EPRI | ELECTRIC POWER RESEARCH INSTITUTE

GRIDED

The Center for Grid Engineering Education

Electric Power Quality – 12 PDH's

Course Description

This short course relates to electric power quality, the characteristics of maintaining rated electrical parameters in a power system. The topics discussed are the main points that encompass this field in the world today including voltage sags, harmonics, momentary events, interference, and waveform distortion. These topics are studied in terms of definitions and theoretical bases; measurement and instrumentation; circuit analysis methods; standards; sources of problems; and alternative solutions. A special focus on power quality issues related to solar photovoltaic and wind energy resources is included. The impact of solid state switched loads is also described. An important objective of the short course is to acquaint the attendee with the most recent developments, issues and solutions in electric power quality engineering.

Who Should Attend

Power engineers familiar with basic AC circuits should attend. Although the subject of electric power quality has a mathematical base, this is not the focus of the short course: instead, applications, case histories, and new issues are discussed.

Registration Information

PDH Available: 12 hours

Registration:

- $1,600 per person
- 20% discount for organizations with three or more attendees
- 25% discount for government employees (non-utility)
- 25% discount for university professors*
- 75% discount for graduate students*

*University IDs required to qualify for professor or graduate student discounts.

Students need to bring: laptops or tablets to access online resources and to follow class notes. Wi-Fi access is provided. Lecture slides will be provided electronically in PDF format.

EPRI Contacts

Amy Feser, afeser@epri.com

Course Instructors:

Jerry Hedyt, heydt@asu.edu

Mark Stephens, mstephens@epri.com

Meet the Instructors

Gerald T. Heydt, Regents' Professor, Professor of Advanced Technology, Arizona State University, Tempe AZ. Gerald holds a BEEE degree from the Cooper Union in New York and MSEE and PhD. degrees from Purdue University. He spent approximately 25 years as a faculty member at Purdue, and in 1994, he took the position of site director of the NSF and industrially supported Power Systems Engineering Research Center (PSerc) at ASU. He has industrial experience with the Commonwealth Edison Company in Chicago, E.G. & G. in Mercury, NV, and with the United Nations Development Program. In 1990, he served as the program manager of the National Science Foundation program in power systems engineering. Dr. Heydt is the author of two books in the area of power engineering. Professor Heydt is a member of the National Academy of Engineering, and a Life Fellow of the IEEE. He is the recipient of the Edison Electric Institute Power Engineering Educator Award, 1989; IEEE Power Engineering Society Power Engineering Educator of the Year, 1995; and the IEEE Kaufmann Award, 2010.

Mark Stephens has over 28 years of professional experience in electrical engineering design, startup, research, and analysis. His experience includes conducting hundreds of Power Quality and Energy Efficiency field projects. Skills include project management, industrial systems, industrial control system design, programming, instrumentation, equipment installation, and startup. Stephens has played a key role in developing power quality standards such as SEMI F47 and IEEE 1668. Furthermore, he started EPRI's PQ Star program for voltage sag testing to SEMI F47. He also served as the secretary for CIGRE/CIRED working group JWGC4-110 and is a contributing member for IEEE 1668. Stephens is also leading a key projects in Microgrid Feasibility Studies while looking at power quality issues associated with distributed energy resources.

Course Outline

Day 1: Thursday, September 14, 2017

Session I:

- What is power quality and why is it important?
- Harmonics
- Power quality indices
- THD
- Standards, guides, recommended practices
- IEEE Standard 519
- The IEC standards
- Power acceptability curves
- CBEMA, ITIC
- Voltage sags
- STATCOMs, DVRs

Session II:

- Power factor
- Voltage regulation and three phase unbalance
- Power quality measurements
- Fourier transform and the fast Fourier transform (FFT)
- Transmission lines (long line, medium line, short line)
- Hyperbolic model for long line
- Resonance
- Transformers

Session III:

- Grounding systems
- Sources of power quality problems
- Harmonics from Graetz bridge rectifiers
- Harmonics in three phase systems
- The 1/h rule, and the sequence of harmonics
- Renewable resources – inverter sources – power quality issues from distributed generation sources and pulse width modulated inverters (PWM)
- Harmonics from ASDs
- Types of ASDs
- Power quality indices
- THD
- Standards, guides, recommended practices
- IEEE Standard 519
- The IEC standards

Session IV:

- Electronic lighting, efficacy
- High efficiency heat pumps, coefficient of performance
- Analytical methods for power quality assessment
- Injection current methods
- Harmonic propagation analysis
- Harmonic load flow studies
- State estimation for power quality engineering
- Linear vs. nonlinear state estimation

Day 2: Friday, September 15th

Session V:

- Flicker
- Aperiodic waves and 'fractional harmonics'
- Noise
- Basic impulse level (BIL)
- K-factor
- IEEE C57.110 derating of transformers
- Power quality improvement

Session VI:

- Reactive power 'support' at 60 Hz
- Power quality and deregulation
- Impact of generation on power quality
- Transmission and distribution influences on power quality
- SAIDI and SAIFI and other event indices

Electric Power Research Institute
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com