ECE201

Course Description

Course Objectives
At the completion of this course, each student should be able to do the following:
1. Understand and describe the properties of basic circuit elements including resistors, capacitors, inductors, controlled sources and op-amps.
2. Apply element constraints, connection constraints, and network theorems for circuit analysis.
3. Apply network theorems for circuit analysis
4. Analyze DC circuits.
5. Analyze first order RL and RC circuits, and second order RLC circuits. Calculate the transient response of first and second order circuits.
6. Enter netlists of basic circuits into Spice software and obtain simulation results.
7. Understand electrical safety.

ECE202

Course Description

Course Objectives
At the completion of this course, each student should be able to do the following:
1. Analyze AC circuits in steady-state using phasors.
2. Understand the properties of the Laplace transform.
3. Analyze circuits using a Laplace transform.
4. Understand the properties of convolution.
5. Sketch Bode plots.
6. Understand the meaning of filtering.
7. Understand the properties of the Fourier Series.
8. Analyze circuits with mutual inductance.
9. Calculate power in sinusoidal steady-state.
10. Use SPICE simulation and MATLAB to predict the response of linear circuits.
ECE320

Course Description
AC machines, transformers, rectifiers and inverters, as well as electrical drives and uninterruptible power supplies.

Course Objectives
Power has two distinct effects in our lives: on one hand we have to produce it, transmit it and receive it in a way that is affordable, reliable, and with minimal negative effect on the environment; on the other hand we have to control its use, so that we can make the best out of it, i.e. use it safely and efficiently, and harness it to achieve qualities like speed, accuracy and efficiency.

This course serves only as an introduction to both electrical machines and power electronics. It focuses on the most common devices and systems that an electrical engineer will encounter: AC machines, transformers, rectifiers and inverters, as well as electrical drives and uninterruptible power supplies.

The course is directed to junior students and aims to introduce them to the theory of operation, analytical and circuit models and basic design concepts of Electric Power components and systems.

At the end of this class students should have a working knowledge of:
- three-phase power and circuits,
- transformers,
- basic electric machines,
- induction machines,
- synchronous machines,
- AC/DC rectifiers,
- DC/AC inverters and
- DC/DC converters.

ECE425 & 821 (co-taught)

Objectives:
At the completion of ECE 425 students should be able to:
1. develop and quantify common performance objectives for power electronic circuits, such as efficiency, power factor, etc.
2. develop simple power electronic converter topologies to meet certain functional specifications
3. analyze power electronic converter operation to develop design guidelines for choice of switching devices and reactive elements
4. identify and use switching device and reactive component performance characteristics to apply them appropriately in power electronic circuits
5. obtain averaged state space description and block diagram representation of power
6. simulate operation of power electronic converter using general purpose system simulation tools
7. develop and describe dynamic behavior of power electronic converters using small signal transfer functions
8. design simple closed loop regulators for power electronic converters to meet functional objectives
9. extend simple power electronic converters to realize inverters and rectifiers
10. describe operation of diode and SCR based power electronic circuits
11. outline operating principles of application of power electronic circuits as motor drives, UPS systems, active filters, etc.
12. use systematic problem solving techniques to partition complex problems
13. use simplifying assumptions to approach solutions to ill-posed design problems
14. present solutions to technical problems effectively using reports
15. use mathematical analysis software tools to solve engineering design problems

Additional

Objectives for ECE821 students include:
1. deeply understand the power electronic system in the context of applications
2. demonstrate the skills of system modeling, design, and control in a chosen research project
3. verify the system operation through a detailed simulation

Course Topics:
1. Power converter topologies and realization (2 weeks)
2. Passive Components (1 week)
3. Modulation and waveform analysis (1 week)
4. Single phase and 3-phase inverters (1 week)
5. Single phase and 3-phase rectifiers (1 week)
6. SCR circuit and cycloconverter (1 Week)
7. Matrix converter and multilevel converter (1 week)
8. Waveform analysis and harmonic filtering (1 week)
9. Steady state model and transfer functions (1.5 weeks)
10. Control and regulator design (1.5 weeks)
11. Gate drive and snubber circuits (1 week)
12. Applications of power electronics (1 week)