

Power Quality and FACTS (Professional Elective -VI)

Prerequisites: Power Electronics

Course Objectives:

- To understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
- To understand the working principles of FACTS devices and their operating characteristics.
- To understand the basic concepts of power quality.
- To understand the working principles of devices to improve power quality.

UNIT 1: (~6 Lecture hours)

Transmission Lines and Series/Shunt Reactive Power Compensation: Basics of AC Transmission, Reactive Power Compensation: Shunt and series compensation at the mid-point of an AC line, Comparison of Series and Shunt Compensation.

UNIT 2: (~9 Lecture hours)

Thyristor-based Flexible AC Transmission Controllers (FACTS):

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Configurations/Modes of Operation, Harmonics and control of SVC and TCSC, Fault Current Limiter.

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UNIT 3: (~10 Lecture hours)

Voltage Source Converter based (FACTS) controllers:

Voltage Source Converters (VSC): Six Pulse VSC, Principle of Operation OF STATCOM, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC).

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UNIT 4: (~8 Lecture hours)

Power Quality Problems in Distribution Systems:

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, and Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations and flicker, Tolerance of Equipment: CBEMA curve.

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UNIT 5: (~12 Lecture hours)

Custom Power Devices:

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM, Synchronous Reference Frame Extraction of Reference Currents, Dynamic Voltage Restorer – Working Principle, Unified Power Quality Conditioner (UPQC) - Working Principle.

Text Books

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 2011.
2. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.
3. Math H J Bollen "Understanding Power Quality Problems", IEEE Press, standard publishers distributors, Delhi, 2001.

References:

1. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2016.
2. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 2010.
3. Bhimsingh, Ambrish Chandra, kamal Al-Haddad "Power quality problems and mitigation techniques" Wiley Publications, 2015.
4. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991.

Course Outcomes:

Students will be able to:

1. Apply various compensation techniques using FACTS devices.
2. Acquire knowledge on Multi level converters.
3. Apply different Pulse width modulation techniques under different operating conditions.
4. Identify the FACTS devices for different applications on system control.
5. Acquire knowledge on power quality issues.
6. Implement different custom power devices to effectively mitigate the power quality problems.

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4) S. S. 8) K. K.

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