HVDC AND FACTS

Course Code	20EE4703C	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective -V	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	EPGT&D and PE
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the importance of FACTS controllers and HVDC in transmission system. **(L2)**
CO2	**Interpret** the concept of AC and DC transmission systems. **(L3)**
CO3	**Identify** the objectives of series and shunt compensation of power systems **(L3)**
CO4	**Analyse** the performance of various compensations by using FACTS controllers. **(L4)**
CO5	**Analyze** converter configurations used in HVDC transmission and evaluate the performance metrics. **(L4)**
CO6	**Ability** to understand the concepts of FACTS controllers, HVDC transmission and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	2						1	1					2	2
CO3	3					1						2	2	2
CO4		2									2		2	2
CO5		3										1	2	2
CO6	3	3							3	3			2	2

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**FACTS Fundamentals:** Introduction to FACTS, Flow of Power in an AC System, Limitations on Loading Capability, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters, Basic Types of FACTS Controllers, Basic Definitions of FACTS Controllers, Checklist of Possible Benefits from FACTS Technology.	CO1 CO2 CO6
II	**Shunt Compensation:** Objectives of shunt compensation, methods of controllable VAR generation –Thyristor controlled Reactor (TCR), Thyristor Switched	CO1 CO3 CO4

	Capacitor (TSC). Switching Converter Type Var Generators, Basic Operating Principles.	CO6
III	**Series Compensation:** Objectives of series compensation, Concept of Series Capacitive Compensation, Basic operation of Thyristor Switched Series Capacitors (TCSC), Basic operating principle of Static synchronous Series Compensator (SSSC). **Combined Compensators:** Unified power flow controller (UPFC) – Introduction, operating principle. Interline power flow controller (IPFC) – Introduction, operating principle	CO1 CO3 CO4 CO6
IV	**HVDC Transmission:** Introduction, Advantages of HVDC Systems over AC systems. Types of DC links, Layout of HVDC Converter station and various equipments.	CO1 CO2 CO5 CO6
V	**HVDC Converter Operation**: Choice of converter configurations, Analysis of Graetz converter with (u<60) and without overlap, Equivalent circuit representation of rectifier and inverter configurations, Basic operating principle of 12-pulseconverter.	CO1 CO5 CO6

Learning Resources

Text Books

1. Hingorani ,L.Gyugyi, 'Concepts and Technology of Flexible AC Transmission System', IEEE Press New York,1st Edition, 2000.
2. Padiyar, K.R., 'HVDC transmission systems', Wiley Eastern Ltd., 2nd Edition, 2010.

Reference Books

1. Jos Arrillaga, 'High voltage Direct Current Transmission' IET Power and Energy Series 29,2nd Edition,1998
2. Padiyar K.R., 'FACTS controllers for Transmission and Distribution systems' New Age International Publishers, 1st Edition, 2007.
3. Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London,1st Edition, 1999.
4. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho 'FACTS –Modeling and simulation in Power Networks' John Wiley & Sons, 1st Edition, 2002.

e-resources:

1. https://nptel.ac.in/courses/108107114
2. https://nptel.ac.in/courses/108104013