POWER QUALITY MANAGEMENT

Course Code:13EE2111 **L P C**
Pre requisites: Basic knowledge in Electrical Networks, Machines, Power Electronics. **4 0 3**

Course Educational Objectives:

To study and understand the definitions, various power quality problems and their mitigation and measuring techniques.

Course Outcomes:

At the end of the course, the student will be able to acquire knowledge in

1. Basic concepts of power quality issues.
2. Causes, effects of long and short interruptions.
3. Sags and phase angle jumps in different types of faults.
4. Various equipment behavior with voltage sags.
5. Various interfacing devices between system and equipment to mitigate the sags and interruptions

UNIT-I: INTRODUCTION AND HARMONICS:

Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage Sag Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon.

Harmonics: Definition, causes of voltage and current harmonics, individual and total harmonic distortion, effect of harmonics on power system devices, guidelines for harmonic voltage and current limitation, harmonic current mitigation.

UNIT-II : INTERRUPTIONS:

Long Interruptions: Definition – Terminology – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption – Overview of Reliability evaluation.

Short Interruptions: Definition, origin of short interruptions - basic principle, fuses saving, voltage magnitude events due to re-closing, voltage during the interruption; monitoring of short interruptions - difference between medium and low voltage systems, Multiple events;

single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

UNIT-III :

VOLTAGE SAGS – CHARACTERIZATION – SINGLE PHASE AND THREE PHASES:

Voltage sag – definition, causes of voltage sag, voltage sag magnitude - monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems; voltage sag duration. Three phase faults- single phase, phase to phase, phase to ground faults; phase angle jumps- theoretical calculations; magnitude and phase angle jumps- phase to phase, single phase, two phase to ground; for three phase unbalanced sags, load influence on voltage sags.

UNIT-IV : VOLTAGE SAGS – EQUIPMENT BEHAVIOR:

Voltage tolerance, computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation methods of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives other sensitive loads.

UNIT-V

MITIGATION OF INTERRUPTIONS, VOLTAGE SAGS AND EMC STANDARDS:

Overview and ways of mitigation methods, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller- basic principle active power injection; shunt controller, combined shunt and series controller.

Purpose of standardization, IEC Electromagnetic compatibility standards.

TEXT BOOKS:

1. Math H J. Bollen, "*Understanding Power Quality Problems: Voltage Sags and Interruptions*", First Indian edition, IEEE Press, 2001. (all units)

2. C.Sankaran, "*Power Quality*", First Indian reprint, CRC press, 2009 (Part of Unit-I).

REFERENCES:

1. Roger Dugan, Surya Santoso, Mark F. Mc Granaghan, H. Beaty, "*Electrical Power Systems Quality*", McGraw-Hill Professional Publishing, Second Edition, November 2002.
2. J. Arrillaga, N. R. Watson, S. Chen, "*Power System Quality Assessment*", John Wiley & Sons, 2000.