The University Of Sheffield.

Electronic & Electrical Engineering.

# EEE6120 MODELLING OF ELECTRICAL MACHINES

## Credits: 10

## Course Description including Aims

1. To introduce transformation techniques for the steady state modelling of rotating machines.
2 To illustrate the underlying commonality between the various topologies of electrical machines.
3 To develop and apply techniques for the linear and non-linear analysis of energy conversion in electrical machines.
4. To introduce concepts of non-linearity in electrical machines and demonstrate its limiting effects on practical machine performance.
5. To illustrate the utility of the various modelling techniques by their application to a range of motor topologies, with particular emphasis on highlighting key features in practical machines.

## Outline Syllabus

**Transformation Techniques :** rotational and transformer voltages in rotating machines ; principles of generalised machine theory; phase and dq axis transformations; application to steady-state analysis of universal machines and single and three phase induction machines.
**Energy Conversion :** revision of linear models for electromechanical energy conversion, introduction of non-linear Ψ-i diagrams, dynamic effects in Ψ-i diagrams, modelling of switched reluctance motors and permanent magnet motors by non-linear Ψ-i diagrams.

## Time Allocation

24 lectures plus 12 hours of additional support material.

## Recommended Previous Courses

EEE202 “Electromechanical Energy Conversion”.

## Assessment

2 Hour Examination.

## Recommended Books

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| Jones C.V. | *Unified Theory of Electrical Machines* | Butterworth |
| Morgan A.T. | *General Theory of Electrical Machines* | Heydon |
| Say M.G. | *Alternating Current Machines* | McGraw-Hill |
| Miller T.J.E | *Switched Reluctance Motors and Their Control* | OUP |
| Adkins B. & Harley R.G. | *The General Theory of Alternating Current Machines* | Chapman & Hall |
| Krause P.C. & Wasynczuk O. | *Electromechanical Motion Devices* | McGraw-Hill |

## Objectives

On completion of the course, students should have an in depth knowledge of two important modelling techniques, and will be able to:

1. Analyse the kron primitive machine using generalised machine theory and identify the transformation steps required to produce a kron primitive equivalent for different motor topologies.
2. Perform transformations and calculate the performance of universal motors, three phase and single phase induction motors.
2. Relate the predicted performance to salient design features.
3. Calculate the performance of singly excited and permanent magnet excited devices from both linear and non-linear Ψ-i diagrams.
4. Calculate the performance of switched reluctance motors by Ψ-i diagrams and have an appreciation of a number of technical issues in practical machines.
5. Calculate the performance of permanent magnet machines by Ψ-i diagrams.