

Fall 2016 - EE 362Q (16795) – Power Quality and Harmonics

meets with **EE 394.9 (17095) Power Quality**

Prof. S. Santoso (instructor)

Class Schedule: MW 9:00 – 10:30 am at GDC 4.302

Office Hours: MW 1-2 pm and by appointment (ssantoso@mail.utexas.edu) in UTA 7.229

Focus	Introduction and analysis of power quality and harmonic phenomena in electric power systems: characteristics and definitions, voltage sags, electrical transients, harmonics, mitigation techniques, impacts of variable energy sources and electric vehicle loads, and technical standards
Expected outcomes	<ul style="list-style-type: none">• Thorough understanding of the concept of utility distribution power quality phenomena.• Proficient in the analysis of power quality disturbances: voltage sags, motor starting, transient phenomena, and harmonics.• Proficient in designing and evaluating solutions to mitigate power quality disturbances.
Pre-requisites	<ul style="list-style-type: none">• Prerequisite: Electrical Engineering 313 with a grade of at least C-.• Preferred: EE 368L, EE 369, or equivalent power systems courses.
Subjects	<ol style="list-style-type: none">-1. Overview of transmission and distribution systems, including primary and secondary circuits.0. Fundamentals of single- and three-phase circuits: Chapter 2 and 3 of Glover and Sarma (Recommended textbook 'g')1. Introduction to electric power quality phenomena: current issues, utility distribution and industrial power systems, relationship between current and voltage in power quality.2. Electric power quality phenomena: IEC and IEEE definitions, transients, short-duration and long duration voltage variations, voltage unbalance, waveform distortion, voltage fluctuation, power frequency variations.3. Voltage sags and momentary interruptions: characteristics, equipment sensitivity (ITIC and equipment ride through capability curves), sources of voltage sags and interruptions, utility fault clearing practices (overcurrent protective devices, overcurrent coordination, fuse saving vs. fuse tripping), methods of reducing voltage sags and momentary interruptions.4. Voltage sag analysis: Thevenin equivalent source, analysis and calculation of voltage sags due to single-line to ground faults, three-phase to ground faults, analysis of voltage swell on grounded and ungrounded systems, transformer secondary voltages with single-line to ground faults on the primary, voltage sags due to induction motor starting.5. Transient overvoltage phenomena: sources, utility capacitor switching transient, applications of shunt capacitors on utility systems, analyses of isolation and back-to-back, magnification, and restrike of capacitor switching transients, managing capacitor inrush and outrush currents, lightning phenomena.6. Fundamental of harmonics: Fourier series analysis, voltage and current distortion, harmonic vs. transient, power system quantities for harmonic analysis, harmonic indices, system response characteristics, effects of harmonic distortion on capacitors, transformers, and motors, interharmonics, harmonic filter designs.7. Impacts of renewable energy sources and electric vehicle loadings on power quality: overview of wind power and photovoltaic sources, electric vehicle charging technologies, reactive power requirement, power factor, voltage regulation, and voltage flicker.
Required textbook	S. Santoso, Fundamentals of Electric Power Quality , Winter 2010 Ed.
Recommended texts	<ol style="list-style-type: none">a. Dugan, McGranaghan, Santoso, Beaty, Electrical Power Systems Quality, McGraw Hill 2012.b. T. A Short, Electric Power Distribution Handbook, 2003.c. J. Grainger, W. Stevenson, Power System Analysis, Mc-Graw Hill 1994.d. Anderson, Analysis of Faulted Power Systems, 1973, 1995.e. A. Greenwood, Electrical Transients in Power Systems, 2nd Ed., John Wiley & Sons, NY 1991.f. Westinghouse Electrical Transmission and Distribution Reference Book, 1944.g. J. D Glover, M. S Sarma, T. J Overbye, Power System Analysis and Design, >4th Ed., Thompson.

Course Site <http://canvas.utexas.edu/>

- Computing Tools**
- Matlab by Mathworks
 - PSCAD/EMTDC by Manitoba HVDC Research Centre

Grading Policy: Numerical grades (*g*) are as follows:

- Exercise Problems and Small Projects: 20 points
- Two midterm exams: 2 x 22.5 points,
- Final exam: 35 points
- Total *g* = 100 points

The correspondence of letter to numerical grade is:

EE 362Q	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F	
	100	95	90	87	83	80	77	73	70	67	63	60	0
EE 394.9	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F	
	100	95	90	87	83	80	77	73	70	67	63	60	0

Exam dates:

- First exam: Mon, October 10, 2016
- Second exam: Wed, November 9, 2016
- Final exam: Refer to the University final examination schedule

Classroom behavior: Class meets on MW between 9 and 10:30 am except during University designated holidays. Although I do not take class attendance, all students are encouraged to be present in all scheduled classes. Late arrivals are indicative of lack of commitment and disruptive to everyone in the class. Be sure to arrive at least 5 minutes before the start of class. I reserve the right to refuse entry to students arriving 10 or more minutes late. Repeat offenders will be subjected to a 25% total grade reduction. The use of all electronic devices (phones, tablets, laptops) unrelated to the learning process is strictly prohibited.

Policies for submitting assignments, projects, take-home exams, computer scripts:

All assignments must be submitted on the due date. Missed exams may be made up due to illness or other emergencies; otherwise a zero is assigned. Grades for late assignments without instructor consent will be reduced by 25%/day.

Academic Integrity:

Any scholastic dishonesty will not be tolerated. Please follow this link:

http://deanofstudents.utexas.edu/sjs/acint_student.php

Accommodations for Student with Disabilities:

The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. For more information, <http://diversity.utexas.edu/disability/>

Emergency evacuation routes and emergency procedures:

Please visit this link and review the procedures: <http://www.utexas.edu/safety/>

Flu Preparation: Stay home until fever free for 24 hours, <http://www.flu.gov/planning-preparedness/school/index.html>

Campus Carry Rules

Please visit this link and follow the procedure: <https://campuscarry.utexas.edu/>