Power Quality and Harmonics

4 Days, 2.8 CEUs

Today's energy grid is changing. We are seeing more renewable energy, the implementation of smart grid as well as the ever increasing use of high speed switching loads. These advances promise increased reliability but they also cause more and new power quality issues, which will only increase with time. Linemen and technicians will need to become familiar with power quality phenomenon. They will need to know their causes, impacts, how to locate them, analyze them and mitigate them. This course provides the information on standard power quality problems phenomenon as well as advanced power quality phenomenon.

This course is intended for engineers, electricians and technicians that install, maintain, repair and/or troubleshoot power and auxiliary systems.

Lab and Classroom Attire

AVO Training Institute is committed to the personal safety of each participant and require long pants and ANSI rated "safety-toe" work shoes for lab activities. Lecture courses may involve a tour of a work or shop area and for this reason open-toe shoes and shorts are not considered appropriate attire for the classroom.

Pre-Requisites

Student must bring a laptop and have full administration rights to install software, to complete the class labs. Laptop must have Windows XP/Vista/7/8, 600+ MHz processor, 4+GB hard drive space, 1+GB RAM, a CD-ROM drive. IPads and tablets without CD-ROM or USB ports are not acceptable.

Learning Objectives

To receive 2.8 CEUs, participants must attend 4 days of class (28 contact hours) and attain a minimum average grade of 80% (overall grade will consist of 50% lab practice and 50% final exam). Upon completion of this course the participant will demonstrate that he/she is able to:

- Identify symptoms and causes of significant types of power quality problems.
- Classify power quality events according to IEEE, ITIC (CEBNA) and public utility standards.
- Explain proper application and interpret results of power quality monitoring equipment.
- Recommend viable solutions including UPS, line voltage regulators, transient (surge) suppressors, harmonic filters, line filters, power conditioners, k-rated, isolations and zig-zag transformers, proper wiring and grounding, etc.

SCOPE

Day 1* (7 contact hours)

I. Introduction (0.5 hr)
   - A. Schedule
   - B. Course Outline

II. Introduction to Power Quality (3.5 hrs)
   - A. The power source
   - B. Delivery of power
   - C. The load

AM Break
   - D. Single-phase model
   - E. Three-phase model
   - F. Lab

Lunch

III. Voltage and Current Disruptions (3 hrs)
   - A. Classifying interruptions, sags, and swells
   - B. Power interruptions
   - C. Undervoltage, overvoltage, sags, swells and flicker
   - D. Transients
   - E. Noise
   - F. CBEMA (ITIC) curve
   - G. Power line conditioners

PM Break
   - H. Lab

Day 2 (7 contact hours)

IV. Power Factor
   - A. Impedance, resistance, and reactance

AM Break
   - B. Ohm's law with complex impedances
   - C. ELI the Ice Man

Lunch
   - D. Complex power
   - E. Power factor
   - F. Cost of low power factor
   - G. Lab

PM Break
   - G. Lab (cont'd)

*Class scheduling times may vary based on discussions and size of class

AVO Training Institute is accredited by the International Association for Continuing Education and Training (IACET) and is accredited to issue the IACET CEU

Power Quality and Harmonics

4 Days, 2.8 CEUs

SCOPE (cont'd)

Day 3 (7 contact hours)

V. Unbalance
- A. Symptom 1: Counter-torque
- B. Symptom 2: Current on neutral wire

AM Break
- C. Why do these symptoms happen?
- D. Unbalance - mathematical definition and standards

Lunch
- E. Mitigating unbalance
- F. Lab

PM Break
- F. Lab

Day 4 (7 contact hours)

VI. Harmonics (4 hrs)
- A. Distortions due to semiconductors
- B. Skin effect
- C. Harmonics problems involving transformers
- D. Harmonics problems specific to three-phase systems
- E. Variable frequency drives
- F. THD and TDD
- G. Crest factor
- H. Displacement power factor
- I. Interharmonics
- J. Harmonic filters

AM Break
- K. Lab

Lunch

VII. Standards (2.5 hrs)
- A. IEEE1159
- B. IEEE519
- C. ANSI C84.1

PM Break
- D. IEC SC77A
- E. IEEE 1789
- F. IEC 61000
- G. IEEE 1250
- H. IEEE 1668

VIII. Conclusion (0.5 hr)
- A. Review Material
- B. Final Exam

AVO Training Institute is accredited by the International Association for Continuing Education and Training (IACET) and is accredited to issue the IACET CEU