

## PPE104 FACTS CONTROLLERS

L	T	P	Cr
3	1	0	3.5

**Course Objectives:** To learn the concept of power flow control through various power electronic controllers including state of art FACTS controllers, operational aspects and their capabilities and their integration in power flow analysis, FACTS controllers and to learn the effectiveness of FACTS controllers in distribution system for harmonic mitigation etc.

**OVERVIEW:** Concept of reactive power compensation, Review of Power Flow methods and series-shunt compensation, Review of voltage and current sourced converters, Concepts of transient stability and voltage stability, Power system oscillations. Need for FACTS controllers- types of FACTS controllers.

**SHUNT COMPENSATORS:** Mid point voltage regulation, Method of controlled VAR generation, principle of operation, Control and characteristics of SVC, STATCOM, General applications, Multi-control functional model of STATCOM for power flow analysis, Implementation of STATCOM models in Newton power flow, STATCOM in optimal power flow (OPF), STATCOM in distribution system (DSTATCOM), DSTATCOM performance in various modes including harmonic mitigation.

**SERIES COMPENSATORS :** Series compensation and voltage stability, Variable impedance type series compensators (TCSC) and switching converter type series converter (SSSC), Configurations, Control and characteristics, General applications, Modelling of multi-control functional model of SSSC in power flow analysis, Implementation of SSC models in Newton power flow, SSSC in OPF, Dynamic Voltage Restorer (DVR) in Distribution, Subsynchronous Resonance, NGH Scheme.

**UNIFIED POWER FLOW CONTROLLERS :** Objectives and principle of operation of voltage, phase angle regulations, Static phase shifter, Operating characteristics of SPS, Unified Power Flow Controller (UPFC) control and characteristics, UPFC as generalised SSSC, Modelling of UPFC for power flow and optimum power flow studies, Implementing UPFC in Newton power flow, Control of power oscillations using UPFC.

**POWER FLOW CONTROLLER:** Principle of operation, Control and characteristics, Model of IPFC for power flow and optimum power flow studies. FACTS Controller interactions – SVC–SVG interaction - co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination

**RECENT TRENDS:** Application of basic active filters, multilevel and multipulse converters and Z-source inverter in various FACTS and FACDS devices for improving the performances of transmission system network and distribution system network, respectively.

### Course Outcome:

Understanding with the power system control through various power electronic controllers including state of art FACTS controllers. Understanding about the operational aspects and their effectiveness in transient stability enhancement, damping to power system oscillations, real and reactive power control capability in power system and their effectiveness in distribution system for harmonic mitigation etc.

### Recommended Books

1. Song, Y.H. and Johns, A.T., *Flexible AC Transmission Systems*, IEEE Press (1999).
2. Hingorani, N.G. and Gyragyi, L., *Understanding FACTS (Concepts and Technology of Flexible AC Transmission System)*, Standard Publishers & Distributors (2001).
3. Mathur, R.M. and Verma, R.K., *Thyristor based FACTS controllers for Electrical Transmission Systems*, IEEE Press (2002).

4. Zhang, X. P., Rehtanz, C. and Pal, B., *Flexible AC Transmission Systems: Modelling and Control*, Springer (2006).
5. A.T.John, "Flexible AC Transmission System", *Institution of Electrical and Electronic Engineers (IEEE)*, 1999.
6. V. K.Sood, "HVDC and FACTS controllers- Applications of Static Converters in Power System", 2004, *Kluwer Academic Publishers*.
7. K.R.Padiyar," *FACTS Controllers in Power Transmission and Distribution*", *New Age International(P) Ltd., Publishers New Delhi, Reprint 2008*

**Evaluation Scheme:**

S.No.	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Tutorials/Quizes etc.)	25