

## Basic details

|                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                                              |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------------------------------------------------|
| UID                                                 | <input type="text"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Cohorts covered | Earliest cohort<br><input type="text" value="Y3 2026/2027"/> |
| Long title                                          | <input type="text" value="Digital Communications and Information Processing"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |                                                              |
| New code                                            | <input type="text" value="ELEC60034"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | New short title | <input type="text"/>                                         |
| Brief description of module<br>(approx. 600 chars.) | <input type="text" value="This module provides a foundation in digital communication systems with applications to modern wireless systems. Topics include digital source coding and compression, modulation and demodulation techniques, channel coding, wireless channel, channel equalization, multicarrier communication. Students will analyse and simulate digital modulation with optimal receivers, convolutional coding with Viterbi decoding, linear equalization, decision-feedback equalization, Viterbi equalization, and OFDM, and will be prepared for advanced communication modules in year 4 and MSc."/> |                 |                                                              |
| Available as a standalone module/ short course?     | <input type="text" value="No"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                                              |

## Statutory details

|              |                                |                                 |                                |             |
|--------------|--------------------------------|---------------------------------|--------------------------------|-------------|
|              | ECTS                           | CATS                            | Non-credit                     | HECOS codes |
| Credit value | <input type="text" value="5"/> | <input type="text" value="10"/> | <input type="text" value="N"/> |             |
| FHEQ level   | <input type="text" value="6"/> |                                 |                                |             |

## Allocation of study hours

|                   |                                    |                                                                            |
|-------------------|------------------------------------|----------------------------------------------------------------------------|
|                   | Hours                              |                                                                            |
| Lectures          | <input type="text" value="20"/>    |                                                                            |
| Group teaching    | <input type="text" value="10"/>    | <i>Incl. seminars, tutorials, problem classes.</i>                         |
| Lab/ practical    | <input type="text" value="0"/>     |                                                                            |
| Other scheduled   | <input type="text" value="0"/>     | <i>Incl. project supervision, fieldwork, external visits.</i>              |
| Independent study | <input type="text" value="95"/>    | <i>Incl. wider reading/ practice, follow-up work, completion of assess</i> |
| Placement         | <input type="text" value="0"/>     | <i>Incl. work-based learning and study that occurs overseas.</i>           |
| Total hours       | <input type="text" value="125"/>   |                                                                            |
| ECTS ratio        | <input type="text" value="25.00"/> |                                                                            |

## Project/placement activity

|                                |                                 |
|--------------------------------|---------------------------------|
| Is placement activity allowed? | <input type="text" value="No"/> |
|--------------------------------|---------------------------------|

## Module delivery

|               |                                             |       |                      |
|---------------|---------------------------------------------|-------|----------------------|
| Delivery mode | <input type="text" value="Taught/ Campus"/> | Other | <input type="text"/> |
| Delivery term | <input type="text" value="2"/>              | Other | <input type="text"/> |

## Ownership

|                     |                                                                                  |
|---------------------|----------------------------------------------------------------------------------|
| Primary department  | <input type="text" value="Department of Electrical and Electronic Engineering"/> |
| Additional teaching | <input type="text" value="0"/>                                                   |

departments

|  |
|--|
|  |
|  |

Delivery campus

South Kensington

## Collaborative delivery

Collaborative delivery?

N

External institution

N/A

External department

N/A

External campus

N/A

## Associated staff

| Role          | CID | Given name | Surname |
|---------------|-----|------------|---------|
| Module Leader |     | Geoffrey   | Li      |
| Lecturer      |     | Bruno      | Clerckx |
|               |     |            |         |
|               |     |            |         |
|               |     |            |         |
|               |     |            |         |
|               |     |            |         |
|               |     |            |         |
|               |     |            |         |

## Learning and teaching

### Module description

Learning outcomes

Upon successful completion of this module, you will be able to:

1. Explain the compression of digital information sources
2. Explain key principles of digital modulation and demodulation techniques, including PSK, QAM schemes.
3. Apply signal space concepts, sufficient statistics, and detection principles (ML, MAP) for optimal receiver design and implementation through Viterbi equalization.
5. Implement and assess convolutional coding schemes with Viterbi decoding under decision conditions.
6. Design equalization strategies, including ZF, and MMSE.
7. Simulate communication systems and wireless channels, with emphasis on Viterbi algorithm (for ML detection and decoding convolutional codes) and OFDM transceivers.

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Module content                 | <p><b>Overview of Communication Systems, Channel Models and Information Sources:</b><br/> Overview of digital communication systems; Baseband and passband signals; Channel models and channel capacity; Source coding (Lempel–Ziv (LZ) coding schemes and universal compression algorithms)</p> <p><b>Channel Coding:</b><br/> Block coding and convolutional coding; maximum likelihood (ML) decoding and minimum-distance decoding; finite machine and Viterbi algorithm for decoding convolutional codes;</p> <p><b>Orthogonal Frequency Division Multiplexing (OFDM):</b><br/> OFDM principle; Cyclic prefix, DFT-based modulation and demodulation; System design and optimization (water-filling).</p> <p><b>Traditional Optimal Transceiver Theory:</b><br/> Modulation degrees of freedom (Nyquist Sampling Theorem); Linear modulation (spectral occupancy, PSK/QAM, Nyquist criterion for ISI avoidance, raised cosine pulse); Maximum likelihood (ML) and maximum a posteriori (MAP) probability principles, detecting known signal in Gaussian noise, Karhunen-Loeve expansion and sufficient statistics; matched filter; ML receiver and Viterbi equalization.</p> <p><b>Channel Equalization:</b><br/> Zero-forcing and MMSE criteria; linear equalization; decision feedback equalisation</p> |
| Learning and Teaching Approach | The module is delivered through lectures and problem solving classes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Assessment Strategy            | This module is assessed by coursework(50%) (simulating OFDM transceiver including wireless channel and channel coding), oral(20%) and individual test (30%).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Feedback                       | Students will be provided with written feedback on their courseworks. In addition, they will complete an oral examination related to their coursework, during which they will be asked to discuss aspects of their submission. Performance in the oral examination will be assessed and awarded a mark.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Reading list                   | 1) Barry, Lee, and Messerschmit, "Digital Communications," Kluwer 2004.<br>2) Haykin and Moher: Communication Systems, J. Wiley & Sons, 2010<br>3) Proakis, Salehi, "Digital Communications", 2008.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## Quality assurance

|                        |           |
|------------------------|-----------|
| Date of first approval | June 2025 |
| Date of last revision  | June 2026 |
| Date of this approval  | June 2026 |

## Office use only

|                    |  |
|--------------------|--|
| QA Lead            |  |
| Department staff   |  |
| Date of collection |  |

Module leader Prof. Geoffrey Li

|               |  |
|---------------|--|
| Date exported |  |
| Date imported |  |

Notes/ comments

## Assessment details

|                |                    |
|----------------|--------------------|
| Grading method | Numerical and oral |
|----------------|--------------------|

Pass mark

40%

## Assessments

[illegible]

100%