

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ELECTRICAL ENGINEERING (07)

APPLICATION OF POWER ELECTRONICS TO POWER SYSTEM

SUBJECT CODE: 2720721

SEMESTER: II

# GUJARAT TECHNOLOGICAL UNIVERSITY

**Type of course:** Engineering

**Prerequisite:**

Power Electronics (2710702) and Fundamental knowledge of Power Systems

**Rationale:** The active as well as reactive power management and control is crucial to utilize the existing power transmission network to its maximum operating limit. The subject aims to develop thorough understanding of requirement of power management in power system by employing power electronics converters.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	0	4	70	30	30	0	10	10	150

**Content:**

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction: Background, Electrical Transmission Networks, Flow of power in AC system and conventional control mechanisms, Definition of Flexible ac Transmission Systems (FACTS) and brief description, possible benefits from FACTS, Emerging Transmission Networks.	4	10
2	Reactive-Power Control in Electrical Power Transmission Systems: Reactive Power, Uncompensated Transmission Lines, Passive Compensation	7	17
3	Objectives of shunt compensation, 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	7	17
4	STATCOM: Principal of operation, VI characteristic, steady state model, harmonic performance, SSR mitigation, transfer function and dynamic performance, transient stability enhancement and power oscillation damping, VAR reverse control, comparison of SVC and STACOM, operation with unbalance AC system.	6	15
5	Objectives of Series compensation, GCSC, TSSC, The Thyristor-Controlled Series Capacitor (TCSC), The TCSC Controller, Operation of the TCSC, The TSSC, Analysis of the TCSC, Capability Characteristics, Harmonic Performance, Losses, Response of the TCSC, Modeling of the TCSC, TCSC Applications: Open-Loop Control, Closed-Loop Control;	7	17

	Mitigation of Sub synchronous Resonance; NGH-SSR Damping Scheme, TCSC Installations.		
6	Static Synchronous Series Compensator (SSSC): principle of operation, transmitted power versus transmission angle characteristics, control range and VA rating, capability to provide real power compensation, immunity to SSR, control scheme for SSSC, summary of series compensators	7	14
7	Combined compensators: Introduction, operating principle and control structure of UPFC, IPFC, Generalized and multi functional FACTS controllers	6	10

### Reference 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,.
4. Reactive Power Control in Electric Systems: T J E Miller, John Willey,
5. Power System Stability and Control, Prabha Kundur, Tata McGrawHill,

### Course Outcome:

After learning the course the students should be able to:

1. Analyze reactive power requirement and management
2. Assess and evaluate various compensators
3. Simulate and design compensators
4. Analyze various control schemes in HVDC system

### List of Assignment / Tutorial:

Course coordinator can offer the assignments which enhance the programming, modeling, analytical and/or design skills. Few assignments for guidelines are suggested here

1. Modeling and analysis of medium and long transmission line in MATLAB/SIMULINK to analyze voltage profile.
2. Modeling and analysis of SVC
3. Modeling and analysis of STATCOM.
4. Case study on TCSC

### List of Open Source Software/learning website:

www.nptel.ac.in  
www.mathworks.com  
www.scilab.org

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.