Aston University REG/03/53(2)

Quality and Standards Committee

Module Specification

School and Subject Group		School of Engineering and Applied Science, Electronic Engineering	
Module Code		EE402A	
Module Title		Optical Communications	
Module Type		Taught	
Date of introduction of new module		2001	
Level		7	Credit Value 10
Programme(s) in which module is available		MSc in Telecommunications Technology MRes in Photonic Network Systems MSc in Telecommunications Technology (Distance Learning)	
Involvement of Other Schools		None	
Resource Split			
Name of Module Co-ordinator		Sergei K Turitsyn	
Name of Module Advisor		P. Harper	
Related Modules	Pre-requisites	None	
	Co-requisites	None	
	Prohibited Combinations	None	
Minimum and Maximum Intake Sizes		None – None	

Aims of the Module

The course will provide understanding of basic principles and techniques of optical communications. This module aims to overview the key elements and methods of modern optical communications and to guide the student the fundamentals of optical fibre waveguide through to operational priciples of modern fibre communication systems. Students are expected to already have a basic knowledge of basic physics and engineering mathematics.

Summary of Content

Introduction to optical communications Brief history of optical communications. Key components and their functions.

Propagation of light in fibres. Principles of optical waveguiding. Detailed study of optical propagation in fibres. Fibre modes and their properties. Single mode, multimode fibres. Recently developed fibre types.

Signal attenuation. Optical losses: intrinsic loss mechanisms; extrinsic loss (bending, splicing, coupling). Dispersion: modal dispersion, waveguide dispersion, dispersion shifting.

Optical Systems Optical transmission formats: return-to-zero, non-return-to-zero encoding. Binary transmission: statistics, noise and errors. Propagation of optical pulses in dispersive media.

Optoelectronic components Detectors of optical signals: principle of operation; responsivity; bandwidth; noise. Photodiodes, materials and structures: heterostructures; p-i-n detectors; avalanche detectors; common types of photodiodes.

Laser: emission and amplification of light; optical gain; principle of laser; laser modes; rate equations. Laser diodes: photons in semiconductors; generic structure of laser diode; double heterostructure; performance characteristics of laser diodes; rate equations; common types of laser diodes.

Optical amplifiers amplified systems Design and principles of optical fibre amplifiers. Main characteristics: power, gain, noise. Noise accumulation in long-span systems. Implications for long distance (trans-oceanic) data transmission.

Nonlinear effects. Effective length of nonlinear interaction. Main effects: Self-phase modulation; Raman scattering; Brillouin scattering; four-wave mixing. Optical solitons.

Advanced optical systems. Wavelength multiplexing and time-division multiplexing of optical signals. Ultrahigh-capacity optical data transmission; review of terabit-per-second systems. Current performance limits.

Summary of Methods and Frequency of Teaching	**Laboratory** 9 hours. **Lectures** 20 hours. **Tutorials** 7 hours. 5 tutorials and 2 OPTSIM software demonstrations

Summary of Methods of Assessment

Assessment Type	*Status*	*%*	*Requirements*	*Due*
Formal Examination	Compulsory	50.0	Final Examination. 1.5hr formal examination	23 Mar 2010
Coursework	Compulsory	20.0	Report. The purpose of the coursework project is to give the students a practice in approaching a simplified task to design a typical fibre transmission link. Assessment is by a written report.	11 Mar 2010
Laboratory	Compulsory	30.0	Laboratory. Assessment of laboratory practice is by a written report. The mark takes into account the effort shown during the lab sessions.	11 Mar 2010

Module Outcomes - what the student should gain from successful completion of the module:	Learning and Teaching and Assessment Strategies to enable outcomes to be achieved and demonstrated	
	Learning and Teaching Methods	Assessment Methods
A. Knowledge and Understanding		
the principles and practice of modern optical communications and to be aware of current developments and future opportunities	Laboratory, Lectures, Tutorials	Coursework, Formal Examination, Laboratory
B. Intellectual Skills		
C. Professional Skills		
apply their knowledge of the principles underlying modern data networks	Laboratory, Tutorials	Coursework, Formal Examination, Laboratory
D. Transferable Skills		
communication skills		Coursework

Please provide either or both of:	
(i) Introductory Learning Resources	EE mathematical tutorials (available via UG student tutors)
(ii) Core Texts	**Course notes** (available from Aston webpages) **Required** (access to at least one of these is essential). 1. G.P.Agrawal, Fiber-Optic Communication Systems, 2-nd ed., Wiley-Interscience, 1997. Full text is now available online from Aston Library. 2. L.Kazovsky, S.Benedetto, A.Willner, Optical Fiber Communication Systems, Artech House, 1996. 3. A.Ghatak, K.Thyagarajan, Introduction to Fiber Optics, Cambridge, 1998. **Supplementary** (for advanced study). 1. G.P.Agrawal, Nonlinear Fiber Optics, 3rd ed. Academic Press, 2001. 2. A.E.Siegman, Lasers, University Science Books, 1986. 3. A.Yariv, Optical Electronics in Modern Communications, Oxford University Press, 1997 4. Iizuka, K. - Elements of photonics, Vol. I and Vol II., Wiley-Interscience, 2002. Full text is now available online from Aston Library.
Reading Lists	Attached

Specification completed by:	Dr. John A.R. Williams
Date	22-Apr-2009
Date module approved by Teaching Committee(s)	
Date module approved by School Board(s)	