



Electric Power & Power Electronics Institute
Department of Electrical Engineering
Texas A&M University
College Station, TX 77843-3128

*Attend the course to gain education and
experience in using advanced hardware
and software tools for solving electric
power quality problems*

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Electric Power and Power Electronics Institute

1999

Electric Power Quality

Short Course

October 20-22, 1999

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Introduction

With the increased use on nonlinear loads in the industry, customer-owned computers and other sensitive electronic circuitry, Electric Power Quality has become vitally important.

In particular, harmonic distortion of voltages and currents can be generated either external or internal to an industrial or commercial facility.

This three-day course will expand on methods of analysis and provide a hands-on introduction to computer tools for solving power quality problems.

Course presentations presume no familiarity with basic power quality issues. Prior knowledge of computer programs for the analysis of the disturbances is not a requirement.

Unique Features/Benefits

- State-of-the-art power quality monitoring instruments and various waveform distortion generators in Texas A&M University's recently established Power Quality Laboratory.
- Simulation software to analyze voltage sags, transient overvoltages and harmonics.
- Popular computer software exercises in EMTP/ATP, Pspice and Matlab to gain practical experience in simulating an example system, computing distortion limits and recommending and evaluating likely solutions to power quality problems posed.

Who Should Attend

- Electric utility distribution and customer service engineers who are responsible for quality of power supply to critical customers.
- Plant electrical engineers in locations having power electronic equipment, adjustable speed drives or critical and sensitive loads, including computers and process control equipment.
- Building designers, facility managers, equipment manufacturers, consultants and senior technical personnel in electrical construction companies.

Instructors

Ali Abur is professor of electrical engineering at Texas A&M University. Abur's teaching and research interests are in power system modeling and simulation, power quality assessment, and optimization methods applied to power system problems. He has conducted research projects related to digital simulators for relay testing, and to power quality assessment computer tools.

Prasad Enjeti is professor of electrical engineering at Texas A&M University. Dr. Enjeti is the lead developer of the Power Quality Laboratory at Texas A&M, being actively involved in many projects with industries while engaged in teaching, research and consulting on issues of power electronics, power quality and clean power utility interface.

Will Gray is assistant chief engineer at Toshiba International Corporation Industrial Division in Houston, with many years of experience in applications of adjustable speed drives.

Asif Jakwani is project engineer with a Dallas-based company called Current Technology, Inc. He is involved in the design and development of surge suppression and harmonic filter products. His areas of interest are power quality, transient suppression and power system harmonics.

Chanan Singh is professor and head of the department of electrical engineering at Texas A&M University and an IEEE fellow. His research interests are in power system reliability and power quality. Dr. Singh is the developer of major software used by the power industry and has consulted for power companies nationally and internationally.

John Soward serves as power quality services manager at TU Electric. His primary responsibility is providing power quality assistance to TU Electric customers with additional responsibilities in developing power quality programs and products. Mr. Soward has served TU Electric in a range of engineering, supervisory/management positions in distribution, marketing and sales.

Course Textbook

Included in the course fee is a copy of the text, *Electrical Power Systems Quality*, by Roger C. Dugan, Mark F. McGranaghan and H. Wayne Beaty, McGraw-Hill, 1996. Additional handouts will be provided.

Course Descriptions

What is Electric Power Quality?

J. Soward

- Utility perspective
- Classification of power quality issues
- Definition of terms and standards

Power Quality Problems in Industrial Power Distribution Systems - W. Gray

- Industry perspective
- Adjustable speed AC drives and harmonic compliance

Definition of Terms and Review

P. Enjeti, A. Abur

- Review of power quality standards (IEEE 519-1992 etc.): harmonic current and voltage distortion limits--discussion
- Measurement of voltage sags: national power quality survey data from distribution systems, characterization of voltage sag parameters
- Equipment Sensitivity Examples: sensitivity to sags, CBEMA equipment tolerance curve, proposed new CBEMA curve, area of vulnerability concept
- Identify key components to model the system and determine the field data required: Utility short circuit kVA, transformer ratings, feeders, linear and nonlinear loads, existing capacitor banks/harmonic filter

Laboratory Exercises and Demonstrations - P. Enjeti, A. Abur

- Introduction to the Power Quality Laboratory for hands-on experience in generating a voltage sag, voltage unbalance, distortion, flicker and short term power interruption on a 54kVA programmable power source

Power Quality Problems in Electrical Systems in Buildings - A. Jakwani, P. Enjeti

- Review of nonlinear loads in a typical building
- Excessive neutral current problem, voltage distortion
- Case study of typical loads in buildings
- Computer modeling of an electrical distribution system
- Determining transformer derating and K-factor calculation
- Review of passive and active filtering

methods to reduce neutral current overloading and improve voltage THD

- Transient surge suppression methods in buildings--a typical case study

Voltage Sags and Interruptions - A. Abur

- Review of Voltage sag phenomena: IEEE STD. 519-1992 definitions
- Measurement of voltage sags: national power quality survey data from distribution systems, characterization of voltage sag parameters
- Modeling and simulation of utility systems for voltage sag and interruptions studies
- Solutions to voltage sag events: Power conditioning for sensitive load equipment
- Advanced solution technologies

