ES4C4-15 Optical Communication Systems

23/24

Department
School of Engineering
Level
Undergraduate Level 4
Module leader
Tianhua Xu
Credit value
15
Module duration
10 weeks
Assessment
40% coursework, 60% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES4C4-15 Optical Communication Systems

Module web page

Module aims

This module is designed to present the key elements driving the growth in optical communication systems. The approach necessary includes not only an appreciation of device principles but also the broader picture of optoelectronic systems integration, essential to the future provision of high bandwidth for multimedia applications. Within the module the principles of optical fibre waveguiding and fibre transmission characteristics are presented. In addition, the operation of modern optical devices is described. Furthermore, the module also considers the detailed design, analysis and operation of optical fibre communication systems and networks. In particular, it presents detailed coverage of important optical fibre and free space networks for future communication applications, with both the facilitating technologies and the networks resulting from their integration being considered. The module aims to provide specialist knowledge of the strategies and techniques involved in the design and implementation of optical communication

systems.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Characteristics of optical fibre transmission: Basic waveguiding; ray propagation, numerical aperture, acceptance angle, skew rays, fibre types. Electromagnetic wave equation; multimode and single mode propagation, approximate solutions, normalised frequency, cut-off wavelength. Linear and non-linear propagation phenomena. Optical fibre coupling.

System components: optical sources; optical filters; optical detectors; doped fibre optical amplifiers; optical modulators; optical multiplexers; applications and system design including the major component types.

Optical transmission systems: System design considerations. Transmitter design; receiver design; noise and sensitivity performance; link design considerations.

Optical Networks: underlying principles; optical access networks; all optical networks; radio-over-fibre; optical wireless systems.

International industry standards including ITU G.700 series and ANSI SONET T1.105.

Learning outcomes

By the end of the module, students should be able to:

- Analyse and design modern optical fibre systems.
- Display advanced knowledge of modern optical components and their integration.
- Exhibit insight into emerging technologies in optical fibre and optical wireless systems.
- Be able to select the best optical sources for different applications based on quantitative performance determination.
- Quantify, and understand the significance of, physical impairments in optical communication systems.
- Comprehend the propagation of signals in optical fibres and utilise appropriate methods to obtain quantitative insight into this topic.
- Demonstrate advanced understanding of optical receiver signals, amplification, noise, distortion and bit errors.

Indicative reading list

G P Agrawal, Fiber-optic communication systems, 4th edition, Wiley, 2010, ISBN 9780470918517 [eBOOK]
J M Senior, Optical fiber communications: principles and practice, 3rd edition, Prentice-Hall, 2009, ISBN 9780130326812 [TK 5103.8.S3]
T E Stern, G Ellinas and K Bala, Multiwavelength Optical Networks: Architectures, Design, and Control, 2nd edition, Cambridge University Press, 2008, ISBN 9780511811708 [eBOOK].
R Ramaswami, K N Sivarajan and G H Sasaki, Optical Networks: A Practical Perspective, 3rd

edition, Morgan Kaufmann, 2009 ISBN 9780123740922 [TK 5103.8.R2]

Subject specific skills

Comprehension of the principles of advanced optical communications components and the fibre characteristics of importance in communication systems.
Ability and skills to design and analyse optical fibre transmission systems using various enabling technologies and modern techniques.
Appreciation of the state-of-the-art in currently deployed optical communication systems and of the future trends in the field.
Ability to make quantitative calculations of optical communication system performance, given knowledge detailed system properties and components.

Transferable skills

Proficiency in using numbers at appropriate levels of accuracy in the solution of complex problems and the interpretation of the answers.
Ability to deconstruct and analyse problems or complex situations to find solutions through analyses and exploration of all possibilities using appropriate methods, resources and creativity.
Production of professional engineering reports based on conducting laboratory work and the associated modelling, analysis and simulation.
Independent learning ability by enhancing existing skills and developing new ones whilst managing time and resources effectively

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Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (13%)
Seminars	1 session of 1 hour (1%)
Tutorials	2 sessions of 1 hour (1%)
Practical classes	3 sessions of 1 hour (2%)
Private study	124 hours (83%)
Total	150 hours

Private study description

Guided Independent Learning 124 hours

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group DD

	Weighting	Study time
Laboratory Exercise Report of up to 10 pages.	40%	
In-person Examination Unseen Examination Paper	60%	

- Answerbook Pink (12 page)
- Students may use a calculator
- Engineering Data Book 8th Edition
- Graph paper

Feedback on assessment

Verbal and written feedback plus mark breakdown for assignment and laboratory report. Model solutions are published for past examination papers.

Past exam papers for ES4C4

Availability

Courses

This module is Core for:

- Year 1 of TESA-H641 Postgraduate Taught Communications and Information Engineering

This module is Optional for:

- Year 4 of UESA-H116 MEng Engineering with Exchange Year
- Year 5 of UESA-H115 MEng Engineering with Intercalated Year
- RESA-H6P9 Postgraduate Research Wide Bandgap Power Electronics
    - Year 1 of H6P9 Wide Bandgap Power Electronics (EngD)
    - Year 2 of H6P9 Wide Bandgap Power Electronics (EngD)

- Year 1 of TCSA-G5PA Postgraduate Taught Data Analytics
- Year 1 of TESA-H642 Postgraduate Taught Energy and Power Engineering
- Year 5 of UESA-H607 Undergraduate Electrical and Electronic Engineering with Intercalated Year

This module is Option list A for:

- Year 4 of UESA-H63X MEng Electronic Engineering
- Year 5 of UESA-H636 MEng Electronic Engineering with Intercalated Year
- Year 5 of UESA-H63Y MEng Electronic Engineering with Intercalated Year
- Year 4 of UESA-H114 MEng Engineering
- Year 4 of UESA-H311 MEng Mechanical Engineering
- Year 1 of TESA-H643 Postgraduate Taught Electrical Power Engineering
- Year 1 of TESA-H644 Postgraduate Taught Electrical and Electronic Engineering
- Year 1 of TESA-H642 Postgraduate Taught Energy and Power Engineering
- Year 4 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng

This module is Option list B for:

- Year 5 of UESA-H636 MEng Electronic Engineering with Intercalated Year
- Year 4 of UCSA-G408 Undergraduate Computer Systems Engineering
- Year 5 of UCSA-G409 Undergraduate Computer Systems Engineering (with Intercalated Year)