Unit Title: Fundamentals of Transmission Channels

Reference Number	ECI-2-826		
Level	2		
Credits	1		
Study hours	150 hours: 48 hrs lectures/tutorials, 102 hrs independent study		
School	School of Engineering		
Devison	Telecommunications and Internet Engineering		
Co-ordinator	Dr Jian-Guo Zhang	(Rm T702)	tel: 020 7815 7576
Lecturers:	Dr. Vincent Siyau	(Rm T710)	tel: 020 7815 7507
	Dr Jian-Guo Zhang	(Rm T702)	

Aims

To establish the fundamentals of electromagnetic-wave propagation in transmission channels. To develop the basic theories of microwave technology, optical fibre and mobile radio links. To introduce the concepts and components which form transmission lines, optical fibre and mobile radio channels. To treat the subject from a system engineering point of view.

Learning Outcomes

At the end of the unit the student will be able to:

- Understand the fundamentals of transmission channels.
- Understand the reasons for particular design choices in practical situations.
- Carry out performance evaluation of typical transmission channels.

Unit Calendar

Study Area	Week No
Introduction to microwave & lightwave technology	1-3
Fundamentals of transmission lines	4-5
Introduction to mobile radio channel	6-9
Light propagation in optical fibres	10-12
Revision	13

Examination 14-15

Expansion of study areas:

Introduction to Microwave & Lightwave Technology (Weeks 1-3)

Microwave technology - Microwave signals with reference to electromagnetic (EM) spectrum. Fundamentals of microwave technology. Typical applications.

Learning outcome

Basic appreciation of microwave frequencies, typical microwave applications, terminology and parameters of EM waves, and EM wave radiation. Including a notion of velocity, frequency and wavelength.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

Lightwave technology - Features of optical fibre channel. System configurations. Typical applications.

Learning outcome

Develop a sound understanding of typical optical fibre transmission systems, their advantages and typical applications.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

Propagation of EM waves - Basic principle of EM wave generation. Concepts of EM wave propagation. Propagation paths.

Learning outcome

Broad understanding of basic theory relating to EM wave generation & propagation, three propagation paths, and analysis of optical range.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

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Fundamentals of Transmission Lines (Weeks 4-5)

Concepts of transmission lines - Line structures, attenuation or power losses, equivalent line circuit.

Learning outcome

Sound understanding of typical transmission lines, loss mechanism, equivalent circuit, line parameters, and characteristic impedance.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

Propagation in transmission lines - Concepts of propagation velocity, velocity factor, and standing waves.

Learning outcome

Broad understanding of propagation velocity, velocity factor, reflection coefficient, return loss, and their evaluation.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

Introduction to Mobile Radio Channels (Weeks 6-9)

Basic concepts - Introduction to mobile radio channel, basic concepts and typical types of radio channels.

Learning outcome

Sound understanding of free space propagation model, relating power to electric field and radio channel types.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

Large-scale path loss – basic theory of Large-scale path loss, three basic propagation mechanisms: reflection, diffraction and scattering. Modelling of outdoor and indoor propagations.

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Learning outcome

Develop a sound understanding of mobile wave propagation for large-scale path loss.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

Small-scale fading and multipath – small-scale multipath propagation, parameters of mobile multipath channels, types of small-scale fading, statistical models for multipath fading channels.

Learning outcome

Sound understanding of mobile wave propagation for small-scale fading and multipath using various empiric models.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

Light propagation in optical fibres (Weeks 10-12)

Dielectric waveguide propagation - Basic theory of light in planar and cylindrical waveguides.

Learning outcome

Sound understanding of modal propagation based on ray model.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

Fibre types and modes - An introduction to single-mode, multimode step index and graded index fibres. Exact fibre modes and the weakly guiding approximation.

Learning outcome

Sound understanding of propagation based on the solution of the wave equation. In particular the nature or the Eigenvalue equation

Tutorial examples

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Fibre attenuation and dispersion - Attenuation mechanisms, typical loss characteristics, power loss. Dispersive mechanisms in typical fibres used for communications. The effects of dispersion information transmission.

Learning outcome

Broad understanding of fibre fabrication, attenuation and dispersion. Evaluation of bit rate-distance product and fibre loss.

Tutorial examples

Tutorial examples sheet will be handed out at the end of formal teaching of this study area.

Teaching and Learning Methods

Teaching is based on a weekly program of a four hour lecture series (including tutorial each week). Lectures will cover all the main aspects of the subject matter in the unit. Printed material, which will include some lecture material and tutorial examples will be provided. The laboratory exercises are designed to supplement the lectures. In addition, you are required to carry out 102 hours of self study.

Assessment

There will be one 3-hour written examination (80%) at the end of the unit and coursework (20%. It will be given in the form of two separate "mini-tests" inside the classroom). You will be required to submit the mini-test papers by the submission dates, which will be notified during the semester allowing you to have sufficient time to do them, respectively. Late submission will be penalized in accordance with the University regulation.

Indicative Book List

Core reading:

1) G.P. Agrawal, 'Fiber-Optic Communication Systems', Third Edition, John Wiley & Sons, Inc., 2002.
2) Theodore S. Rappaport, 'Wireless Communications: Principles and Practice', 2/E, Prentice Hall PTR, 2002, ISBN: 0-13-042232-0.

Background Reading:

1) R. E. Collin, 'Foundation of Microwave Engineering', McGraw Hill, 2nd. Ed. '92, ISBN 0-07-112569-8

2) D.K. Mynbaev and L.L. Scheiner, 'Fiber-Optic Communications Technology', Prentice Hall, Inc., 2001.
3) J. M. Senior, 'Optical Fibre Communications', 2nd Edition, Prentice Hall Europe, 1992.
4) D.J.G. Mestdagh, 'Fundamentals of Multiaccess Optical Fiber Networks', Artech House, Inc., 1995.
5) R.A. Barry, 'Optical Networks and Their Applications', Optical Society of America, 1998.
6) A. J. B. Fuller, 'Microwaves an introduction to theory and techniques'.

You may also find useful Open University publications & Videos in the Library.

Study Hours

You may notice that this guide states that the unit requires 150 study hours, whereas previous guides have defined each unit as 120 study hours. The University has made this change in line with the way study time is likely to be expressed, in future, in the majority of Universities. There is no change in teaching time, and no change in what you are expected to do or achieve. The change concerns the way study time is measured. Previously, the unit was defined as 120 hours work over 12 teaching weeks. The new measure is still 10 hours per week over 15 weeks, including assessment.

The workload for a full time student is still expected to be approximately 40 hours per week.