The University Of Sheffield.

Electronic & Electrical Engineering.

EEE6217 OPTICAL COMMUNICATION DEVICES & SYSTEMS

Credits: 15

Course Description including Aims

The course examines the behaviour of the components in a communications system and the way in which their design and individual performance is determined by that of the system requirements. The course is delivered as a set of 30 one hour lectures and includes a visit to the Central Facility. Copies of incomplete OHP transparencies are distributed to students and these are supplemented by additional notes taken during the lecture. The module aims are

1. To study the characteristics of the device components used in optical fibre communication systems and to examine their dependence on design.
2. To study the dependence of the system performance on device design.

Outline Syllabus

Introduction to optical fibre communications.

Optical fibres; structure, fabrication, ray and wave optics, attenuation and dispersion, bit-rate, bit-error-rate, acceptance angle, NA. Optical mode, single-model fibres, multimode fibres, modal dispersion, cutoff. Graded index fibres. Fibre amplifiers. Eye diagram. Fibre optical sensor. Visible light communication. Non line-of-sight communication. System design and power budget. Loss and Dispersion Limits for System. Detailed System Analysis. Network Architecture WDM systems and components

III-nitride semiconductors, LEDs including white LEDs, spontaneous emission, surface and edge emitters, linewidth and speed, internal quantum efficiency, extraction efficiency, radiative recombination, non-radiative recombination, recombination life-time.

Semiconductor lasers; structure, material growth, device fabrication, gain and feedback, materials, heterostructures, carrier and optical confinement. Threshold gain and Fabry-Pérot mode separation. Dependence of gain on n, λ and T, lasing emission spectrum. DBR and DFB, VCESL, I_{th}, turn-on delay, dynamic response. Advanced laser structures. Advanced semiconductor growth technologies.

Detectors; photoconductor, pin diodes, responsivity, absorption, Si photodiodes. Quantum efficiency, transit-time, current gain, structure. APD, impact ionisation, field dependence, multiplication, noise and breakdown. APD design.

Time Allocation

30 hours of lectures plus 6 hours of additional support material.

Recommended Previous Courses

EEE118 “Electronic Devices”

Assessment

Assessment is primarily in the form of a 3 Hour Examination the end of semester 2. Candidates must choose any four out of six questions

Recommended Books

Senior, J.M.	*Optical Fibre Communications*	Prentice-Hall
Battacharya, P.	*Semiconductor Optoelectronic Devices*	Prentice-Hall
Gowar, G.	*Optical Communications Systems*	Prentice-Hall
Singh, J.	*Semiconductor Optoelectronics*	McGraw-Hill

Objectives

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

1. Understand the major application areas of modern optical communication
2. Understand the present market and future development in optical communication
3. Have knowledge of the basic structural and optical properties of semiconductor materials of relevance to optical communication
4. Understand the principles of semiconductor LEDs, lasers, detectors and optical fibres.
5. Describe the basic structure and electronic properties of solid-state devices
6. Understand each component and its operation mechanism
7. Appreciate the dependence of device performance on design.
8. Understand how device design and performance feeds through into system performance.
9. Understand the principles of semiconductor light emitting diodes, lasers, detectors and optical fibres and apply this knowledge to the design of a lightwave system.
10. Calculate the limits to bandwidth distance product in a fibre-optic system and recognize methods to improve system operation.
11. Calculate the light collection and data transmission properties of a fibre-optic system.