

POWER QUALITY IMPROVEMENT TECHNIQUES

Module-I : (15 Hours)

Concept of Power Quality: Frequency variations, voltage variations- sag and swell, waveform distortion –dc offset, harmonics, inter-harmonics, notching and noise. Fundamentals of Harmonics: Representation of harmonics, waveform, harmonic power, measures of harmonic distortion; Current and voltage limits of harmonic distortions: IEEE, IEC, EN, NORSOK.

Causes of Harmonics: 2-pulse, 6-pulse and 12-pulse converter configurations, input current waveforms and their harmonic spectrum; Input supply harmonics of AC regulator, integral cycle control, cycloconverter, transformer, rotating machines, ARC furnace, TV and battery charger.

Module-II : (14 Hours)

Effect of Harmonics: Parallel and series resonance, effect of harmonics on static power plant – transmission lines, transformers, capacitor banks, rotating machines, harmonic interference with ripple control systems, power system protection, consumer equipments and communication systems, power measurement. Elimination/ Suppression of Harmonics: High power factor converter, multi-pulse converters using transformer connections (delta, polygon).

Passive Filters: Types of passive filters, single tuned and high pass filters, filter design criteria, double tuned filters, damped filters and their design. Active Power Filters: Compensation principle, classification of active filters by objective, system configuration, power circuit and control strategy.

Module-III : (15 Hours)

PWM Inverter: Voltage sourced active filter, current sourced active filter, constant frequency control, constant tolerance band control, variable tolerance band control. Shunt Active Filter: Single-phase active filter, principle of operation, expression for compensating current, concept of constant capacitor voltage control; Three-phase active filter: Operation, analysis and modelling; Instantaneous reactive power theory.. Three-phase Series Active Filter: Principle of operation, analysis and modelling. Other Techniques: Unified power quality conditioner, voltage source and current source configurations, principle of operation for sag, swell and flicker control.

Text/References:

1. Derek A. P., "Power Electronic Converter Harmonics", IEEE Press. 1989
2. Arrillaga J., Smith B. C., Watson N. R. and Wood A. R., "Power System Harmonic Analysis", 2nd 2008 Ed., Wiley India.
3. Arthur R. B., "Power System Analysis", 2nd Ed., Pearson Education. 2008
4. Arrillaga J., Braedlley D. A. and Bodger P. S., "Power System Harmonics", John Wiley and Sons. 1985
5. Dugan R. C., McGranaghan M. F. and Beaty H. W., "Electrical Power System Quality", McGraw-Hill International Book Company. 1996
6. Sankaran C., "Power Quality", CRC Press. 2001