Course Title: Electric Power Markets **(Elective Course)**

Course Code: EPE-816

Course Objectives:

The objectives of this Electric Power Markets course are: To impart an understanding of electric power sector to the students, To realize feasible policy and management options for electric power markets, To comprehend interplay of economics and electrical engineering that underlies modern electric power market operations, To discuss and understand electric power markets emerging in Pakistan.

Course Outcomes:

On completion of the course, the students will be able to uunderstand the potential of hydrogen. To impart the understanding of electric power sector to the students, comprehend models and management of electric power markets. To comprehend interplay of economics and electrical engineering that underlies modern electric power market operations. The students will be able to comprehend the policy options and management of electric power sector.

Detailed Contents:

Electric Power Industry in the Context of Microeconomics

Power Production Cost

Marginal Costs and the Supply Curve of the Firm

Types of Markets for Commodities, Resources, and Services

Markets with Perfect Competition, Monopoly and Oligopoly

Models of Electricity Market Organization

Basic Electricity Market Models: Regulated Natural Monopoly, Single Buyer,

Competition in the Wholesale and Retail Markets

Qualitative Analysis and Comparison of Models: Criteria, Factors, Competition, and Regulation

Flaws of the Competitive Electricity Market

Case Studies of different market models

Risks of Participation in Electricity Markets

Price risk management and contracts

Principles of portfolio design

Forward and spot (balancing) markets; power exchanges

Perspectives of producers, retailers, customers, hybrid participants

Efficient Short-Term Operation of an Electricity Industry

Optimal Dispatch of Both Generation and Load Assets

Total Surplus Maximisation and Generation Cost Minimisation

The Benefit or Utility Function

Startup Costs and the Unit-Commitment Decision

Efficient Use of Generation and Load Resources by a Market Mechanism

Decentralisation, Competition and Market Mechanisms

Achieving Optimal Dispatch Through Competitive Bidding

Compulsory Gross Pool and Net Pool

Pay-as-Clear versus Pay-as-Bid Mechanisms

Day-Ahead versus Real-Time Markets

Reducing the Exercise of Market Power

Efficient Use of Generation and Load Resources by a Market Mechanism

Decentralisation, Competition and Market Mechanisms

Achieving Optimal Dispatch Through Competitive Bidding

Compulsory Gross Pool and Net Pool

Pay-as-Clear versus Pay-as-Bid Mechanisms

Day-Ahead versus Real-Time Markets

Reducing the Exercise of Market Power

Representing Networks Constraints

Representing Networks Mathematically

Net Injections, Power Flows and the DC Load Flow Model

The Matrix of Power Transfer Distribution Factors

Constraint Equations and the Set of Feasible Injections

Efficient Dispatch of Generation and Consumption Resources in the Presence of Network Congestion

Achieving Optimal Dispatch Using a Smart Market

Optimal Dispatch in a Meshed Network with Constraints

The Merchandising Surplus, Settlement Residues

Congestion Rents and Network Losses

Transmission Cost Allocation Methods and Congestion Management

Transmission Cost Allocation Methods

Locational Marginal Price (LMP)

LMP Application in Determining Zonal Boundaries

Financial Transmission Right (FTR)

FTR Auction

Zonal Congestion Management

Case Studies of Transmission Cost Allocation Methods

Text/Ref Books:

- Darryl R. Biggar, Mohammad Reza Hesamzadeh. The Economics of Electricity Markets (2014)
- Lev S. Belyaev, Electricity Market Reforms (2011)
- Mohammad Shahidehpour, Hatim Yamin. Market Operations in Electric Power Systems (2002)
- Daniel S. Kirschen, Goran Strbac, Fundamentals of Power System Economics (2004)