IV Year I Semester 17EE733

ELECTRIC POWER QUALITY (Professional Elective-II)

Preamble:

Power quality is a major problem for utilities and customers. Customers using sensitive critical loads need quality power for proper operation of the electrical equipment. It is important for the student to learn the power quality issues and improvement measures provided by the utility companies. This course covers the topics on voltage and current imperfections, harmonics, voltage regulation, power factor improvement, distributed generation, power quality monitoring and measurement equipment.

Learning objectives:

- 1. Able to learn different types of power quality phenomena.
- 2. Able to identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
- 3. Able to describe power quality terms and study power quality standards.
- 4. Able to learn the principle of voltage regulation and power factor improvement methods.
- 5. Able to explain the relationship between distributed generation and power quality.
- 6. Able to understand the power quality monitoring concepts and the usage of measuring instruments.

Unit – I

Introduction

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short– duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations.

Unit – II

Voltage imperfections in power systems

Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients

Unit – III

Voltage Regulation and power factor improvement:

Principles of regulating the voltage – Device for voltage regulation – Utility voltage

Regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement.

Unit – IV

Harmonic distortion and solutions

Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering – Numerical problems.

Unit – V

Distributed Generation and Power Quality

Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks.

Unit – VI

Monitoring and Instrumentation

Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data – Application of intelligent systems – PQ monitoring standards.

Learning Outcomes:

- 1. Capable of identifying different types of power quality problems.
- 2. Will know the sources of voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
- 3. Also analyze power quality terms and power quality standards.
- 4. Can go through the principle of voltage regulation and power factor improvement methods.
- 5. Demonstrate the relationship between distributed generation and power quality.
- 6. And also knows the power quality monitoring concepts and the usage of measuring instruments.

Text books:

- 1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw–Hill, 2012, 3rd edition.
- 2. Electric power quality problems -M.H.J.Bollen IEEE series-Wiley India publications, 2011.

Reference books:

- 1. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.
- 2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M HJ, First Edition, IEEE Press; 2000.
- 3. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
- 4. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
- 5. Power Quality c.shankaran, CRC Press, 2001
- 6. Harmonics and Power Systems Franciso C.DE LA Rosa–CRC Press (Taylor & Francis)
- 7. Power Quality in Power systems and Electrical Machines–EwaldF.fuchs, Mohammad A.S. Masoum–Elsevier.