Course Title: Smart Grid
Course Code: EPEG 426
Credit: 3

Course Description:
This course intends to present the fundamentals requirements of a smart grid and the technologies used for its implementation.

Course Contents:

Unit 1: The Traditional Power Grid
Power System, Power System Reliability and Quality, Voltage Profile of Power System, Power System Stability and Control, Protection System, SCADA System

Unit 2: Introduction to Smart Grid
Smart Grid: Definitions, Characteristics of Smart Grid, Traditional Grid Versus Smart Grid, Evolution of Smart Grid, Components of Smart Grid: Monitoring and Control Technology Component, Transmission Subsystem Component, Smart Devices Interface Component, Intelligent Grid Distribution Subsystem Component, Storage Component, Demand-side Management Component, The Environmental Impacts of Smart Grid, Overview of the Technologies Required for Smart Grid

Unit 3: Integration of Renewable Energy Sources
Renewable Energy sources, Requirement of integration of renewable energy sources to grid, Impacts of renewable energy sources into the Grid, Existing Research on Integrating DER with the Grid: Solar Energy Integration, Wind Energy Integration

Unit 4: Energy Storage Systems
Different Energy Storage Technologies: Battery Energy Storage System, Superconducting Magnetic Energy Storage, Super Capacitors Energy Storage, Flywheel Energy Storage, Thermal Energy Storage, Pumped Hydroelectric Storage, Compressed Air Energy Storage, Hydrogen Energy Storage; Applications of Energy Storage System, Integration of Energy Storage into the Power Network, Role of Energy Storage: Case Studies

Unit 5: Smart Meter
Benefits of Smart Meter, Requirement of Smart Meter in Smart Distribution Network, Technical Configurations of Smart Meter, Smart Meter Monitoring Program, Smart Meter in Distribution Network, Communication Protocol and Standards in Smart Meter Network, Bandwidth Requirement for Smart Meter Distribution Network, Communication Coverage of Smart Meter Distribution Network

Unit 6: Demand Forecasting and Data base system in Smart Grid
Electricity Demand Data, Time Series Analysis, Algorithm Description, Case Study for demand forecasting; Power Grid Database Management, Synchro-Phasor Measurement Units (PMUs), Wide Area Measurement Systems (WAMS), Internet of things (IOT) in Smart Grid, , Power Grid Data Mining, Cloud computing in smart grid

Unit 7: Security in Smart Grid

Smart Grid Security Issues: System Level Threats, Radio Subversion or Takeover, Network Barge-in by Strangers, Denial of Service, Malicious Code, Glitching; System Level Theft of Service, Breach of Privacy or Confidentiality, Threat Mitigation, An Intelligent Denial of Service Attack Prevention Mechanism, Data Collection for Denial of Service Attack

Unit 8: Smart Grid Communications and Networking Technologies

SCADA System, Communication and Networking in the Smart Grid, Network Topologies (Home Area Network, Neighboring Area Network, Wide Area Networking), Communication Technologies for the Smart Grid (ZigBee, WLAN, WiMAX, Cellular Networks and Femtocells), Standardization Activities, Research Challenges

Unit 9: Economy of Smart Grid

Costs of Smart Grid, Economic Indicators of Smart Grid, Design Variables of Smart Grid, Case Study

References:

1. Shawkat Ali A. B. M., "*Smart Grids: Opportunities, Developments and Trends*", Springer, 2013
2. Sioshansi F. P., "*Smart Grid, Integrating Renewable, Distributed & Efficient Energy*", Menlo Energy Economics, 2012 Elsevier Inc
3. Keyhani A., "*Design of Smart Power Grid Renewable Energy Systems*", Wiley
4. Momoh J., "*Smart Grid: Fundamentals of Design and Analysis*", Wiley

Evaluation:

In-Semester Evaluation: 50%
End-Semester Evaluation: 50%