The University Of Sheffield.

Electronic & Electrical Engineering.

EEE340 ANALOGUE AND SWITCHING CIRCUITS

Credits: 10

Course Description including Aims

1. To equip students with the ideas necessary as a foundation for interpretation of discrete power switching circuits and component behaviour.
2. To introduce the concept of electronic switches and examine factors that limit performance of BJT and MOSFET devices.
3. To elucidate the principles behind linear and switching regulators.
4. To describe smoothing filters based on choke energy storage.
5. To describe the operation of boost and buck-boost converter circuits.
6. To introduce the concept of a linear (sinusoidal RC) oscillator.
7. To introduce common non-linear applications of op-amps.

Outline Syllabus

Power Supplies : idea of switch-mode supplies and switching regulators, pwm as regulation mode, choke input filtering in smps context. **Real diodes :** forward and reverse recovery and problems caused, choosing a diode. **Transistors as switches :** BJTs, the need for saturation effects on turn-on and turn-off, reducing base storage effects. **MOSFET switches :** switching speed, switching losses. Switching inductive loads. **Non-linear op-amp applications**. Schmitt trigger, astable, function generators, shaping circuits, oscillators, sample and hold gates.

Time Allocation

24 lectures and 12 problem solving classes in semester 1.

Recommended Previous Courses

EEE101 “Circuits and Signals”, EEE103 “Analogue circuits”.

Assessment

2 hour examination, answer 3 questions from 4

Recommended Books

Horowitz and Hill	*Art of electronics*	Cambridge
Millman and Grabel	*Microelectronics*	McGraw-Hill
Ghausi	*Electronic Devices and Circuits*	Holt, Rinehart and Wilson
Mohan, Undeland & Robins	*Power Electronics*	Wiley
Bradley	*Power Electronics*	Van Nostrand

Objectives

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

1. Show awareness of the effects of stored base charge (in BJT switches) and of some ways of remedying those effects.
2. Understand physically how the feedback mechanism in power MOS devices controls the drain voltage slew rate and hence to estimate switching times and energy losses in a power MOS switch.
3. Design a choke input smoothing filter in the context of a switching regulator.
4. Work out first order estimates of buck-boost and boost converter behaviour.
5. Understand and apply the conditions that must be met for oscillation in RC oscillators and how those conditions are maintained in a circuit, and work out oscillation frequency for both RC and relaxation oscillators.
6. Design an operational amplifier Schmitt trigger circuit with defined switching levels and analyse the behaviour of standard function generator circuits.
7. Design operational amplifier circuits with non-linear feedback such as precision rectifiers, sample and hold gates and shaping circuits.