



Massachusetts Institute of Technology

Department of Electrical Engineering and Computer
Science

Notes For A Summer Professional Institute Course

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

James L. Kirtley Jr.
Steven B. Leeb

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Design of Electric Motors, Generators and Drive Systems

These notes are, in part, the descendents of supplementary material used in a graduate subject at MIT in **Electric Machines**. They were originally meant to supplement the textbook by Fitzgerald, Kingsley and Umans of the same title, generally providing more mathematical detail and rigor. They have been expanded to encroach on the actual subject material of that textbook and may eventually turn into a book in their own right. Substantial parts of these notes have been adapted to **Electric Motor Handbook**¹.

Other sections of the notes have been written to be used in other MIT subjects, including **Introduction to Electric Power Systems** and **Power Electronics Project Lab**.

We try to *not* assume substantial familiarity with the general subject material of electric machinery and power electronics, but we do assume some level of mathematical sophistication of the reader, particularly in the areas of ordinary and partial (generally linear) differential equations. In several places, typically where it appears to be particularly important, we go quite far back to the basics. It is our feeling that the proper way of approaching electromechanics is from first principals, and you will find quite a few references to Maxwell's equations here.

¹**Electric Motor Handbook**, H. Wayne Beaty, James L. Kirtley Jr., McGraw-Hill Book Company, 1998

Table of Contents

Syllabus Schedule for the week

README Notes on the Matlab Scripts: Each chapter is matched by listings of MATLAB scripts which are intended to both illuminate the subject material of that chapter and to implement the design principles discussed in the chapter. All of these scripts are included in the diskette that accompanies these notes. The scripts were written for and tested on MATLAB Student Edition version 6.5 (MATLAB release 13) running under Windows XP. The scripts will run with at most minor modifications on other versions of MATLAB.

Chapter 1 Electromagnetic Forces and Loss Mechanisms

Chapter 2 Synchronous Machine and Winding Models

Chapter 3 DC (Commutator) and Permanent Magnet Machines

Chapter 4 Synchronous Machine Simulation Models

Chapter 5 Permanent Magnet “Brushless DC” Motors

Chapter 6 Analytic Design Evaluation of Induction Machines

Chapter 7 Variable Speed Power Electronic Motor Drives

Chapter 8 High Torque Motors

Chapter 9 Design Synthesis and Optimization