Department of Electronic and Electrical Engineering
The University of Sheffield

EEE6210 AEROSPACE ACTUATION

Credits: 15

Course description including aims

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.

5. To introduce state of the art hydraulic actuation systems.

6. To introduce Electro hydrostatic and electromechanical actuation.

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. **Induction motor drives:** Review of operation, development of phasor diagram and lumped circuit model, operational characteristics, speed control, scalar and vector control schemes. **Hydraulic actuation systems:** principle of force generation, the role servo valves, control schemes, operational characteristics, Electro hydrostatic actuation. **Electromechanical actuation:** principles of rotary to linear motion conversion, modelling of electromechanical actuators, control schemes, operational characteristics, advantages and limitations, case study of an aircraft electromechanical actuation system.

Time allocation

36 lectures.

Recommended previous courses

Entry qualifications.

Assessment

3-hour examination, answer 4 questions from 6.

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., et al.	*Applications and Design*	John Wiley
Bose, B.K.	*Electronics and Variable Frequency Drives*	IEEE Press

Objectives

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.
5. Understand the principle of operation of hydraulic actuation systems.
6. Understand the principle of operation of electromechanical actuation systems.
7. Demonstrate the ability to model electromechanical actuators.