



The  
University  
Of  
Sheffield.

Electronic &  
Electrical  
Engineering.

## EEE335            INTEGRATED ELECTRONICS

**Credits:**            10

### Course Description including Aims

This course aims to describe the generic circuit elements, analogue and digital and their associated properties which are typically used within IC circuits. Additionally, this course aims to bring the student to level of understanding of VLSI design, such that they can:

1. Understand the alternatives available to and constraints that act upon a VLSI designer.
2. Understand the underlying technologies, trends, and critical issues that affect and will affect VLSI design.
3. Design and analyse analogue and digital circuits (and understand the limitations)

### Outline Syllabus

**Introduction:** Technology development: historical perspective, trends, and future problems and issues.

**Economics and Design Styles:** Economics of chip production. Economics of chip design.

**Implementation options:** Full custom; cell based, Gate Arrays, FPGAs and Programmable Logic Devices. **Synchronous Design:** Methodology. Clocks and clocking. **Logic design:** CMOS technology and characteristics. Noise margins. Gate design/sizing. Switching speed. **Analogue circuit structures:** Circuit operating characteristics of BJTs and MOSFETs; single transistor circuit elements; two transistor circuit elements; differential amplifiers; current mirrors and output stages.

**Analogue VLSI design:** CMOS operational amplifier.

### Time Allocation

24 lectures plus 12 hours of additional support material.

### Recommended Previous Courses

Some previous knowledge of MOSFET operation is assumed, EEE118 Electronic Devices and Circuits would be appropriate. A familiarity with digital circuit design is essential, EEE117 Digital System Engineering provides a suitable background.

### Assessment

3-out-of 4 question, 2 Hour Examination

### Recommended Books

Weste N & Eshragian K	<i>Principles of CMOS VLSI Design A Systems Perspective</i>	Addison Wesley
	<i>Technology Roadmap for Semiconductors 2001</i>	<a href="http://public.itrs.net">http://public.itrs.net</a>
Uyemura J P	<i>Introduction to VLSI Circuits and Systems</i>	Wiley
Rabaey J	<i>Digital Integrated Circuits - A Design Perspective</i>	Prentice Hall
Geiger R L, Allen P E & Strader N R	<i>VLSI Design Techniques for Analog and Digital Circuits.</i>	McGraw Hill

Gray P R, Hurst P J,  
Lewis S H, Meyer R J  
Millman J

*Analysis and Design of Analogue Integrated  
Circuits*  
*Microelectronics*

Wiley

McGraw Hill

## **Objectives**

By the end of this unit successful students will be able to:

1. Demonstrate an understanding of the costs, options, technological difficulties, behaviour of, and benefits of VLSI for particular applications;
2. Calculate the costs (to a first order) of a VLSI design;
3. Use the appropriate terminology associated with VLSI;
4. Outline the VLSI design process and the methodologies used in system implementation;
5. Design simple logic gates based on an understanding of the required logic and the behaviour of the technology. Students should also be able to estimate the performance of these gates (power, speed, area).
6. Design simple analogue IC structures to achieve particular goals.
7. Identify those parts of a circuit that play a major role in limiting the frequency response and write down and use the high frequency equivalent circuit of a circuit to calculate high frequency behaviour.
7. Understand design issues relate to VLSI operational amplifiers and analyze analogue circuits for CMOS operational amplifiers.