The University Of Sheffield.

Electronic & Electrical Engineering.

EEE223 ELECTRICAL ENERGY MANAGEMENT AND CONVERSION

Credits: 20

Course Description including Aims

An outline of the electrical supply infrastructure, including the plurality of electrical energy generation modalities currently in use, is followed by elementary ideas behind protection, safety and tariff structures. The characteristics of electrical machines are discussed together with the circuit strategies that can be used to control of machine performance. Circuits for more general high efficiency power management are also described. Circuits dealing with power will dissipate energy and that energy must be removed if overheating is to be avoided - elements of thermal management are discussed in the context of audio power amplifiers.

Specific aims of the unit are

1 make students aware of the operation of the UK power grid system
2 give students an understanding of tariff structures and system protection
3 cover sufficient magnetostatics for understanding of machine operation
4 introduce the idea of pulse width modulation (pwm) as energy flow control mechanism
5 apply pwm ideas to motor control and power management problems
6 consider energy dissipation within an electronic device
7 introduce simple thermal modelling and heatsinking strategies

Outline Syllabus

Energy supply system – overview of organisation, generation, protection, tariffs, Energy sources, renewables, efficiency. Magnetic fields, Ampère's Law, Bio-Savart Law, forces, self and mutual inductance. Basic ideas behind AC and DC machines (brushed and brushless), actuators. Switching power controllers, buck and boost, simple lossless considerations – energy in = energy out equilibrium. Thermal issues with devices – diodes and transistors – estimating power loss, heatsinking, power amplifiers, classes, B (efficiency, maximum power dissipation and working out of P_{DISS}) and D (outline of components of class D system), advantages and disadvantages.

Time Allocation

48 lectures, 24 problem classes, 125 hours guided independent study

Recommended Previous Courses

Knowledge equivalent to first year modules EEE117 and EEE118.

Assessment

Three hour examination, answer 4 from 6

Recommended Books

Dewan	Power Semiconductor Drives	Wiley
Hindmarsh J	Electrical Machines and their Applications	Pergamon
Hindmarsh J	Worked Examples in Electrical Machines and Drives	Pergamon
Slemon	Electric Machines	Addison-Wesley
Williams B W	Power Electronics	Macmillan

Objectives

By the end of the unit, a candidate will be able to . . .

1 show awareness of various conventional and renewable methods of power generation.
2 describe various method of protection used in power systems
3 make simple estimates of electrical energy costs based on prevailing tariff structures
4 perform basic force calculations related to the magneto-statics
5 compare and contrast the characteristics of several types of electrical machine
6 identify the aspects of a machine characteristic that can be used for performance control
7 design simple pwm control circuits
8 estimate the switching time of a power MOS switch and the consequences for switching losses.
9 design a choke input smoothing filter in the context of a switching regulator.
10 work out first order estimates of buck-boost and boost converter behaviour.
11 estimate the power dissipated in an audio power amplifier output stage
12 choose a heatsink capable of removing heat well enough to keep system temperatures within defined boundaries.