

Subject Code: 1RI3000102	Subject Title: Essentials of Disciplinary Research Subject-1 Subject Sub-Title: Power System Restructuring
Pre-requisite Subject	Computer methods in Power System Analysis and Power System Management

Objectives of course: This course is intended to provide a comprehensive treatment towards understanding of the new dimensions associated with deregulation of the power system. □

Learning outcomes: The course will bring out the differences between the conventional power system operation and the restructured one. The course will prepare a background with fundamentals of microeconomics.

Teaching Scheme (Credit Distribution)				Evaluation Scheme(% Marks)	Total Marks
Lecture	Tutorial	Practical	Credit	Continuous (Internal) Assessment	100
3	1	--	4	100%	

Subject Contents			
Unit	Topic	No of Lectures	Weightage %
1.	Introduction to restructuring of power industry Reasons for restructuring of power industry; Understanding the restructuring process, Entities involved, The levels of competition, The market place mechanisms, Sector-wise major changes required; Reasons and objectives of deregulation of various power systems across the world	6	15%
2.	Fundamentals of Economics Consumer and suppliers behavior, Total utility and marginal utility, Law of diminishing marginal utility, Elasticity of demand and supply curve, Market equilibrium, Consumer and supplier surplus, Global welfare.	6	15%
3.	The Philosophy of Market Models Monopoly model, Single buyer model, Wholesale competition model, Retail competition model, distinguishing features of electricity as a commodity, Four pillars of market design, Cournot, Bertrand and Stackelberg competition model.	8	20%
4.	Transmission Congestion Management Transfer capability, Importance of congestion management, Effects of congestion, Classification of congestion management methods, ATC, TTC, TRM, CBM, ATC calculation using DC and AC model, Nodal pricing, Locational Marginal Prices (LMPs), Implications of nodal pricing, Price area congestion management Capacity alleviation methods, Re-dispatching, Counter-trade, Curtailment.	12	30%
6.	Pricing of transmission network usage and loss allocation Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing, Rolled-in transmission pricing paradigm, Marginal transmission pricing paradigm, Composite pricing paradigm, Merits and de-merits of different paradigms, Classification of loss allocation methods.	8	20%

List of References:

1. NPTEL Course-Restructured Power Systems, A. R. Abhyankar, S. A. Khaparde, Available: <http://nptel.iitm.ac.in/courses/108101005/>
2. Fundamentals of Power System economics Daniel Kirschen and Goran Strbac, John Wiley & Sons Ltd, 2004 (for chapter 1,2,3 &5)
3. Making competition work in electricity Sally Hunt, John Wiley & Sons, Inc., 2002
4. Power system restructuring and deregulation by Loi Lei Lai Wiley India.

Subject Code: 1RI3000103	Subject Title: Essentials of Disciplinary Research Subject-2 Subject Sub-Title: Power Electronics For Renewable Energy Systems
Pre-requisite Subject	Fundamental Knowledge of Power Electronics and Renewable Energy

Objectives of course: This course is aimed to provide detailed knowledge of these renewable energy sources, need of power electronic converters, issues in their operation, control and integration etc.

Learning outcomes: 1. Correlate the need of renewable energy for the benefit of the society
2. Select appropriate power electronic converter for particular renewable energy source.

Teaching Scheme (Credit Distribution)				Evaluation Scheme(% Marks)	Total Marks
Lecture	Tutorial	Practical	Credit	Continuous (Internal) Assessment	50
2			2	100%	

Subject Contents			
Unit	Topic	No. of Lecture	Weightage
1.	Energy Scenario National and International current energy scenario; Share of renewable and non-renewable energy sources.	01	5%
2.	Photovoltaic Energy Conversion Systems Introduction to solar cell, PV cell technology, I-V and P-V curves of PV cell/modules/array, Electrical modelling of PV cell, MPPT techniques, I-V and P-V curves under non-uniform conditions, PV inverter configurations, Distributed MPPT, Control of PV inverter/converter configurations, Grid connected Systems, Islanded systems, Recent development in converter configurations for PV.	08	40%
3.	Wind Energy Conversion Systems Basics of wind energy, Components of wind turbine, Wind turbine aerodynamics, MPPT control, Modelling of wind energy system, Types of generators: induction (singly fed and doubly fed) and synchronous generators, Converters for wind energy conversion system, Fixed speed and variable speed wind energy conversion system,	08	40%
4.	Energy Storage system Introduction, The Structure of Power Storage Devices, Pumped-storage Hydroelectricity, Compressed Air Energy Storage System, Flywheels, Battery.	03	15%

List of References:

1. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, "Grid Converters for Photovoltaic and Wind Power Systems", Wiley IEEE Press, Jan 2011.
2. Bin Wu, Yongqiang Lang, Navid Zargari, Samir Kouro, "Power Conversion and Control of Wind Energy Systems", Wiley IEEE Press, July 2011.
3. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications", Wiley IEEE Press, June 2014.
4. Ali Keyhani, Mohmmad N. Marwadi, Min Dai; "Integration of Green and Renewable energy in electric power system", John Wiley & sons, 2010.
5. Chetan S. Solanki; "Solar Photovoltaics: Fundamentals, Technologies & applications", Prentice Hall of India, 2009.