The University Of Sheffield.

Electronic & Electrical Engineering.

EEE6216 ENERGY EFFICIEINT SEMICONDUCTOR DEVICES

Credits: 15

Course Description including Aims

The efficient use of energy is of critical importance to future growth and well-being, providing a mechanism to reduce global emissions and to offset the impact of increasing fuel costs. Semiconductor devices can play can crucial role in this key global challenge, providing options which can both improve energy efficiency and also means for renewable energy generation. The course describes four key sectors where semiconductor devices are making considerable impact on energy efficiency. Current approaches for **Solid state lighting** using light emitting diodes are described which provide an efficient means to light our future living and working environments. A major focus of this sub-module will be the development of gallium nitride materials from research through to the mass-production of lighting systems. The current status of organic LED materials will also be discussed. A second segment discusses modern **Display Technologies** focusing on new and emerging approaches such as LED backlit LCD displays, full LED panels, projection displays and the opportunities for laser displays. Semiconductor approaches for **Energy Generation** are described in a third section. This will focus on the important role of semiconductor in photovoltaics (solar cells), but will also discuss thermal energy recovery and the use of semiconductor devices in photo-electrolysis. A final section describes **Energy Efficient Semiconductor Devices,** looking at various approaches to reduce the power consumption of electrical and photonic devices and systems and also the use of semiconductor detectors in remote thermal and environmental sensing to assist the achievement of energy efficient devices and systems.

Course Objectives

On successful completion of this module the students should be able to:

1. Understand the need for energy efficiency and its context against ever increasing global energy demands.
2. Understand that semiconductor devices can play a crucial role in reducing energy consumption and describe the major areas of future impact.
3. Understand the fundamentals of solid-state lighting, form materials to lighting systems, with particular emphasis on GaN LED technology.
4. Have knowledge of present-day energy efficient display technologies and introduce possible future developments utilizing full-colour LED and laser technology
5. Describe the basic operation of semiconductor solar cells and gain knowledge over different device and system approaches. Understand the importance of semiconductor photovoltaics within in a range of renewable energy options.
6. Understand alternative energy generation methods, such as thermo-photovoltaic and photo electrolysis methods

7. Understand the fundamental issues and present-day technological approaches being taken in electronics and photonics to achieve future energy efficient devices. Understand the potential impact of this within the communications, computer processing and power conversion sectors
8. Gain knowledge of the use of semiconductor detectors for thermal sensing to assist energy efficiency. Develop a wider understanding of the use of a range semiconductor sensors in environmental sensing applications

Recommended Previous Courses

Students are required to have a background which covers basic semiconductor device structure, electronic and optical properties together with some previous knowledge of semiconductor technology. Sheffield undergraduates should have taken the s modules EEE118 "Electronic Devices" and EEE225 "Analogue and Digital Devices" and passed in previous years. PGT students or have taken external courses with equivalent learning outcomes (see module descriptions for those courses)

Assessment

Assessment is primarily in the form of a 2 Hour Examination the end of semester 2. Candidates must choose any three out of four questions (75% total marks)
Students will be provided with a short interim test after completion of the individual sections which may be written or computer based and will account for 25% of the module score.

Recommended Books

S.M.Sze and M.J Lee *Semiconductor Devices: Physics and Technology* Wiley

More needed