits | Maximum Marks | | |
| BPSE27 | Elective | L | T | P | C | CIA | SEE | Total |
| | | 3 | - | - | 3 | 40 | 60 | 100 |
| Contact Classes: 45 | Tutorial Classes: Nil | Practical Classes: Nil | | | Total Classes: 45 | | | |
| Prerequisite: Power systems | | | | | | | | |

I. COURSE OVERVIEW:

The Power system reliability course will provide students with a fundamental knowledge on the reliability evaluation of engineering systems with emphasis on electric power systems. Models and methodologies for power systems reliability assessment will be studied. Application of probability theory for design and management of power generation, transmission and distributionsystems using SCADA.

II. COURSE OBJECTIVES:

The students will try to learn:

- I. How to Estimate loss of load and energy indices for generation systems model.
- II. Merging generation and load models.
- III. Various indices for distribution systems.
- IV. Reliability of interconnected systems. Illustrate the basic concepts and techniques of modern reliability engineering tool

III. COURSE OUTCOMES:

- CO1 Apply concepts of the probability theory for power systems reliability evaluation
- CO2 Apply probability methods to formulate and probabilistically simulate simple electric energy systems for computing reliability indices and production costs
- CO3 Evaluate generation capacities by pooling all sources of generation with all loads
- CO4 Analyze distribution system networks with indices to improve powersystem performance
- CO5 Illustrate optimal solutions for improvising power transfer capability,enhancing power quality and reliability
- CO6 Justify the basic tasks of Supervisory Control Systems (SCADA)aswell as their typical applications in industries

IV. COURSE CONTENT:

MODULE –I: BASIC PROBABILITY THEORY (10)

Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution. Definition of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time between Failure.

MODULE –II: GENERATING SYSTEM RELIABILITY ANALYSIS (09)

Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal –Evaluation of loss of load and energy indices– Examples. Frequency and Duration methods –Evaluation of equivalent transitional rates of identical and non -identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units–2-level daily load representation- merging generation and load models– Examples.

MODULE –III: RELIABILITY EVALUATION (10)

Basic concepts - risk indices – PJM methods – security function approach– rapid start and hot reserve units– Modeling using STPMapproach, Bulk Power System Reliability Evaluation: Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines –Weighted average rate and Markov model – Common mode failures.

Inter Connected System Reliability Analysis: Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity - imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency.

MODULE –IV: DISTRIBUTION SYSTEM RELIABILITY ANALYSIS (10)

Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices – load point and system reliability indices – customer oriented, loss and energy-oriented indices – Examples. Basic concepts of parallel distribution system reliability

MODULE –V: SUBSTATIONS AND SWITCHING STATIONS Classes: (09)

SCADA Applications: Utility applications, transmission and distribution sector operations, monitoring, analysis and improvement, industries, oil, gas and water, case studies, implementation, simulation exercises.

V. TEXT BOOKS:

1. R. Billinton, R.N. Allan, “Reliability Evaluation of Power systems”, BS Publications, 2007.
2. J. Endrenyi, “Reliability Modeling in Electric Power Systems”, John Wiley and Sons, 1978

VI. REFERENCE BOOKS:

1. Alessandro Birolini, “Reliability Engineering: Theory and Practice”, Springer Publications.
2. Charles Ebeling, “An Introduction to Reliability and Maintainability Engineering”, TMH Publications.
3. E. Balaguruswamy, “Reliability Engineering”, TMH Publications.
4. Elsayed A. Elsayed, “Reliability Engineering”, Prentice Hall Publications.

VII. ELECTRONICS RESOURCES:

1. <https://www.researchgate.net>

2. <https://www.aar.faculty.asu.edu/classes>
3. <https://www.facstaff.bucknell.edu/>
4. <https://www.electrical4u.com>

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech-talk topics
4. Definition and terminology
5. Assignments
6. Model question paper-I
7. Model question paper-II
8. Lecture notes
9. Power point presentations