

INSTITUTE OF TECHNOLOGY
SCHOOL OF
ELECTRICAL AND COMPUTER ENGINEERING

COURSE DESCRIPTION FOR
POWER QUALITY & RELIABILITY, MSC PROGRAM,

Instructor: Dr.-Ing. Getachew Biru

Course Description and Scope:

The quality of power can have a direct economic impact on many residential and industrial consumers. Today more and more electronically controlled, energy-efficient equipment which are more sensitive to deviations in the supply voltage are used widely. Thus, power quality has become a very important issue for utility industries as well as to customers.. Power quality problems encompass a wide range of different phenomena, like surges, voltage dips and swells, voltage distortions, harmonics and others. The course starts with the definition of power quality, the various indicators of power quality and the problems that are commonly encountered. Each of these problems are discussed in detail, the reasons analyzed and corrective measures to resolve these problems are discussed. It is thus useful for electrical power engineering students to understand the phenomena to be able to investigate the problem and come-up with design solutions to mitigate the problems.

Another topic of this course is that of power reliability as reliability of power system is becoming increasingly important in today's environment in which economic and commercial activities are fully dependent on the availability of electrical power. Thus, in this courses reliability assessment methods are discussed in detail

Course objective:

- Recognize the cause and source of power system disturbances.
- Analyze types of electrical systems loads and their power quality considerations.
- Calculate harmonic voltages and currents
- Explain how to mitigate any existing and potential problems.
- Understand how to design power mitigating devices.
- Understand power reliability assessment methods.

Course outline:

1. Introduction
 - 1.1. What is power quality?
 - 1.2. Why are we concerned about power quality?
 - 1.3. Terms and definitions
 - 1.4. Categories of power quality problems
2. Common Power Disturbance Analysis
 - 2.1. Transient and voltage surges
 - 2.2. Under voltage and over voltage
 - 2.3. Voltage sags and swells
 - 2.4. Voltage unbalance
3. Harmonics
 - 3.1. Harmonic distortion and harmonic sources
 - 3.2. Effects of harmonic distortions
 - 3.3. Harmonic analysis and calculations
 - 3.4. K-factor and derating factor
 - 3.5. Harmonic resonance
 - 3.6. Filter Design
4. Power Quality Monitoring and Mitigation
 - 4.1. Assessment of power quality problem
 - 4.2. Devices for power quality mitigation
 - 4.3. Grounding
5. Power Reliability
 - 5.1. Introduction
 - 5.2. Basic reliability concepts
 - 5.3. Reliability block diagrams
 - 5.4. Reliability assessment methods
 - 5.5. Performance indices
 - 5.6. Comparison of different power system design

Assignment:

Power Quality Analysis of a Particular Industrial Plant-Case Study

The study include:

- Description of site (Profile of electrical load)
- Discussion with Engineers on Power Quality Problem of the industry
- Field measurement of voltage, current, PF, Harmonics
- Selection of appropriate filtering techniques Computer modeling and simulation
- Recommendation

The assessment is done as follows:

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| Assignment | 40 % |
| Final Exam | 60 % |
| Total | 100 % |

References

1. Greenwood: *Electrical Transients in Power Systems*
2. Dugan: *Electrical Power System Quality*.
3. Barry, Kennedy: *Power Quality Primer*.