GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2023-2024

Electromagnetic-aware High Frequency Design (E033021)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2023-2024

Lecturers in academic year 2023-2024

Rogier, Hendrik	TW05	lecturer-in-charge
Vande Ginste, Dries	TW05	co-lecturer

Offered in the following programmes in 2023-2024	**crdts**	**offering**
Bridging Programme Master of Science in Electrical Engineering (main subject Communication and Information Technology)	6	A
Bridging Programme Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)	6	A
Master of Science in Electrical Engineering (main subject Communication and Information Technology)	6	A
Master of Science in Electromechanical Engineering (main subject Control Engineering and Automation)	6	A
Master of Science in Electromechanical Engineering (main subject Electrical Power Engineering)	6	A
Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)	6	A
Master of Science in Electromechanical Engineering (main subject Maritime Engineering)	6	A
Master of Science in Electromechanical Engineering (main subject Mechanical Construction)	6	A
Master of Science in Electromechanical Engineering (main subject Mechanical Energy Engineering)	6	A
Master of Science in Electrical Engineering	6	B
Master of Science in Photonics Engineering	6	A

Teaching languages

Dutch, English

Keywords

multi-port, microwave circuits, circuit models, EMC, signal and power integrity, interference, norms

Position of the course

- Insight in circuit and EMC concepts
- Application of the concepts to interconnections and IC-packages
- Familiarise students with EMC norms

Contents

- Black box models for multi-port circuits: Concept of port and port impedance and S-parameters, Passivity and lossless properties of multi-port circuits, Multi-port applications and measurements
- Extraction of circuit models of multi-port circuits: Circuit models for multi-port circuits, Parameter extraction for transfer function models, Parameter extraction for physical models
- Analysis and design of passive microwave components: circulator, isolator, directional coupler, filters, matching networks
- Circuit properties of interconnections and IC-packages: Models for reflection, transmission

and attenuation, Crosstalk and differential versus even mode, Measurements on interconnections and IC-packages
- Non-linear termination of interconnections: Circuit models for non-linear terminations, Circuit simulation techniques
- Concepts for EMC in circuits: Emission, immission and interference, Routes for an EMC problem
- Intra-system interference: Concepts of ground, earth, and reference, Static and dynamic noise margin, Modelling of the power supply circuit, Switching noise
- Inter-system interference: Radiative sources, Shielding (cables, connectors, houding), Conductive sources, Filtering for conductive interference
- EMC norms and certification: Emission and immission norms, certification process

Initial competences

Having succesfully completed the courses on "Applied Electromagnetics" or "Electromagnetism II" or having acquired the final competences provided by these courses in any other way.

Final competences

1 Analyse and design microwave circuits based on impedance, admittance and scattering matrices.
2 Synthesize filters and matching networks.
3 Have insight in the role of electromagnetic phenomena on EM aware design, including radiated/conducted emission/immunity.
4 Be familiar with EMC norms.

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

Excursion, lecture, seminar, independent work, practical

Extra information on the teaching methods

Classroom lectures: Mix of on-campus and online teaching; Flipped classroom with interactive contact sessions; Scored exercises as homework; Classroom problem solving sessions; Lab sessions
In particular the part EMC/SI/PI consists of lectures about theory and exercises, without making a strict, traditional distinction between them. All lectures are seminars which require interaction with and input from the students. If circumstances permit (e.g., COVID-dependent cirumstances), a mandatory company visit takes place. There are also mandatory lab sessions.

Learning materials and price

syllabus (10EUR in print, free electronic version on UFora) + handouts with notes (free electronic version on UFora)

References

David M. Pozar, Microwave Engineering, third edition, John Wiley & Sons, 2004
Jasper Goedbloed, Electromagnetic Compatibility, Prentice Hall 1992, ISBN 0-13-249293-8, 381 pp
Prentice Hall, 2nd edition: 2010
Introduction to Electromagnetic Compatibility
C. R. Paul
ISBN: 978-0-471-75500-5
John Wiley & Sons, Inc., 2nd edition: 2006
Signal and Power Integrity -- Simplified
E. Bogatin
ISBN: 978-0-13-234979-6

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment open-book, written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment open-book, written assessment

Examination methods in case of permanent assessment

Assignment, skills test

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

During examination period:
Part EMC/SI/PI:
Written closed-book assessment
- Theory + theoretical excercises
- Questions about EMC norms in the context of the Certification Lab visit

Part Design of Passive Microwave Circuits:
A) Written closed-book assessment
- Theory

B) Written open-book assessment
- Exercises

During semester: Graded lab sessions, Graded exercises as homework.
Second chance: Possible in adapted form

Calculation of the examination mark

Evaluation throughout semester as well as during examination period. Special conditions: 1/2 Exam Design of Passive Microwave Circuits (1/6 theory exam + 1/6 exercise exam + 1/6 scored exercises as homework) + 3/8 Exam EMC/SI/PI + 1/8 Lab reports+Certification Lab visit.
Students who eschew one or more parts of the assessment (part Design of Passive Microwave Circuits, part EMC/SI/PI, part continuous assessment) cannot obtain a pass mark for the course unit. Should the final mark be higher than 7/20, it will be reduced to the highest non-passable mark (i.e. 7/20). When the student obtains less than 8/20 for at least one of the components (part Design of Passive Microwave Circuits, part EMC/SI/PI, part continuous assessment), they can no longer pass the course unit as a whole. If the total score does turn out to be a mark of ten or more out of twenty, this is reduced to the highest fail mark (9/20).