ESE352: Electromechanical Energy Converters
Fall 2017

Fall 2016-2017 Catalog Description:

Basic principles of energy conversion; DC, induction, and synchronous rotary converters; the three-phase system and symmetrical components; the relationships between voltage, current, flux, and m.m.f.; equivalent circuits and operating characteristics of rotary converters; and analysis of saturation.

Course Designation: Elective

Text Book: Electric Machinery Fundamentals (5th ed. McGraw Hill) Chapman

Prerequisite: ESE 372

Credit Hours: 3

Coordinator: Timothy J. Driscoll

Goals: Teach analysis and design techniques associated with the conversion of (1) mechanical energy to electrical energy (generators) and (2) electrical energy to mechanical energy (motors).

Objectives: Upon completion of this course, students will obtain an understanding of the following:

1. The interaction of magnetic fields, electric current, and moving conductors in the production of electromagnetic force and induced voltage.
2. The design and application of three phase AC synchronous generators, induction machines and synchronous motors.
3. The design and application of DC generators and motors.
4. The design and application of single-phase AC machines.

Topics Covered:

Week 1.	Overview of electromechanical energy converter fundamentals: rotational motion, power, magnetic fields, Faraday's Law, induced force, induced voltage, linear DC machine.
Week 2.	Rotating loop in magnetic field, induced voltage in AC machines, induced torque, power flow, losses. Assign Team Model 1.
Week 3.	Real, Reactive, and Apparent Power flow in AC circuits. Discuss Team Model Assignment. Form class teams.
Week 4.	Synchronous generators including the following: construction, relationship between rotor mechanical speed and electrical frequency, internal generator voltage, equivalent circuit, phasor diagram representation, power and torque, operation, and ratings.
Week 5.	Synchronous motors including: rotating magnetic field, equivalent circuit, steady-state operation, starting issues, phasor diagrams, ratings. Team Presentations: Synchronous Machine Team Model 1

Week 6.	Review sessions 1 through 5.
Week 7.	First exam.
Week 8.	Review First Exam. Induction machines including: construction, slip and frequency, equivalent circuit, torque, torque-speed characteristics, induction motor design, starting challenges, speed control, induction generators, and induction machine ratings.
Week 9.	DC machinery fundamentals including: rotating coil between magnetic poles, commutation, induced voltage and torque, machine construction, power flow, losses. Assign Team Model 2.
Week 10.	DC motors and generators including: equivalent circuits for separately excited, shunt, permanent magnet, series and compound machines; starting circuits, and machine efficiency.
Week 10.	Team Presentations: DC Machine Team Model 2. Single phase motors including: universal motor, single phase induction motor, starting challenges, equivalent circuits.
Week 12.	Special-purpose motors including: split phase, capacitor start, capacitor start/capacitor run, shaded pole, and stepper motors. Assign Team Presentation for Practical Single Phase Applications.
Week 13.	Team Presentations for Practical Single Phase Applications
Week 14.	Review for final exam.

Week 15 Final Exam

Class/laboratory Schedule: 3 lecture hours per week.

Student Outcomes	**% contribution***
(a) an ability to apply knowledge of mathematics, science and engineering	20
(b1) an ability to design and conduct experiments	
(b2) an ability to analyze and interpret data	10
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	10
(d) an ability to function on multi-disciplinary teams	10
(e) an ability to identify, formulate, and solve engineering problems	10
(f) an understanding of professional and ethical responsibility	5
(g) an ability to communicate effectively	5
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	5
(i) a recognition of the need for, and an ability to engage in life-long learning	5
(j) a knowledge of contemporary issues	10
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	10
Any other outcomes and assessments?	

Document Prepared by: Timothy J, Driscoll on 5/27/2017