

## Modulation and Detection (E012130)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course size (nominal values; actual values may depend on programme)  
Credits 6.0 Study time 180 h Contact hrs 60.0 h

### Course offerings and teaching methods in academic year 2020-2021

Offering	Language	Location	Teaching Methods	Hours
A (semester 1)	Dutch	Gent	seminar: coached exercises guided self-study	20.0 h 30.0 h
B (semester 1)	English		seminar: coached exercises	20.0 h

### Lecturers in academic year 2020-2021

Moeneclaey, Marc	TW07	lecturer-in-charge
Jacobs, Lennert	TW07	co-lecturer

### Offered in the following programmes in 2020-2021

Programme	crdts	offering
<a href="#">Bridging Programme Master of Science in Electrical Engineering (main subject Communication and Information Technology )</a>	6	B
<a href="#">Bridging Programme Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems )</a>	6	B
<a href="#">Master of Science in Electrical Engineering (main subject Communication and Information Technology )</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Control Engineering and Automation)</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Electrical Power Engineering)</a>	6	B
<a href="#">Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Maritime Engineering)</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Mechanical Construction)</a>	6	B
<a href="#">Master of Science in Electromechanical Engineering (main subject Mechanical Energy Engineering)</a>	6	B
<a href="#">Master of Science in Computer Science Engineering</a>	6	A
<a href="#">Master of Science in Computer Science Engineering</a>	6	B
<a href="#">Master of Science in Electrical Engineering</a>	6	A
<a href="#">European Master of Science in Photonics</a>	6	B

### Teaching languages

Dutch, English

### Keywords

modulation, detection, channel estimation, equalization

### Position of the course

The course aims at providing insight in the operation and the performance of optimum and suboptimum receivers for digital communication over various types of channels. Topics are : detection, channel estimation, equalization, multi-user communication, modulation for dispersive channels.

### Contents

- Decision and estimation theory: Likelihood function, decision and estimation according to ML and MAP criteria

- Channel models: Static channels, fading channels, coherence time, coherence bandwidth
- Detection of digital information: Time, frequency and spatial diversity; equalization (linear, decision-feedback, Viterbi)
- Multiuser communication: FDM(A), TDM(A), FDD, TDD Modulations suited for dispersive channels: Spread-spectrum and CDM(A), multiuser interference; OFDM, cyclic prefix
- Estimation of channel parameters

#### Initial competences

Communication Theory: partim Communication Techniques (or equivalent)

#### Final competences

- 1 To have insight in the operation of algorithms for detection, equalization and channel estimation.
- 2 To apply techniques for multiuser communication.
- 3 To apply modulation techniques for transmission over dispersive channels and to determine their performance.
- 4 To estimate the effect of channel properties (fading, dispersion) on the reliability of the communication link.

#### Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

#### Conditions for exam contract

This course unit cannot be taken via an exam contract

#### Teaching methods

Guided self-study, group work, lecture, seminar: coached exercises, online group work, online lecture, online seminar: coached exercises

#### Extra information on the teaching methods

Part of the course is taught during classical lectures. During the workshops, exercises are solved by the students under the supervision of a teacher. The students independently acquire knowledge for another part of the course; the students independently carry out a group assignment related to this part, with interim supervision being provided on request. Because of COVID19 modified work formats (online or on campus) can be rolled out if necessary.

#### Learning materials and price

lecture notes (about 10 EUR)

#### References

- J.G. Proakis, Digital Communications. McGraw-Hill
- H. Meyr, M. Moeneclaey, S.A. Fechtel, Digital Communication Receivers - Synchronization, channel estimation, and signal processing. J. Wiley

#### Course content-related study coaching

The lecturer and assistants are available during contact hours, on appointment and via e-mail.

#### Evaluation methods

end-of-term evaluation and continuous assessment

#### Examination methods in case of periodic evaluation during the first examination period

Written examination, open book examination

#### Examination methods in case of periodic evaluation during the second examination period

Written examination, open book examination

#### Examination methods in case of permanent evaluation

Assignment

#### Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible in modified form

#### Extra information on the examination methods

During examination period: written open-book exam. During semester: graded team work. Frequency: 1 report at end of semester.

#### Calculation of the examination mark

First examination period: non periodical (graded team work) 30%; periodical (exam)

70%. If both scores are not at least 8/20, the student cannot pass for the course. The end score is then at most 7/20.

Second examination period: written exam counts for 70%, score from team work in first examination period counts for 30%. If the score from the team work in the first examination period is less than 8/20, the student will have to pass an additional (individual) oral examination on the team work. If the score of the written examination and, if applicable, of the additional oral examination is not at least 8/20, the student cannot pass for the course. The end score is then at most 7/20.