Florida International University
Department of Electrical and Computer Engineering
EEL-6219 Electric Power Quality, Fall 2024

Course Catalog and Offering Information

- Name of Course: Electric Power Quality
- Course Number: EEL 6219
- Schedule and Duration: Thursdays from 5:00-7:30 PM
- Classroom: EC-3930
- Semester: Spring 2024
- Course Instructor: Professor O. A. Mohammed, ECE Department, Florida International University, Office: EC-3951, mohammed@fiu.edu, 305-348-3040, Office Hours: Thursdays: 4:00-5:00 PM

Course Notes and Lecture Materials, as well as references

- Extensive Lecture Notes by Professor Mohammed
- Many other readings for the class will be available in the form of articles with online links on the course webpage located at http://www.aln.fiu.edu/courses.

References:

- G.T. Heydt, Electric Power Quality, 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994.
- M.H.J. Bollen, Understanding Power Quality Problems: Voltage Sags and Interruptions (New York: IEEE Press, 1999).
- J. Arrillaga, N.R. Watson, S. Chen, Power System Quality Assessment (New York: Wiley, 1999).
- Electrical Power Systems Quality, Second Edition by Dugan, McGranaghan, Santoso, and Beaty. (McGraw-Hill, 2003, ISBN 0-07-138622-X)

Course Topics and Outline:

1. Power Quality Fundamentals
   - What is Power Quality? What is Power Quality Engineering? Why is Power Quality important?
   - Review: AC Circuit Theory, Fourier series, Power Electronics Basics
   - Vocabulary and Definitions
   - Planning Power Quality Investigations
   - Measurers and standards of power quality
   - Power quality improvement.
2. Sags and Short Interruptions
   - Sources
   - Range and Impact on Sensitive Circuits
   - Standards
   - Fundamental Principles of Protection
   - Solutions and Mitigation
   - Equipment and Techniques
   - Case Studies in Motor-Starting Sags
   - Case Studies in Fault-Clearing

3. Transients
    - Origin and Classification Impact on Users
    - Flickers, impulses, radio frequency signals, and susceptibility of loads to these signals.
    - Principles of Protection Hardware for Mitigation
    - Case Studies in Capacitor Switching Transients
    - Case Studies in Lightning Protection
    - Case Studies in Load Switching
4. Harmonics
    - Sources
    - Definitions and Terms Standards and Measures Impacts
    - System Response.
    - Modeling of networks and components under non-sinusoidal conditions
    - Loads that may cause power quality problems.
    - Analysis methods.
    - Resonant Effects Calculation and Simulation
    - Mitigation and Control Techniques
    - Filtering (passive and active)
    - Examples and Case Studies Harmonic Studies
5. Longer Duration voltage Variations
    - Causes
    - Voltage Regulators
    - Uninterruptible Power Supplies
    - Utility Side Support
    - Reliability Indices
    - Case Studies
6. Measurements
    - Indices
    - Measurement Techniques
    - Contracts and Insurance Concepts
    - State Estimation
    - Use in Planning
7. Distributed Generation Grid Connection Issues
    - What is Distributed Generation? Interface to Utility
    - Harmonics in power systems.
    - Power Quality Issues
    - Examples
    - Interconnection Standards
8. Wiring and Grounding
    - Definitions and Terms
    - Reasons
    - Requirements
    - Standards
    - Missing and Multiple Ground Connections
    - Ground Loops Neutral Sizing Common Errors Resonant Effects
    - Solutions to Grounding Problems
    - Case Studies

9. Instruments and Analyzers
    - What is available? How does it operate? What to expect
    - Safety
    - Case studies
10. AI Applications in Power Quality

The topics listed may be subject to revision during the semester.

Course Grading The expected learning outcomes will be assessed by review of written assignments (project assignments and other homework), class participation, and performance on the unit tests and the final exams. Project assignments and other homework. Much of the course efforts will be practical (as described in more detail in assignments). In addition, short homework assignments may be given from time to time.

Projects/Homework and classwork	30%
Midterm Exam	30%
Final Exam	40%

References for your use:

Power Electronics:

- N. Mohan, T.M. Undeland, and W.P. Robbins, Power Electronics: Converters, Applications, and Design: Third Edition New York, John Wiley & Sons, 2003.
- M.S. Rashid, Power Electronics: Circuits, Devices, and Applications (New York: Prentice-Hall, 2003).
- J. Agrawal, Power Electronic Systems (New York: Prentice-Hall, 2001).
- P.R. Krein, Elements of Power Electronics (New York: Oxford, 1999).
- D. Hart, Introduction to Power Electronics (New York: Prentice-Hall, 1996).
- J. Kassakian, M. Schlecht, and G. Verghese, Principles of Power Electronics (Boston: Addison- Wesley, 1991).

Power Electronics for Utilities

- N. Hingorani, L. Guygyi, Understanding FACTS : Concepts and Technology of Flexible AC Transmission Systems, (New York: Wiley, 1999).

Power Systems

- A.R. Bergen and V.J. Vittal, Power System Analysis, Second Edition, (New York: Prentice-Hall, 2000).
- W. Grainger and W. Stevenson, Power System Analysis, (New York: McGraw-Hill, 1994).
- C.A. Gross, Power System Analysis, Second Edition (New York: Wiley, 1986).
- W. Elgerd, Electric Energy Systems Theory: An Introduction (New York: McGraw-Hill, 1982).

Power Quality

- G.T. Heydt, Electric Power Quality, 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994.
- M.H.J. Bollen, Understanding Power Quality Problems: Voltage Sags and Interruptions (New York: IEEE Press, 1999).
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