POWER SYSTEM RELIABILITY

IIISemester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC27	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

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 distribution systems 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.
V. Illustrate the basic concepts and techniques of modern reliability engineering tools.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Apply** concepts of the probability theory for power systems reliability evaluation	Apply
CO 2	**Apply** probability methods to formulate and probabilistically simulate simple electric energy systems for computing reliability indices and production costs	Apply
CO 3	**Evaluate** generation capacities by pooling all sources of generation with all loads	Analyze
CO 4	**Analyze** distribution system networks with indices to improve power system performance	Analyze
CO 5	**Illustrate** optimal solutions for improvising power transfer capability, enhancing power quality and reliability	Apply
CO 6	**Justify** the basic tasks of Supervisory Control Systems (SCADA)as well as their typical applications in industries	Evaluate

IV SYLLABUS

MODULE –I: BASIC PROBABILITY THEORY (09)

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 (09)

Basic concepts - risk indices – PJM methods – security function approach– rapid start and hot reserve units– Modeling using STPM approach, 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 (09)

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”, TMHPublications.
3. E. Balaguruswamy, “Reliability Engineering”, TMH Publications.
4. Elsayed A. Elsayed, “Reliability Engineering”, Prentice Hall Publications.

VII. Web References:

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. E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com