Department of Electrical and Computer Engineering
ECE 732 Dynamics and Control of Electric Machines

Course Overview

Dynamic behavior of AC electric machines and drive systems; theory of field orientation and vector control for high performance induction and synchronous machines; permanent magnet and reluctance machines and their control; principles of voltage source and current source inverters, and voltage and current regulation methods.

Instructor: Dr. Iqbal Husain
Office: 100 Keystone Rm. 19, Tel: 513-5927;
Office Hours: Mon. & Wed 3 - 4 PM or by appointments.
Email: ihusain2@ncsu.edu

Teaching Assistant: To be Assigned
Office: Keystone
Office Hours: TBD.
Email:

Lectures: Mondays and Wednesdays 1:30-2:45 AM, Rm. 02220 EBIII

Recommended Text books:

1) D.W. Novotny and T.A. Lipo, *Vector Control and Dynamics of AC Machines*, Oxford Science Publications, 1996.
2) Seung-Ki Sul, *Control of Electric Machine Drive Systems*, Wiley-IEEE Press, 2011

Reference books

1. N. Mohan, *Advanced Electric Drives*, MNPERE, Minneapolis, MN, 2001
2. A.M. Trzynadlowski, *The Field Orientation Principle in Control of Induction Motors*, Kluwer Academic Publishers, Norwell, MA, 1994
3. P. C. Krause, *Analysis of Electric Machinery*, IEEE Press, Piscataway, NJ 1995

Grading: The grade distribution is as follows:

Modeling projects	45%
2 Exams	40%
HW	15%
Total	100%

Modeling Projects:

Electric machine and control modeling projects to be developed with computer simulation tools will be assigned during the course related to the topics covered in the course. Matlab-Simulink will be the primary platform for the simulations. The assignments will be collected and graded.

Homeworks

Homeworks will be assigned in addition to the study assignments. Homeworks may include some computer simulation assignments to help prepare for the modeling projects. Homework assignments will be collected, and graded.

Drop Deadlines

Confirm the last day to drop ECE732 from the University Calendar. Lack of prerequisites is not grounds for dropping a course after the deadline.

Policy on Absences

Attending the class regularly is required. Students should notify the instructor if she/he will miss the class. Unexcused absences from exams, homework, or final exam will receive a grade of zero. Scheduled absences (approved in advance) and unscheduled absences (due to illness) must be certified in writing to the instructor. Make-up exams will not be given except under extenuating circumstances.

For complete attendance policies, please see http://policies.ncsu.edu/regulation/reg-02-20-3

Grading and Assignments

The letter grade will be on a 90, 80, 70, 60 scale. Within this range +/- will be used. Any grading questions arising as a result of a particular test or exam must be resolved within one week after that test or exam is returned. See your instructor if you have questions about tests and exam grading.

Lecture # (75 min. each)	Topic	Book Chapter/Notes/Paper
1	Electric Machine Dynamics - Introduction	Chapter 1 & Lecture Notes
2	DC Machine Background	Lecture Notes
3	Space Vector and Reference Frame Transformations	Lecture Notes from Krause Chap. 3
4	Dq Complex Vector Theory 1	Chapter 2
5	Dq Complex Vector Theory 2	Chapter 2
6	Machine Winding Inductances	Chapter 2
7	Induction Machine dq Modeling 1	Chapter 2
8	Induction Machine dq Modeling 2	Chapter 2
9	Rotor Flux Reference Frame	Chapter 2 & Notes
Induction Machine Simulation Assignment (in Matlab-Simulink)		
10	Synchronous Machine dq Modeling 1	Chapter 2 and Notes from Krause Chap. 5
11	Synchronous Machine dq Modeling 2	Chapter 2 and Notes from Krause Chap. 5
12	Synchronous Machine Vector Control – Steady State	Chapter 5
13	Synchronous Machine Vector Control - Dynamic	Chapter 6
Mid-Term Exam (Wed. 10/17/2018)		
15	Induction Machine Vector Control - Introduction	Chapter 5
16	Induction Machine Vector Control - Steady State 1	Chapter 5
17	Induction Machine Vector Control - Steady State 2	Chapter 5
18	Induction Machine Vector Control - Dynamic 1	Chapter 6
19	Induction Machine Vector Control - Dynamic 2	Chapter 6
Induction Machine Vector Control Simulation Assignment (in Matlab-Simulink)		
20	Voltage source inverters(VSI)	Chapter 1 & Lecture Notes
21	PWM Control of inverters	Lecture Notes
22	Space Vector PWM	Lecture Notes
23	PWM control with Wide bandgap inverters	Lecture Notes
24	Current Regulation	Chapter 7
25	Direct Torque Control for Induction Machines	Lecture Notes from Peter Vas's book
SV-PWM based VSI Simulation (in Matlab-Simulink)		
26	PM Machines and their control	Lecture Notes
27	IPM Machine Controls	IEEE Ind. Appl. Tr. 1991 Tom Jahns paper
28	Wind System and DFIG	Lecture Notes
29	Switched Reluctance Machines	Lecture Notes
Final Exam (Fri. Dec. 14, 2018; 1-4PM)		

Course Contents

Electric Machine Dynamics - Introduction
Reference Frame Transformations
Dq Complex Vector Theory
Induction Machine dq Modeling
Synchronous Machine dq Modeling
Synchronous Machine Vector Control – Steady State and Dynamics
Induction Machine Vector Control - Steady State and Dynamics
Voltage Source Inverters(VSI)
PWM Control of Inverters
Direct Torque Control for Induction Machines
Current Regulation
PM Machines Principles and Control
IPM Machine Controls
Switched Reluctance Machine Principles and Controls

Component	Weight	Details
Mid-Term Exams	**20%**	One mid-term examination will be administered. The mid-term and the final exams are equally weighted.
Homework	**15%**	Six to seven homeworks are assigned during the semester.
Simulation Projects	**45%**	Three computer simulation projects will be assigned. The students submit completed Matlab/Simulink programs and reports. Simulation will be assigned to include wide-bandgap devices for the inverter component simulation.
Final Exam	**20%**	A non-comprehensive final exam is administered at the end of the semester.