

EE 534: Control of AC Machines Drives

Lecture Schedule	4:00 to 7:00 pm (Friday) See Lecture Plan for details.	Semester	Fall 2008
Credit Hours	Three	Pre-requisite	Undergraduate Courses <ul style="list-style-type: none"> • Power Electronics. • Control Systems. • Electric Machines.
Instructor	Dr K M Hasan	Contact	kmhasan@uet.edu.pk
Office	SUPCON-UET Automation Laboratory, Ground Floor, EE Dept.	Office Hours	8:00am to 2:00pm
Teaching Assistant		Lab Schedule	See the Timetable Attached.
Course Description	This is an advanced level course on electric machine drives. Emphasis will be on the speed control of the induction motor, the most widely used electric machine in industrial and domestic applications. Amongst various control methods, a voltage-source-inverter (VSI) fed pulse-width-modulation (PWM) induction motor drive will be discussed in detail using mathematical modeling, analysis and simulation.		
Expected Outcomes	<p>Upon completion of this course, students should:</p> <ul style="list-style-type: none"> • Understand the basic structure of an ac machine drives. • Be able to understand the interaction of mechanical, electrical, power processor and control subsystems in ac machine drives. • Have gained mathematical skills to perform transient and steady-state analysis using Matlab[®] and Simulink[®]. • Have an understanding of control methods used in open-loop and closed-loop operation. • Gained knowledge and understanding of an experimental drive system. • Be familiar with emerging technologies and future trends in electric drives. 		
Textbooks	<p>No single textbook is available for this course. Photocopies of selected material from various books and other resources will be supplied.</p> <p>REFERENCES</p> <ol style="list-style-type: none"> 1. Ned Mohan, “<i>Electric Drives: An Integrated Approach</i>,” MNPERE Minneapolis, 2003. 2. Ned Mohan, “<i>Advanced Electric Drives: Analysis control and Modeling using Simulink[®]</i>,” MNPERE Minneapolis, 2001. 3. B. K. Bose, “<i>Modern Power Electronics and AC Drives</i>,” Pearson Education, 2002. 4. Krishnan, “<i>Electric Motor Drives: Modeling Analysis and Control</i>,” Prentice-Hall, 2001. 5. Marian P Kazmierkowski, R Krishnan and Frede Blaabjerg, “<i>Control in Power Electronics</i>,” Academic Press, 2002. 6. Sergey E Lyshevski, “<i>Electromechanical systems, Electric Machines and Applied Mechatronics</i>,” CRC Press, 2000. 7. K M Hasan, “<i>Artificial Neural Networks in On-line Energy efficient Control of Variable Speed Induction Machine Drives</i>,” PhD Thesis, University of Bradford, UK, 1999. 		
Grading Policy	<ul style="list-style-type: none"> • Assignments • Quizzes • Midterm 	<ul style="list-style-type: none"> 05% 10% 20% 	

	<ul style="list-style-type: none"> • Final 50% • Viva 15%
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Lecture Plan

Week	Course Contents
1-2	Introduction to AC Drive Systems, Mechanical system, mathematical modeling of mechanical system. Simulation of mechanical systems. Types of drives, Types of loads in various applications. Generic power processor used in power electronic converters and its use in AC Drives.
3	Fundamentals of energy conversion, production of torque in cylindrical machines
4-7	Dynamic modeling of three phase induction motor using dq -axis theory. AC machine modeling in stationary-reference-frame and synchronously-rotating-reference-frame. Scalar control, types of continuous-time and discrete-time controllers, transient and steady-state performance analysis of open-loop system by simulation using MATLAB and SIMULINK.
8	Class discussion on course material discussed before and written test of one hour duration.
9-10	DC to AC converters and their control used in induction motor drives. Familiar three phase gate drive ICs used in voltage source inverters.
10-13	Vector control methods. Study of transient and steady-state behavior and performance of induction motors by simulation using MATLAB and SIMULINK. Vector control of permanent-magnet synchronous motor drives.
14	Speed estimation methods in vector control, sensorless vector control techniques. Introduction to Artificial Intelligence Techniques used in the energy efficient operation of induction motors.
15	Design of a laboratory-scale experimental drive system.
16	Class discussion for overall assessment of the course and written test of one hour duration.

Practical Part

During this course, two to three practical demonstrations of an induction motor drive will be arranged. Date and time will be announced in the fourth week. Faculty members taking this course will be assigned various tasks in the arrangement of these practical demonstrations. Volunteers, possibly full-time students, are also encouraged to come forward in this regard.