Course Syllabus, Winter 2018

2017-18 Catalog Data: ECE 3600- Electrical Machines (4 credits)

> Magnetic circuits, transformers, magnetic energy, force/torque and heat dissipation. DC and AC machines and their equivalent circuits, torque analysis and power efficiency. Three-phase transformers, synchronous and induction machines. Per unit system and introduction to power distribution. With laboratories in transformers, DC and AC machines.

Textbook: S. Umans, *Fitzgerald & Kingsley's Electric Machinery*, 7th Edition, McGraw Hill, 2014, ISBN 978-0-07-338046-9.

Instructor: S. Ali Arefifar, Assistant Professor of ECE, arefifar@oakland.edu, EC 432, (248) 370-2222.

Teaching Assistants: Md Shahin Alam (malam2@oakland.edu), Sanjay Surisetty (sanjaysurisetty@oakland.edu)

Prerequisite: (ECE 276 or ECE 2005) and major standing

Course Objectives: Upon successful completion of ECE 3600, the students will be able to:

1. Solve electromagnetic systems using magnetic circuit analysis.
2. Solve circuits with ideal as well as real transformers.
3. Determine the energy stored in a magnetic system and calculate magnetic force and torque.
4. Describe steady state equivalent circuits of separately excited, shunt, permanent magnet, and series DC motors.
5. Perform steady-state analysis, calculate torque, power and the efficiency of DC machines.
6. Perform transient analysis of DC motors including speed and torque control.
7. Analyze 3-phase induction motor, steady-state equivalent circuits, internal torque and power.
8. Analyze synchronous machines, steady-state equivalent circuits, internal torque and power.

Class Schedule: 1:00pm - 2:47pm, Mon. & Wed. at Human Health Building 2085.

Lab Schedule: 9:00am – 11:59am Thu. & Fri., 1:00pm – 3:59pm Fri. at 458 Engineering Center.

Evaluation: Homework   7%,   Pop Quiz   8%,   Labs   10%

First Exam	25% ----	Ch1, Ch2, Ch3	----	Wednesday February 14th --- 1:00pm - 2:47pm
Second Exam	25% ----	Ch4, Ch7	----	Wednesday March 21st ---- 1:00pm - 2:47pm
Final Exam	25% ----	Ch5, Ch6	----	Wednesday April 25th ---- 12:00pm to 3:00pm

Extra Marks: Presentation/Project 3%, Constructive Feedback 2%.

Policy: 1. Follow OU's Academic Conduct Policy,

> 2. No late homework is acceptable and no make-up exam will be offered,

> 3. One-page formula is allowed, no sharing and no wireless devices are allowed in an exam.

Major Topics from the Course Book:

Chapter 1 - Magnetic Fields and Magnetic Circuits

1. Fundamentals of Magnetic Fields and Analysis
2. Introduction to Magnetic Circuits
3. Multi-Coil Systems and Applications

Chapter 2 - Transformers

1. Transformer Applications and Ideal Transformer Model
2. Complex Power, Power Factor and Analysis of Real Transformers
3. Three-Phase Voltages, Currents and Y- and Δ-Connections
4. Autotransformers and Three-Phase Transformers

Chapter 3 - Electromechanical Energy Conversion

1. Energy stored in Magnetic Fields
2. Force and Torque Analysis in Magnetic Circuits

Chapter 4 – Introduction to Rotating Machines

1. Rotating Field and Reluctance Machine
2. Classification of Electric Machines

Chapter 7 - DC Machines

1. Different Types of DC Machines
2. Equivalent Circuits for DC Machines
3. Steady-State Analysis, Internal Torque, Characteristics of Torque vs. Speed, and Power Analysis
4. Transient Analysis and Control of DC Motors

Chapter 6 - AC Induction Machines

1. Single-Phase and Poly-Phase Induction Machines
2. Steady-State Equivalent Circuits, Internal Torque and Power Analysis

Chapter 5 - AC Synchronous Machines

1. Modeling and Analysis of Synchronous Machines and Applications
2. Steady-State Equivalent Circuits, Internal Torque and Power Analysis