Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NEED521	**Cyber Security in Power Systems**	3	0	0	3

Course Objective

The Syllabus is concerned with the fundamental knowledge of power system operation and communication networks, introduces cybersecurity principles such as the CIA triad, analyzes cyber threats and detection methods, and explore Blockchain applications for securing modern smart grid infrastructures.

Learning Outcomes

- Understand the structure and operation of modern power systems and associated communication infrastructures.
- Explain cybersecurity fundamentals based on the CIA triad (Confidentiality, Integrity, and Availability).
- Apply security mechanisms such as authentication, encryption, and digital signatures in power system applications.
- Identify and analyze cyber threats and vulnerabilities in smart grid environments.
- Evaluate cyber-attack detection techniques using state estimation methods.
- Analyze the application of the Kalman Filter for cyber-attack detection and system monitoring.
- Assess Machine Learning–based techniques for detecting anomalies and cyber intrusions in smart grids.
- Examine the role of Blockchain in secure energy transactions and decentralized security frameworks.
- Evaluate cybersecurity protection strategies for cyber-physical power system infrastructures.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Power System Fundamentals:** Power generation, transmission, and distribution; Stability and control of power systems. Renewable energy integration; Microgrids and distributed generation	[7L]	Students will understand power generation, transmission, and distribution systems. They will analyze, stability, and control of power systems. The module also enables evaluation of renewable energy integration, microgrids, and distributed generation in modern power systems.
2	**Communication Networks in Power Systems:** SCADA Systems; Wide Area Measurement Systems (WAMS); Phasor Measurement Units (PMU); Communication protocols: IEC 61850, DNP3, Modbus; Internet of Things (IoT) in smart grids	[9L]	Students will understand communication infrastructures in modern power systems.
3	**Fundamentals of Cyber Security:** Basic cyber security concepts: Confidentiality, Integrity, Availability (CIA triad); Authentication and authorization; Encryption techniques; Public key infrastructure; Digital signature	[3 L]	Students will understand the core principles of cybersecurity.
4	**Cyber Threats in Power Systems**: Types of cyber-attacks in power System : False Data Injection Attack (FDIA); Replay Attack; Man-in-the-Middle Attack; Denial of Service (DoS); Malware attacks on control centres	[3L]	Students will be able to identify and analyze major cyber-attacks affecting power systems.
5	**Cyber-Attack Detection Techniques :** Detection methods include: i. State Estimation Based Detection	[8 L]	Students will understand and apply cyber-attack detection techniques in power systems.

	ii. Kalman Filter Based Detection iii. Machine Learning Approaches		
6	**Blockchain for Power System Security:** Blockchain applications include: • Secure energy transactions • Distributed energy resource management • Tamper-proof sensor data • Secure peer-to-peer energy trading .	[8L]	Students will understand the fundamentals of Blockchain and its applications in power systems.
7.	**Case Studies in Power Grid Cybersecurity:** Case studies include: • Smart grid cyber attacks • Renewable energy cyber protection	[4L]	Students will analyze real-world cybersecurity incidents in modern power infrastructure, including vulnerabilities in Smart Grid environments.
	Total	**42 L**	

Text Books:

1. S. Sridhar, A. Hahn, and M. Govindarasu, *Cyber-Physical System Security for the Electric Power Grid*, CRC Press.
2. Gilbert N. Sorebo and Michael C. Echols, *Smart Grid Security: An End-to-End View of Security in the New Electrical Grid*, CRC Press.

Reference Books:

1. Eric D. Knapp and Raj Samani, *Applied Cyber Security and the Smart Grid*, Elsevier.
2. Massoud Amin, *Smart Grid: Fundamentals of Design and Analysis*, Wiley.
3. Aranya Chakrabortty and Marija Ilić, *Control and Optimization Methods for Electric Smart Grids*, Springer.
4. Hassan Haes , Alhelou Nikos Hatziargyriou , Zhao Yang Dong *Power Systems Cybersecurity: Methods, Concepts, and Best Practices,* Springer