



# ECE 4501 - Power Systems

*Spring semester 2008*

## **2005-2007 Catalog Course Description:**

Fundamentals of rotating machines: DC, synchronous, and induction machines. Transformers. Power system representation. Transmission lines. Power system analysis: stability and dynamic performance. Balanced and unbalanced faults. Power system protection. (3 hrs lect, 3 hrs lab)

## **Prerequisites:**

ECE 2006 - Electrical Circuit Analysis

## **Educational Goals:**

This course provides a broad overview of the engineering concepts associated with power systems and energy conversion. In-depth emphasis is placed on selected topics including 3-phase circuit analysis, magnetic circuits, transformers, DC motors, induction motors, transmission line modeling, power system network representation, powerflow and stability modeling, balanced and unbalanced faults, system protection, and power electronics.

The student will gain skills and understanding in the areas of sinusoidal analysis, phasor analysis, Maxwell's Equations as applied to electromagnetic circuits, energy conversion in rotating machines, motor performance analysis, Norton and Thevenin equivalents, Gauss-Seidel and Newton-Raphson methods for iterative solution of power system networks, hybrid-PI modeling of transmission lines, symmetrical components and fault calculations.

The accompanying laboratory exercises introduce the student to the various components of power systems and their underlying engineering principles. These exercises demonstrate concepts in single phase and three phase powerflow, DC machines, AC machines, Transformers, AC Transmission lines, HVDC Transmission and Motor Controls using Power Electronics.

## **Course Outcomes (indexed to ABET):**

- Represent Sinusoidal waveforms as rotating phasors (a)
- Master the analysis of single phase and three phase AC circuits (a, b, n)
- Analyze magnetic circuits (a)
- Understand electromagnetic energy conversion (a, b, n)
- Calculate voltage regulation and efficiency of transformers (a, b, n)
- Analyze DC motors and generators (a, b, n, e)
- Learn the differences between Induction and Synchronous machines (a, b, n, e)
- Analyze 3-phase induction motors (a, b, n, e)
- Calculate motor efficiency and speed regulation (a)
- Apply standard methods for controlling motors (a, b)
- Perform sending end and receiving end calculations on transmission lines (a)
- Represent power system networks in powerflow simulations (a, k)
- Discover methods for converting AC to DC using power electronics (a, b, n)
- Understand positive, negative and zero sequence equivalents (a)
- Calculate balanced and unbalanced faults (a)
- Learn methods for protecting power systems
- Undertake a design project on a power systems topic (c, e, k, n)

## **Relationship to ECE Program Objectives:**

- Builds on fundamental concepts learned in physics and circuit analysis
- Incorporates math skills acquired in calculus and differential equations
- Improves ability to design electrical and electronic circuits at power frequency
- Broadens range of engineering skills acquired in curriculum