The University Of Sheffield.

Electronic & Electrical Engineering.

EEE6022 MOTION CONTROL AND SERVO DRIVES

Credits: 10

Course Description including Aims

This unit builds upon the second year unit EEE202, "Electromechanical Energy Conversion", to investigate in more detail the performance and operational characteristic of both modern a.c. and d.c. variable speed drives and actuation systems. The unit also complements the module EEE307 "Power Electronics".

1. To introduce d.c. drives and permanent magnet brushless a.c. drives.
2. To examine in more detail the operational requirements of induction motors at variable speeds under scalar and vector controlled modes of operation.
3. To introduce power electronic inverters and develop control strategies and switching schemes for inverter fed drives.
4. To develop techniques for modelling the performance of drive systems and for their control system design.

Outline Syllabus

Introduction to servo drive systems: Drive system configuration, characteristics of mechanical loads, velocity profiles, matching motor and load, and criteria for selecting drive components. **D.C. machine drives**: Review of d.c. servo drive characteristics (4 quadrant operation), speed control, development of transfer function for both motor and drive subsystems, design techniques for current and speed control loops, power electronic converters for d.c. drives, supply considerations. **Permanent magnet brushless a.c. drives**: Rotating magnetic field of AC windings, operational characteristics of permanent magnet brushless motors, d-q axis transformation, and modelling and field-oriented control of permanent magnet a.c. machines. **Voltage source Inverters**: Inverter topology, review of operation, sinusoidal PWM modulation, switching harmonics, over modulation and six-step operation, space vector modulation and their implementation in a digital controller. **Induction motor drives**: Review of operation, development of phasor diagram and lumped circuit model, operational characteristics, speed control, scalar and vector control schemes.

Time Allocation

24 lectures plus 12 hours of support material.

Recommended Previous Courses

Background knowledge equivalent to EEE202 "Electromechanical Energy Conversion", EEE342 "Feedback Systems Design", EEE340 "Analogue and Switching Circuits" and EEE307 "Power Electronics"

Assessment

2 Hour Examination, answer 3 questions out of 4

Recommended Books

Williams B.W.	*Power Electronics - Devices, Drivers & Applications*	Macmillan
Miller T.J.E.	*Brushless Permanent-Magnet and Reluctance Motor Drives*	OUP
Leonhard, W.	*Control of Electrical Drives*	Springer
Mohan, N., Undeland, T.M. & Robbins, W.P.	*Power Electronics: Converters, Applications and Design*	John Wiley
Bose, B.K.	*Electronics and Variable Frequency Drives*	IEEE Press

Objectives

By the end of this module successful students will be able to

1. Describe alternative drive technologies for motion control systems.
2. Demonstrate detailed understanding of the operational characteristics of variable speed drive systems.
3. Use standard techniques for drive system modelling and control system design.
4. Display in-depth knowledge of power electronic converters/inverters used in modern drive systems, and their modulation schemes and control strategies.