



EE495: Transmission Lines, RF Propagation & Radio Link Design

Module Details

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| Title: | Transmission Lines, RF Propagation & Radio Link Design DRAFT |
| Long Title: | Transmission Lines, RF Propagation & Radio Link Design |
| Language of Instruction: | English |
| Module Code: | EE495 |
| Credits: | 7.5 |
| NFQ Level: | 8 |
| Field of Study: | Electronic Engineering |
| Valid From: | 2017/18 (Sep 2017) |
| Module Delivered In | no programmes |
| Administrator: | Noel Murphy |
| Module Coordinator: | Pascal Landais |
| Module Department: | 20 - ELECTRONIC ENGINEERING |
| Module Description: | The course objectives are: to evaluate antennas' performance such as dipoles, to design radio terminals and sight radio links; and to understand of lossless transmission lines. The module objectives also include a thorough development and analysis of the mathematical tools to understand and to solve the Telegraphy equations. It explains how the Smith chart is related to these equations and shows how this graphical tool can be used in various TL problems such calculation of line impedance, reflection coefficient or admittance and how it can exploited to design various impedance matching circuits. |

Learning Outcomes

On successful completion of this module the learner will be able to:

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| LO1 | Design and evaluate the performance of receiver, transmitter in radio terminals. |
| LO2 | Assess the performance of a line-of-sight RF links. |
| LO3 | Analyse electromagnetic radiation of an oscillating elemental dipole. |
| LO4 | Mathematically solve second order differential equation and represent a current, voltage wave. |
| LO5 | Manipulate scalar quantities that arise in solving the telegraphy equations. |
| LO6 | Analyse the transmission of the quantities arising in solving the telegraphy equations. |
| LO7 | Solve various transmission line related problems with or without Smith chart. |

Pre-requisite learning

Module Recommendations

This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.

No recommendations listed

Co-requisite Modules

No Co-requisite modules listed

Pre-Requisite

This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.

EE323



Module Content & Assessment

Indicative Content and Learning Activities

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|---|
| <p>Mathematical background An overview of the wave equation, and a presentation and resolution of the telegraphy equation in a case of loss-less transmission line.</p> |
| <p>Transmission lines Derivation of mathematical expression of voltage, current and impedance along a TL. Derivation of loss-less TL properties. Presentation and concept of Smith chart. Use of Smith chart for various TL problems, calculation of impedance, admittance at various locations along the TL. Design of impedance matching circuit: quarter wave transformer, single and double stub networks.</p> |
| <p>Antenna theory Gain and radiation patterns of aperture antennas and wire antennas, isotropic radiation, design and analysis of waveguide horn, parabolic reflectors and dipoles.</p> |
| <p>Line of Sight Radio Links Initial planning and site selection; path analysis; receiver thermal noise, IF frequency; C/N ratio.</p> |
| <p>Radio Terminal Design Basic terminal, noise figure, noise bandwidth, element of super-heterodyne receivers and up-conversion transmitters.</p> |

| Assessment Breakdown | % |
|-----------------------------|----------|
| Continuous Assessment | 20.00% |
| End of Academic Session | 80.00% |

Continuous Assessment

| <i>Assessment Type</i> | <i>Assessment Description</i> | <i>Outcome Addressed</i> | <i>% of total</i> | <i>Assessment Date</i> |
|------------------------|-------------------------------|--------------------------|-------------------|------------------------|
| Laboratory Portfolio | Class test | 1,2,3,4,5,6,7 | 25.00 | n/a |

End of Module Formal Examination

| <i>Assessment Type</i> | <i>Assessment Description</i> | <i>Outcome Addressed</i> | <i>% of total</i> | <i>Assessment Date</i> |
|------------------------|-----------------------------------|--------------------------|-------------------|------------------------|
| Formal Examination | End-of-Semester Final Examination | 1,2,3,4,5,6,7 | 75.00 | End-of-Semester |

DCU reserves the right to alter the nature and timings of assessment



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Design**

Module Workload

| Full Time hours per semester | | |
|-------------------------------------|-----------------------------|--------------|
| <i>WorkLoad Type</i> | <i>WorkLoad Description</i> | <i>Hours</i> |
| Lecture | No Description | 36 |
| Independent Study | No Description | 151 |
| Total Hours | | 187.00 |

This module has no Part Time workload.

Module Resources

Essential Book Resources

Doble, J., *Mobile Radio Communications*, Steele, S., Pentech Press, 1992. *Introduction to Radio Propagation for Fixed and Mobile Communications*, Artech House Ed.

Kraus J D, *Electromagnetics*, McGrawHill Ed. Ed.

David M. Pozar 2004, *Microwave engineering*, Wiley Ed. Ed.

Nannapaneni N. Rao 2004, *Elements of Engineering Electromagnetics*, Prentice Hall ed. Ed.

Duffin W J, *Electricity and Magnetism*, McGraw-Hill Ed. Ed.

Marshall & Skitek, *Electromagnetic concepts and applications*, Prentice-Hall Ed. Ed.

Dearholt, DW & McSpadden,W.R., *Electromagnetic Wave Propagation*, McGraw-Hill Ed. Ed.

Supplementary / Recommended Book Resources

Freeman, R.L., *Radio System Design for Telecommunications*, Wiley Ed.

Rappaport, T.S, *Wireless Communications*, Prentice Hall Ed.

This module does not have any article/paper resources

This module does not have any other resources

Module Managers & Teachers

| Module Managers | | |
|------------------------|---------------------|---------------------|
| <i>Semester</i> | <i>Staff Member</i> | <i>Staff Number</i> |
| Semester 1 | Pascal Landais | 75066874 |
| Semester 2 | Pascal Landais | 75066874 |
| Autumn | Pascal Landais | 75066874 |

| Module Teachers | |
|------------------------|-----------------------|
| <i>Staff Member</i> | <i>Staff Email</i> |
| Pascal Landais | pascal.landais@dcu.ie |