Transient Overvoltages - A. Abur

- Review of capacitor switching transients
- Modeling and simulation of transient overvoltages: assessing the effects of capacitor switching

Harmonics - A. Abur

- Sources and effects of harmonics
- Harmonic analysis: frequency and capacitor scans
- System modeling for harmonics studies
- Harmonic power flow studies
- Harmonics mitigation: use of passive filters
- Harmonics standards: compliance studies

Computer Exercises and Laboratory

Demonstrations - P. Enjeti, A. Abur

- Computer modeling of a typical system
- Review system impedance/frequency scans
- Investigate the impact of system capacitors
- Meet IEEE limits by applying harmonic filters
- Harmonic case study
- Effects/Solutions: voltage sag on an electronic adjustable speed drive system
- Measurement of harmonics generated by an adjustable speed drive; evaluate the effects of voltage sags on the drive performance (Lab demonstration)

Reliability of Industrial and Commercial Distribution Systems - C. Singh

- Review of basic reliability analysis techniques along with examples
- Case study of a typical power distribution system of a telecommunication facility: choice of single vs. dual feed, bus configuration, UPS selections guides, overall configuration for continuity and quality of power supply

TIMES	DAY 1	DAY 2	DAY 3	POWER QUALITY SCHEDULE
8:00	What is Electric Power Quality?	Power Quality Problems in Electrical Systems in Buildings	Reliability in the presence of Poor Power Quality-Distribution Systems, Commercial and Industrial	
10:00	Power Quality Problems in Industrial Power Distribution Systems		Adjourn	
10:30		Voltage Sags and Interruptions		
11:00				
Noon	Lunch	Lunch		
1:30	Definition of Terms and Review	Transient Overvoltages		
2:00		Harmonics		
3:00		Computer Exercises and Lab Demos		
3:30	Laboratory Exercises & Demos			
5:30	Adjourn	Adjourn		

TRAVEL, HOTEL, AND PARKING INFORMATION

American and Continental Airlines serve College Station through Dallas and Houston. College Station is located 90 miles north of Houston Intercontinental Airport on Texas Highway 6 via Interstate Highway 45 and State Highway 105.

A partial list of local hotels is provided below. Make reservations early. Hotels marked with (*) asterisk may provide transportation to campus *if requested at check-in*.

Parking fees on campus may be paid in two ways: (1) in advance by mail with registration (least cost) and (2) on a daily basis at the parking garage on a first-come-first-serve basis.

On-Campus Lodging may be obtained by calling the Memorial Student Center, (409) 845-8908.

Off-Campus Lodging:

Best Western Inn at Chimney Hill, 901 University Dr.	(409) 260-9150
Comfort Inn*, 104 Texas Ave. S.	(409) 846-7333
Days Inn College Station, 2514 Texas Ave. S.	(409) 696-6988
Fairfield Inn, 4613 S. Texas Ave.	(409) 268-1552
Hampton Inn*, 320 Texas Ave. S.	(409) 846-0184
Hilton Hotel *, 801 University Dr.	(409) 693-7500
Holiday Inn-College Station, 1503 Texas Ave.	(409) 693-1736
LaQuinta, 607 Texas Ave. S.	(409) 696-7777
Ramada Inn, 1502 Texas Ave. S.	(409) 693-9891
Super 8 Motel, 301 Texas Ave.	(409) 846-8800

REGISTRATION FORM

Electric Power & Power Electronics Institute Short Course

Dept. of Electrical Engineering
Texas A&M University
College Station, Texas 77843-3128

Tel: (409) 845-1814
Fax: (409) 845-7161
E-mail: nancy@ee.tamu.edu

Name _____
(Last) (First/Middle)

Organization _____

Job Title _____

Mail Address _____

Telephone _____ Fax _____

E-mail _____

REGISTRATION FEE **

One Person	\$ 800.00
CEU Processing Fee	\$ 25.00
(SS# _____)	
On-Campus Parking	
\$4 per day x ___ days	\$ _____

TOTAL \$ _____

** Discounts available for EPPEI members. Inquire about discounts & membership.

Mail registration form with payment to:
EPPEI, Texas A&M University
ATTN: Nancy Reichart
Dept. of Electrical Engineering
College Station, TX 77843-3128 USA

PAYMENT

Company Check (U.S. Dollars) \$ _____

Credit Card* (circle one)

Master Card Visa AmEx

Name as it appears on the card:

Card # _____

Exp. Date _____

Signature _____

*Bank surcharge added for credit card payments.

Continuing Education Units (CEU) are available upon request by marking the appropriate box on the registration form and submitting the fee. Completing the course will earn 1.4 CEUs.

Cancellation Policy Guaranteed registration deadline is Oct. 1. After Oct. 1, registration is on a first-come-first-serve basis only. Registration fees will be refunded, less a cancellation fee of \$100, if written cancellation request is received on or before Oct 8. TAMU reserves the right to cancel the course, if necessary, due to low registration before Oct. 8 and will provide full refund of paid registration fees.

Internet Information

This Course:

<http://ee.tamu.edu/~eppe/ShortCourses/scs3.htm>

Other Courses:

<http://ee.tamu.edu/~eppe/ShortCourses/services.htm>

EPPEI Membership/Discounts:

<http://ee.tamu.edu/~eppe/summary.htm>