



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Power Electronics

Course / Subject Code: ME01000251

Course / Subject Name: FACTS Devices

w. e. f. Academic Year:	2024-25
Semester:	I
Category of the Course:	PEC

Prerequisite	Knowledge of Power Electronics and Power Systems at UG level
Rationale:	Power Electronics is a rapidly growing field within electrical engineering as the enabling technology for most of the industry. With the constant development of technology and society, power quality leads more and more people to pay attention to. Large-scale wind power stations, photovoltaic, micro grid, electric vehicle, etc, these facility's parallel operation would have some influence on power quality. The application of SVC (Static Var Compensator) in power system could improve power supply stability and power quality, control voltage flicker and compensate var according to load variation to achieve the high-quality operation. FACTS (Flexible AC Transmission System) is based on power electronic devices, combined with modern control theory to control former power system key parameter and grid topology, which changes the status that relying on inaccurate facility fundamentally and improves strong control and transmission ability of system.

Course Outcome:

After Completion of the Course, the student will be able to:

No	Course Outcomes
01	Distinguish the performance of Transmission line with and without FACTS Devices
02	Compare the SVC and STATCOM
03	Understand the operation and control of various Static Series Compensators
04	Understand the operation and control of Unified Power Flow Controller
05	Distinguish various power quality issues and how are they mitigated by various FACTS

Teaching and Examination Scheme:

Teaching Scheme in hours/week			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightag
1.	Introduction: Reactive power flow control in Power Systems – Control of dynamic power un-balances in Power System. Power flow control - Constraints of maximum transmission line loading.	4	10
2.	Introduction to FACTS: FACTS Concept and general system consideration, Transmission Interconnections, Flow of Power in AC Systems, Loading capability, Power flow and Dynamic Stability Considerations of a transmission interconnection, Relative Importance of Controllable Parameters, Basic types of FACTS Controller.	10	20
3.	Shunt Compensation: Static Shunt Compensators: Objectives of Shunt Compensation, Methods of Controllable VAR Generation, Static VAR Compensators: SVC and STATCOM, Comparison between STATCOM and SVC.	10	20
4.	Series Compensation: Static Series Compensators: Objectives of Series Compensation, Variable Impedance type Series Compensators, Switching Converter type Series Compensators, External Control for Series Reactive Compensators.	10	20
5.	Angle Compensation: Static Voltage and Phase angle Regulators, Objective of Voltage and phase angle regulators, Approaches to Thyristor-controlled voltage and phase angle regulators, switching converter-based voltage and phase angle regulators, Hybrid phase angle	06	10
6.	Combined Compensation: Combined Compensators: Unified power flow controller (UPFC) and Interline power flow controller (IPFC)	05	10
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
40	20	20	15	05	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No	Title of Book
1	K R Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International Publishers, 2007



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2	Hingorani N. G. and Gyugyi L., Understanding FACTS, IEEE Press, Standard Publishers Distributors
3	Song Y. H. and Johns A. T., Flexible AC Transmission Systems (FACTS), IEE Press
4	Mathur R. M. and Varma R. K., Thyristor Based FACTS Controllers for Electrical Transmission Systems, John Wiley and Sons
5	X.P. Zang, C. Rehtanz and B. Pal, <i>Flexible AC Transmission Systems: Modeling and Control</i> , Birkhauser, 2006.
6	Acha, Esquivel, Prez and Camacho, <i>Modeling and simulation in power networks</i> , Wiley India Private Limited, 2012
7	T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982

(b) Open-source software and website:

1. <https://nptel.ac.in/>
2. <https://www.mathworks.com/>
3. <https://powersimtech.com>
4. <https://www.scilab.org/>

Suggested Course Practical List:

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. Each student can be given some case studies for different topics given in syllabus, prepare a report and give presentation.

List of Laboratory/Learning Resources Required:

PC with internet connection and simulation software

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