

Massachusetts Institute of Technology

Department of Electrical Engineering and Computer Science

6.11s: Design of Electric Motors, Generators and Drive Systems

Syllabus, June 12 – 16, 2023

Monday, June 12

09:30 Introduction, Introductions (JLK)
09:45 Elements of Energy Flows in Electromechanics (JLK)
11:00 Introduction to MATLAB (SBL)
12:00 Models of PM DC and Brushless Machines (JLK)
1:00 Lunch Break
2:00 Simulation of Electromechanical Systems (SBL)
3:00 - 5:00 Lab: Getting Started, Simulating DC Machines

Tuesday, June 13

09:00 MATLAB Programming and functions (SBL)
10:30 Parks Transformation, D-Q Modeling of Synchronous Machines (SBL)
12:30 Lunch Break
1:30 Internals of PM Machines: Gap and Winding Functions (JLK)
2:30 Design of PM Synchronous Machines. Brushless Motors
3:30 Drives Using Interior Magnet PM Machines: Field Oriented Control (JLK)
4:30 - 5:30 Lab: Simulating Brushless (PM) Drive Systems

Wednesday, June 14

09:00 Power Electronic Converters: DC-DC Converters, Switching Losses (SBL)
10:30 Gate Drive (SBL)
11:30 Inductor Selection and Design (SBL)
12:30 Lunch Break
1:30 Go-Cart Drive and AC Inverters (SBL)
3:30 Application to Electric Automobiles and High Performance Motors (JLK)
4:30 - 5:30 Lab: Build a Brushless Motor Drive

Thursday, June 15

09:00 Induction Machine Modeling. Space Harmonics (JLK)
10:30 Induction Machine Design Techniques (JLK)
11:30 Induction Motor Drives: 6-pulse and PWM (JLK)
12:30 Lunch Break
1:30 Field Oriented Control of Induction Motors (JLK)
2:30 Design Strategy and models/ Good and Bad Designs, Adaptation to Application (JLK)
4:30 - 5:00 Lab: Optimization of Designing Brushless Machines

Friday, June 16

09:00 Motor Control Models (SBL)
11:15 Field Oriented Control Revisited (SBL)
12:30 The Rest of the Control Loop: Stability and Responsiveness (SBL)
1:30 Lunch Break
2:30 Introduction to Afternoon Lab (SBL)
3:00 - 5:00 Lab: Simulation and Analysis of Induction and Synchronous Motor Drives