IV Year II Semester 17EE832

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FLEXIBLE AC TRANSMISSION SYSTEMS (Professional Elective-III)

Preamble:

Flexible Alternating Current Transmission System controllers have become a part of modern power system. It is important for the student to understand the principle of operation of series and shunt compensators by using power electronics. As the heart of many power electronic controllers is a voltage source converter (VSC), the student should be acquainted with the operation and control of VSC. Two modern power electronic controllers are also introduced. **Learning objectives:**

- 1. To learn the basics of power flow control in transmission lines using FACTS controllers
- 2. To explain operation and control of voltage source converter.
- 3. To understand compensation methods to improve stability and reduce power oscillations of a power system.
- 4. To learn the method of shunt compensation using static VAR compensators.
- 5. To learn the methods of compensation using series compensators
- 6. To explain operation of Unified Power Flow Controller (UPFC).

Unit–I

Introduction to FACTS

Power flow in an AC System – Loading capability limits – Dynamic stability considerations– Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high power devices – Voltage and current rating – Losses.

Unit–II

Voltage source and Current source converters

Concept of voltage source converter(VSC) – Single phase bridge converter – Square–wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter– Three–phase current source converter – Comparison of current source converter with voltage source converter.

Unit-III

Shunt Compensators-1

Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability–Power oscillation damping.

Unit-IV

Shunt Compensators-2

Thyristor Switched Capacitor (TSC)–Thyristor Switched Capacitor – Thyristor Switched Reactor (TSC–TCR). Static VAR compensator (SVC) and Static Compensator (STATCOM): The regulation and dynamic performance – Transient stability enhancement and power oscillation damping– compensation control.

Unit V

Series Compensators

Static series compensators: Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – GTO Thyristor controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC).

Unit-VI

Combined Controllers

Schematic and basic operating principles of Unified Power Flow Controller (UPFC).- Application on transmission lines.

Learning Outcomes:

- 1. Understand power flow control in transmission lines using FACTS controllers.
- 2. Explain operation and control of voltage source converter.
- 3. Analyze compensation methods to improve stability and reduce power oscillations in the transmission lines.
- 4. Explain the method of shunt compensation using static VAR compensators.
- 5. Understand the methods of compensations using series compensators.
- 6. Explain operation of Unified Power Flow Controller (UPFC).

Text books:

1. "Understanding FACTS" N.G.Hingorani and L.Guygi, IEEE Press. Indian Edition is available:—Standard Publications, 2001.

Reference books:

- 1. "Flexible ac transmission system (FACTS)" Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
- 2. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R.MohanMathur and Rajiv k.Varma,Wiley.