The University Of Sheffield.

Electronic & Electrical Engineering.

EEE6204 PERMANENT MAGNET MACHINES AND ACTUATORS

Credits: 15

Course Description including Aims

The aims are:

1. To develop an understanding of the relationship between dimensions and rating of machines.
2. To develop techniques for the design of permanent magnet machines.
3. To introduce the topologies of different permanent magnet machines and actuators.
4. To develop an understanding of the relationship between power losses and thermal management.
5. To introduce winding arrangement and calculate representative winding reactances.

Outline Syllabus

Machine Ratings: leading dimension of machines, electric and magnetic loadings, thermal design considerations. **Windings:** special types of windings for permanent magnet machines, their design, choice of winding arrangements, harmonic effects, winding reactance. **Permanent Magnets:** types of magnet, magnetic circuit, demagnetization, analysis and design of PM devices. **Machine and actuator topologies**: electromagnetic torques, Brushless AC/DC, fractional slot, switched/transvers flux permanent magnet machines, etc. **Thermal management**: types of losses, thermal phenomena, thermal modeling using lumped parameter and finite element.

Time Allocation

36 lectures plus 12 hours of additional support material.

Recommended Previous Courses

Students should have background knowledge equivalent to EEE202 “Electromechanical Energy Conversion” and EEE220 “Electric and Magnetic Fields”.

Assessment

3-hour examination, answer 4 questions from 6.

Recommended Books

Hanselman, D.C.	Brushless Permanent-Magnet Motor Design	(McGraw-Hill)
Hendershot, J.R.& Miller, T.J.E.	Design of Brushless Permanent Magnet Motors	(Oxford Science)
Pyrhonen, J., Jokinen, T, & Hrabovcova, V.	Design of Rotating Electrical Machines	(John Wiley)
Lipo, T.A.	Introduction to AC machine design	(Univ of Wisconsin)
Gireas, J., & Wing,	Permanent Magnet Motor Technology	(Marcel Dekker)

M.

Objectives

On completion of the module successful students will be able to

1. Calculate the leading dimensions of a machine subject to the specified design constraints.
2. Develop winding layouts and calculate the harmonic content of their MMF or of the EMF induced in the windings by a rotating field.
3. Suggest the choice of an appropriate permanent magnet material and its main dimensions when used in an electric machine.
4. Introduce different topologies of modern permanent magnet machines and actuators.
5. Calculate the copper and iron losses as well as temperature distribution within permanent magnet machines.
6. Calculate the reactance of a winding or components of the reactance from the dimensions of a machine and relate these to equivalent circuit models developed in earlier years of the course.