FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Electrical Engineering)**

Semester: **VII**

Course Code: **202050710**

Course Title: **Restructured Power System**

Course Group: **Professional Elective Course-IV**

Course Objectives: The restructuring of the power industry has changed the way of operation of the power systems. Along with the secured and reliable operation of power systems, economic efficiency has become an equally important consideration. Unlike the knowledge of conventional operation of power systems, understanding the restructured power systems requires basic knowledge of electrical engineering, power systems, and also economics. This course is intended to provide a comprehensive treatment towards understanding of the new dimensions associated with the operation of power systems.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	0	3	50 / 18	50/17	0 / 0	0/0	100 /35

* **J**: Jury; **V**: Viva; **P**: Practical

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Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction to Power System Deregulation and Restructuring:** Motivation for Restructuring of power system; Electricity market entities and model; Benefits of Deregulation; Basic terminologies; Deregulation – International scenario; Milestones, Reasons and objectives of deregulation of various power systems across the world of deregulation; Indian power sector – Past and present status: Growth of power sector in India – An overview, A timeline of the Indian power sector, Players in the Indian power sector, Research and professional bodies. A vertically integrated utility, Structure of a Deregulated Industry, Indian Scenario, Concluding Notes. Reasons for restructuring of power industry; Understanding the restructuring process, Entities involved, the levels of competition, The marketplace mechanisms, Sector-wise major changes required;	10
2	**Fundamentals of Economics and Market Models** Introduction, consumer behavior, supplier behavior, market equilibrium, short-run and long-run costs, various costs of production, perfectly competitive market, philosophy of market models, market models based on contractual arrangements, comparison of various market models, electricity as a other commodities, market architecture, trading of electric energy	10
3	**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.	05
4	**Ancillary Service Management** Introduction, types of ancillary services, classification, load-generation balancing related services, voltage control and reactive power support services, black start capability services, mechanism for ancillary services, co-optimization of energy and reserve services, international comparison	05
5	**Pricing of Transmission Network Usage and Loss Allocation** Introduction, principles of transmission pricing, classification of transmission pricing method, rolled in transmission pricing, marginal transmission pricing, composite pricing paradigms, comparison between different paradigms, debated issues in transmission pricing; introduction to loss allocation methods, classification of loss allocation methods, comparison between various methods.	08
6	**Reforms in Indian Power Sector:** Framework of Indian Power Sector, reform initiatives during 1990-1995, The Availability Based Tariff (ABT) and Deviation Settlement Mechanism (DSM), Indian Electricity Act 2003 salient features, open access issues, power exchange, discussion of role of RLDC, NLDC and ALDC.	04

List of Practicals / Tutorials: NA

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Reference Books:

1	S. A. Khaparde and A. R. Abhyankar, "Restructured Power Systems", Alpha Science, U.K., 2011
2	Lo Lei Lai, "Power System Restructuring and Deregulation: Trading, Performance and Information Technology", Indian Edition, Wiley India Ltd., 2001.
3	Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured Electrical Power Systems: Operation, Trading and Volatility", CRC Press, 200
4	Daniel Krischen and Goran Strbac, "Fundamental of Power System Economics", John Wiley and Sons Ltd ,2004
5	Kankar Bhattacharya, Math H.J. Boller and Jaap E.Daalder, Operation of Restructured Power System, Kluwer Academic Publishers.

Supplementary learning Material:	
1	https://archive.nptel.ac.in/courses/108/101/108101005/ (Restructured Power Systems)
2	https://www.coursera.org/learn/electricity (Electric Industry Operations and Markets)
3	Bhanu Bhushan, "ABC of ABT - A primer on Availability Tariff" - www.cercind.org.
4	Web Course: Power System Operation and Control by Prof A. M. Kulkarni, NPTEL SWAYAM Available at : http://nptel.iitm.ac.in
5	SWAYAM NPTEL web course Module No: 7 (Lecture number 37 to 40) of Power Systems Operation and Control, IIT Bombay by Dr. A.M. Kulkarni available at https://nptel.ac.in/courses/108101040

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation

Internal Evaluation: The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	

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30%	20%	20%	10%	10%	10%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Identify, formulate and solve electrical engineering problems in the broad area like power systems and its economics.	15
CO-2	Understand market models and mechanisms for electricity as a commodity	25
CO-3	Appreciate legal, financial and economic issues related with transmission congestion management, locational marginal pricing and ancillary management.	30
CO-4	Appreciate issues like fairness and social welfare with reference to transmission system usage and loss allocation	20
CO-5	Appreciate the need of reforms in the power sector with focus on the Indian power sector.	10

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025

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