

Subject Code: 1ET2130202	Subject Name: HVDC and FACTS
Pre-requisite Subject	Interconnected Power System

Course Objective: To understand working, analysis and control of HVDC line and FACTS controllers.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	5	60	40	30	20	150

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
1	Introduction: Background, Electrical Transmission Networks, Conventional Control, Mechanisms, Flexible ac Transmission Systems (FACTS), Emerging Transmission Networks. HVDC transmission and Converter Circuit Comparison of AC and DC transmission, Advantages and Disadvantages of DC transmission, Kinds of DC links and its applications, MTDC System, Components of HVDC transmission, HVDC systems in world and India Valve Characteristics, Single phase converters, Three phase converters, Graetz Circuit, Additional six pulseconverter circuits and twelve pulse converter.	7	20 %
2	Principles of Reactive-Power Compensators: Shunt Compensators: Synchronous Condensers, The Saturated Reactor (SR), The Thyristor-Controlled Reactor (TCR), The Thyristor-Controlled Transformer (TCT), The Fixed Capacitor-Thyristor-Controlled Reactor (FC-TCR), The Mechanically Switched Capacitor-Thyristor-Controlled Reactor (MSC-TCR), The Thyristor-Switched capacitor and Reactor, The Thyristor-Switched capacitor-Thyristor-Controlled Reactor (TSC-TCR), A Comparison of Different SVCs-Summary. Series Compensators : The TCSC Controller, Operation of the TCSC, The TSSC, Analysis of the TCSC, Open-Loop Control, Closed-Loop Control, Improvement of the System-Stability Limit, Enhancement of System Damping, Sub synchronousResonance (SSR) Mitigation, Voltage-Collapse Prevention.	10	28%
3	Concepts of SVC Voltage Control & its Application : Voltage Control, Effect of Network Resonances on the Controller Response, The 2nd Harmonic Interaction between the SVC and ac Network, Application of the SVC to Series-Compensated ac Systems, 3rd Harmonic Distortion, Voltage-Controlled Design Studies, Increase in Steady-State Power-Transfer Capacity, Enhancement of Transient Stability, Augmentation of Power-System Damping, SVC Mitigation of Sub synchronous Resonance (SSR), Prevention of Voltage Instability.	6	17%
4	Emerging FACTS Controllers The STATCOM, The SSSC, The UPFC, Comparative Evaluation of Different FACTS Controllers, Future Direction of FACTS Technology.	7	20 %

5	Grid Control, Harmonics and Filters: Grid control and its characteristics, limitations of manual control, constant current versus constant voltage system, Actual control characteristics, Measurement of DC current, voltage, power Reactive power requirements, Sources of reactive power, SVS Generation of AC and DC harmonics, Characteristic Harmonics and uncharacteristic harmonics, Fourier analysis of valve currents and line currents on valve side Means of reducing harmonics, AC filters and DC filters.	5	15 %
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Course Outcome:

After learning the course the students should be able to:

1. The students will acquire the knowledge regarding the different compensating systems that affect the performance of the system.
2. The students will also acquire the knowledge of FACTS devices modelling for the improvement of performance of the system.

List of Text Books:

1. Thyristor-based FACTS controllers for Electrical Transmission Systems: R Mohan Mathur, R K Verma, Wiley IEEE Press.
2. Understanding FACTS, N.G.Hingorani and L.Gyugyi, Standard Publishers, Delhi, 2001.
3. FACTS Controllers in Power Transmission & Distribution: Padiyar K R, New Age International (P) Limited.

List of Reference Books:

1. Reactive Power Control in Electric Systems: T J E Miller, John Willey.
2. Power System Stability and Control, Prabha Kundur, Tata McGrahill.

List of Experiments:

1. Modeling and analysis of medium transmission line.
2. Modeling and analysis of long transmission line.
3. Simulation and analysis of STATCOM.
4. Simulation and analysis of SVC.
5. Simulation and analysis of HVDC line.