ECE4335 Course Syllabus

ECE4335

Electric Machinery Analysis (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 3070/3300

Corequisites
None

Catalog Description
Advanced theory of AC machines, including AC motor winding design, finite element analysis, induction motor design, permanent magnet machine design, and synchronous machine dynamics. Credit not allowed for both ECE 4335 and ECE 6335.

Textbook(s)
Sarma, *Electric Machines* (4th edition), PWS Publishing Co., 1994. ISBN 9780078028168 (required)

Course Outcomes
Upon successful completion of this course, students should be able to:
1. Analyze synchronous machines in both the steady and dynamic states.
2. Design inductors and transformers with cores and air gaps, from given specifications.
3. Use equivalent circuits to analyze single phase, double cage, wound rotor and linear induction machines.
4. Apply scaling laws to understand how performance varies with size.
5. Design 3 phase induction motors using appropriate approximations.
6. Understand the properties and use of permanent magnets in synchronous 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) Steady State Synchronous Machines
a) Per unit system and rated values
b) Review of basic operation
c) Salient pole machines
d) Design of machine windings and Finite Element Analysis of m
e) Machine modeling
i) Calculation of machine inductances
ii) Open and short circuit tests
iii) Leakage reactance measurement - Potier triangle
iv) Saturation modeling
f) Permanent magnet machines
g) Synchronous reluctance machines
h) Performance characteristics

2) Dynamics Of Synchronous Machines (Sarma 10.1 thru 10.4)
a) Coupled circuit (DQ) modeling of AC machines
b) Transient reactances and time constants
c) Transient parameters
d) Transient stability
e) Short circuit and sudden voltage change behavior
f) Constant flux linkage theorem
g) Time domain solution
h) Small signal modeling and block diagram
i) Control of synchronous generators

3) Induction Machines
a) Review of basic operation
b) Wound rotor machines
c) Squirrel cage machines
d) Double cage and deep-bar motors
e) Single phase machines
f) Linear induction motors

4) Scaling Laws for AC Machines

5) Design of Induction Machines
a) Factors affecting main magnetizing inductance
b) Factors affecting leakage inductance
c) Slot design
d) Machine resistances, skin effect
e) Thermal design

6) Switched Reluctance Machines