EE 522: SMART GRID: PLANNING, OPERATION & SECURITY (3-0-0:3)

Introduction

Smart Grid Architecture, Smart Grid Control Layer & Elements, Planning Aspects of smart grid, Operational Concept of smart grid, Basic concept of load side management, Control & Operation of distribution system integrated with renewable energy sources (RES), Power flow in distribution Network, Peer-to-Peer (P2P) Network, Planning & Operation of Microgrid.

Demand Side Management

Introduction, demand side management (DSM), demand response (DR) and dynamic demand response (DDR), planning and implementation strategy, load shape objectives, DSM regulations and policies, essential & non-essential loads, commercial building as demand response, AMI infrastructure, Smart Meters, Current scenario in India and abroad, challenges in implementing DSM, P-F Control using DSM.

Vehicle-to-Grid Technology

Vehicle-to-grid (V2G) infrastructure, Basic structure of V2G in existing power system, Electric vehicles (EV) characteristics and impacts, driving characteristics, EV Charging Stations, EV fleets modelling, EV aggregator, primary reserve calculations for frequency control, SOC calculations, frequency/Voltage regulation using EV/PHEV, integration of EVs to radial distribution network, charging/discharging of EV in presence of renewable sources, Placement of EV charging stations, skepticism and current improvement in V2G structure, V2X, current pilot projects.

Transactive Energy System

Introduction of transactive energy (TE), Rise of prosumers, transactive energy attributes, transactive energy principles, the evolution of the grid and its impact on transactive energy, elements of TE, framework, policy, and market design, P2P Markets, Power loss allocation due to P2P energy flow, Risk mitigation analysis.

Security and Data Privacy in Smart Grid

Security Challenges in Smart Grid Implementation, IOT, Legal Protection of Personal Data in Smart Grid and Smart Metering Systems, Cyber-Physical Layer, Vulnerable points in Smart Grid, Communication Protocols, False Data Injection (FDI) Attacks, DOS Attacks, Replay Attack, Security issues in transactive energy infrastructure, Detection & Mitigation of Attacks, Model-based & Data-driven based methods, Application of Machine Learning (ML) Algorithms.

References:

1. Smart Grid Handbook, Vol. 1, 2, and 3 - By - Chen-Ching Lui, Stephen McArthur, Seung-Jae Lee, 2016, ISBN: 978-1-118- 75548-8.
2. Smart Grid Communications and Networking, Hossain, Ekram (Ed.) Cambridge University Press 2012.
3. C. W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press
4. S. Barrager, E. Cazalet, “Transactive Energy: A Sustainable Business and Regulatory Model for Electricity”, Baker Street Publishing
5. The GridWise Architecture Council, GridWise Transactive Energy Framework Version 1.0, 2015.
6. Manimaran Govindarasu, Adam Hahn, and Peter Sauer, Cyber-Physical Systems Security for Smart Grid, White Paper, PSERC Publication 2012.