The University Of Sheffield.

EEE6205 POWER ELECTRONICS CONVERTERS

Credits: 15

Course Description including Aims

This unit introduces power conversion principles, defines the terminology and analyses operational principles, modulation methods and control of selected power converters topologies for industrial applications. The aims of the module are to understand:

1. Main operational principles of power electronic converters
2. Current-source and voltage-source converter requirements and restrictions
3. Multi-level modulation and control strategies for standard multilevel converters
4. Operation of load resonant, resonant-switch and resonant dc-link converters
5. Challenges in control of matrix converters

Outline Syllabus

Introduction to power conversion: Structure of power converters, main characteristics and requirements, elementary commutation cells, overview of switching power devices, overview of thermal management and packaging. **Two-level voltage source and current source converters**: Requirements on the switches, standard modulation strategies, implementation in a digital controller and analysis of output voltage harmonics, power factor control and active damping control of current source rectifiers. **Multilevel voltage source converters**: Multilevel modulation strategies and capacitor voltage balancing approaches for the cascaded symmetrical and asymmetrical H-bridge multilevel converter, diode clamped multilevel converter and flying capacitor multilevel converter, control of multilevel converters for power quality improvements. **Matrix converters**: Main requirements and restrictions on the switches, input filter and converter operation, overview of direct and indirect modulation and control methods. **Resonant converters**: Basic resonant circuit concept and main classification of resonant converters, analysis of load-resonant, resonant-switch and resonant dc-link converters.

Time Allocation

36 lectures plus 12 hours of support material.

Recommended Previous Courses

Background knowledge equivalent to EEE202 “Electromechanical Energy Conversion”, EEE342 “Feedback Systems Design”, and EEE307 “Power Electronics”

Assessment

3-hour examination, answer 4 questions from 6.

Recommended Literature

Williams B.W. *Power Electronics - Devices, Drivers & Applications* Macmillan

Mohan, N., Undeland, T.M. & Robbins, W.P.	*Power Electronics: Converters, Applications and Design*	John Wiley&Sons
D.Grahame Holmes, Thomas A.Lipo	*Pulse width modulation for power converters: Principles and Practice*	John Wiley&Sons
Gonzalez .A., Verne S.A. & Valla M.I.	*Multilevel Converters for Industrial Applications*	CRC Press Taylor& Frances Group
Bin Wu	*High-Power Converters and AC Drives*	IEEE Press
M.Kazimierczuk& D.Czarkowski	*Resonant power converters*	John Wiley &Sons,Inc.
J.Rodriguez, M.Rivera, J.W.Kolar& P.W.Wheeler	*A Review of Control and Modulation Methods for Matrix Converters*	IEEE Transactions on Industrial Electronics Vol. 59, No. 1, pp. 58-70, January 2012.

Objectives

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

1. master standard modulation and control techniques for two-level current/voltage source converters
2. demonstrate detail understanding of multilevel modulation strategies and capacitor voltage balance issues for standard multilevel power converter topologies
3. design controllers for multilevel power converters for power quality improvements
4. understand matrix converters operation principles, major restrictions and requirements
5. display in-depth knowledge of resonant power electronics converters