ECE3300 Course Syllabus

ECE3300

Electromechanical and Electromagnetic Energy Conversion (3-0-0-3)

CMPE Degree
This course is Elective for the CMPE degree.

EE Degree
This course is Elective for the EE degree.

Lab Hours
0 supervised lab hours and 0 unsupervised lab hours

Course Coordinator
Habetler,Thomas G

Prerequisites
ECE 3025 [min C]

Corequisites
None

Catalog Description
Introduction to three phase power systems, electromechanical energy conversion and operating principles of electric machines.

Textbook(s)
Sarma, *Electric Machines: Steady-State Theory and Dynamic Performance* (2nd edition), PWS Publishing, 1997. ISBN 0534938434, ISBN 978-0534938437 (required)

Course Outcomes
Upon successful completion of this course, students should be able to:

1. Analyze magnetic systems using equivalent magnetic circuits.
2. Design inductors and transformers with cores and air gaps, from given specifications.
3. Use equivalent circuits to analyze transformers with electromagnetic nonidealities.
4. Determine linear forces in electromagnetic systems such as relays and actuators.
5. Analyze the operating characteristics of 3 phase AC induction and synchronous machines.
6. Describe the operation of single-phase AC, and DC machines.

Student Outcomes
In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.
“M” for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
“LN” for “little to none” indicates that the course does not contribute significantly to this outcome.

1. (P) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. (LN) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. (LN) An ability to communicate effectively with a range of audiences
4. (LN) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. (LN) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. (LN) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. (M) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

1) AC Power
   a) Real and reactive power

2) Magnetic Circuits
   a) Properties of magnetic materials
   b) Ampere's law and magnetic circuits
   c) Faraday's law and induced voltages
   d) Permanent magnets
   e) Induction and coupled magnetic circuits
   f) Analysis and mitigation of electromagnetic noise

3) Transformers
   a) Ideal transformer
   b) Physical model and equivalent circuits
   c) Transformer testing
   d) Three phase transformers
   e) Autotransformers

4) Electromechanical Energy Conversion
   a) Electromagnetic energy storage
   b) System energy conservation
   c) Forces, Lorentz torque, and reluctance torque
   d) Sensors and Actuators
   e) Electromechanical relays
   f) Stepper and positioning systems
   g) Switched reluctance machines
   h) Synchronous reluctance machines

5) Symmetrical AC Synchronous Machines
   a) Round rotor machines
   b) MMF of a distributed winding and rotating magnetic
   c) Torque in rotating machines.
   d) Motor ratings and capability.
   e) Equivalent circuit.
   f) Analysis of salient pole machines

6) AC Induction Machines

a) Construction and layout
b) Rotor field and slip
c) Equivalent Circuit
d) Single Phase Induction Machines

7) DC Machines
a) Construction and Layout
b) Commutation and Equivalent Circuit
c) Motor Characteristics
d) DC motor connections