Course Code EPE 811	Credit Hours (Th-Pr) 3.0-0	**Electric Power Quality (Elective)**	Contact Hrs/Week (Th-Pr) 3.0-0	Total Contact Hrs (Th-Pr) 45-0

Course Outline:

1. Topics include introduction to Power Quality Phenomenon, Short and long duration voltage variations, Voltage sags and swells, Transient over voltages, Harmonics, Causes of harmonics and methods to mitigate harmonics, standards of power quality, time and frequency domain methods of analysis; power quality monitoring; power quality improvement methods.

Eligibility Criteria:

2. B.E (Electrical Engineering)

Recommended Books:

S. No.	Title	Author(s)	Assigned Code	Remarks
a.	Electrical Power Systems Quality, Third Edition	Roger C. Dugan	A	Text
b.	Fundamentals Of Electric Power Quality	Surya Santoso	B	Reference
c.	Power Quality in Power Systems and Electrical Machines	Ewald Fuchs	C	Reference

Course Objectives:

- To highlight the importance of Power Quality Standards with reference to Pakistan
- To discuss the need of DG integration into Power System

- To discuss the Characteristics of Power Quality and highlight the factors that degrade it
- To discuss the impact of Distributed Generation on Power Quality of modern Power System.
- To equip engineers with skills and knowledge to select, apply and operate protection systems

Learning outcome:

After completing the course, the student shall be able to

- Understand power quality through the study of disturbances in the electricity supply system that might prevent customer equipment from operating as intended. learn about the different categories of power quality problems, their impact on customer operations and methods for analyzing these problems
- Have understanding of the causes and effects of poor Power Quality on the existing network and the need for a better power system, as well as have knowledge about important terminology.
- Have knowledge about current technologies and challenges faced by engineers working in the Pakistani energy sector and also in the years ahead, such as challenges regarding the deployment of Distributed Generation.
- Have knowledge about technology for the integration of renewable energy such as wind power, solar power, including the characteristics of these sources, in the power system, and technology related to the improvement of Power Quality

Topics Covered:

No.	Topics	Text Book	Contact Hours
a.	**Power Quality Phenomenon** 1. Definition and importance of PQ 2. Causes of Disturbance in PQ in modern Electric Power Systems 3. Classification of PQ issues 4. Standards and Guidelines for PQ	A	4
b.	**Short Duration Voltage Variations** 1. Voltage Sags & Swell	A	6

	2. Momentary interruptions 3. Characteristics of short duration Voltage variations 4. Utility fault clearing practices 5.Voltage sag analysis • single phase to ground faults • three phase to ground faults • Induction Motors • Transformer connections 6. Voltage swell analysis on single and three phase to ground faults 7. Methods of reducing voltage sags		
c.	**Long Duration Voltage Variation** 1. Sources of Long Duration Voltage variations 2.Utility Capacitor switching transient 3.Shunt capacitor on utility systems 4.Back to back switching capacitor transients 5. Lightning Transients phenomenon 6.	A	6
d.	**Harmonics** 1. Linear & nonlinear load 2. Causes & effect in Power System harmonics 3. Power System Quantities for Harmonic analysis 4. Effects of Harmonic Distortion 5. Analysis of Power System Harmonics 6. System Response characteristics 7. Principles of Controlling harmonics 8. Passive Mitigation Techniques	B	6
e.	**Computational Tools for Smart Grid Design** 1. Introduction to Computation Tools 2. Optimization Techniques for Smart Grids 3. Classical Optimization Methods 4. Heursistic Optimization Methods 5. Computational Challenges	A	8

f.	**Power Quality Monitoring** 1. Monitoring considerations 2. PQ measuring equipment 3. Smart PQ monitors 4. Assessment of PQ 5. Application of Intelligent systems	C	4
g.	**Distributed Generation & Power Quality** 1. DG Technologies Benefits 2. Interfacing With Electric Power System 3. Power Quality issues 4. Operating conflicts 5. DG in low voltage Distribution Network 6. Interconnection Standards 7. Storage Technologies 8. Tax Credits		6
h.	**Unified Power Quality Conditioner (UPQC)** (1) Custom Compensation devices (2) FACTs Devices (3) Custom Power Devices (4) APLC (5) UPQCs (6) UPQC control Systems (7) Performance (8) Application Examples of UPQC	B	6
	Total		45