# Electromagnetic compatibility - course description

## General information

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| Course name | Electromagnetic compatibility |
| Course ID | 06.2-WE-AutP-ElecComp-Er |
| Faculty | Faculty of Computer Science, Electrical Engineering and Automatics |
| Field of study | Automatic Control and Robotics |
| Education profile | academic |
| Level of studies | Erasmus programme |
| Beginning semester | winter term 2017/2018 |

## Course information

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| Semester | 6 |
| ECTS credits to win | 4 |
| Course type | obligatory |
| Teaching language | english |
| Author of syllabus | • dr hab. inż. Adam Kempski, prof. UZ |

## Classes forms

| The class form | Hours per semester (full-time) | Hours per week (full-time) | Hours per semester (part-time) | Hours per week (part-time) | Form of assignment |
|---|---|---|---|---|---|
| Lecture | 30 | 2 | - | - | Exam |
| Laboratory | 30 | 2 | - | - | Credit with grade |

## Aim of the course

- to acquaint students with issues of electromagnetic compatibility (EMC) of electrical systems, electronic and automation

- to familiarize students with the rules of operation of EMC technical law and procedures for obtaining the CE mark

- to make up basic skills in EMC measurement

## Prerequisites

Disturbances in electrical power systems, Selected issues of power electronics

## Scope

Introduction to electromagnetic compatibility (EMC). Basic terms. EMC terminology. Immunity and emissions of electric equipment. Interference sources – intentional and non-intentional.

Electromagnetic fields and coupling mechanisms. Near and far field terms. Conducted and radiated interferences. Basic mechanisms of electromagnetic interferences couplings and propagations: galvanic, by means of near and far fields. Propagation of EMI in transmission lines. Basics of EMI signal analysis.

EMC measurement and investigations. Methods of electromagnetic emission measurement. Immunity measurements. Measurements at the development stage.

Electromagnetic compatibility in the electronic equipment. Characteristics of real elements in the interference frequency range. Electromagnetic compatibility of PCB. Signal integrity. EMC of control and transmission systems. EMC of telecommunication systems. EMC and functional safety of electronic equipment.

EMC strategy. EMC analyses and simulations. Techniques of EMI effects reduction – earthing and bonding, shielding, topology and structure of circuits, EMI filters. development of devices according to EMC requirements. Internal and external EMC. EMC for systems and installations.

EMC standardization. International Standardization Organization. Directives of New Approach and Global Approach. EMC Directive. EMC standards. EMC standards classification – generic, basic and product standards. Standards for electromagnetic environments. Safety related EMC standards. Present stage of EMC standardization. Routes to declaring compliance and CE marking and legal responsibility of manufacturer.

Electric power quality. Definitions of power quality. Voltage characteristics of electricity supplied by public distribution systems. Voltage sags or dips, short interruptions, asymmetry and distortions. Methods of improvement of electric power quality. Influence of loads on electric power quality. Measurements of characteristics of electric power quality.

## Teaching methods

Lecture: conventional lecture
Laboratory: laboratory exercises, group work
Project: project method, discussions and presentations

## Learning outcomes and methods of theirs verification

| Outcome description | Outcome symbols | Methods of verification | The class form |
|---|---|---|---|
| Can identify and analyze situations of lack of electromagnetic compatibility in electrical and electronic systems. | | • an evaluation test<br>• an exam - oral, descriptive, test and other<br>• an ongoing monitoring during classes | • Lecture |
| Knows and understands the basic mechanisms of coupling and spreading of electromagnetic disturbances, and the concept of emission and immunity of devices. | | • an evaluation test<br>• an exam - oral, descriptive, test and other<br>• an ongoing monitoring during classes | • Lecture |
| Can use the measurement techniques used to measure electromagnetic emissions and to immunity of devices to disturbances. | | • a test<br>• an ongoing monitoring during classes | • Lecture<br>• Laboratory |
| Knows and understands the rules of the technical law in the field of EMC (electromagnetic compatibility) | | • an evaluation test<br>• an exam - oral, descriptive, test and other | • Lecture<br>• Laboratory |
| Knows and is able to apply measures to reduce the effects of electromagnetic interference. | | • an exam - oral, descriptive, test and other<br>• an ongoing monitoring during classes | • Lecture |

## Assignment conditions

Lecture – obtaining a positive grade in written or oral exam.
Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.
Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester

Calculation of the final grade: lecture 35% + laboratory 35% + project 30%

## Recommended reading

1. Weston D.A.: Electromagnetic Compatibility. Principles and Applications. Marcel Dekker Inc., 1991.
2. Williams T., Armstrong K.: EMC for systems and Installations, Newnes, 2000.
3. Tichanyi L.: Electromagnetic Compatibility in Power Electronic. J.K.Eckert & Company, 1995.
4. Magnusson P.C. et al.: Transmission lines and wave propagation, CRC Press, 2001.

## Further reading

1. Charoy A.: Zakłócenia w urządzeniach elektronicznych, WNT W-wa, 1999 (in Polish).
2. Więckowski T.W.: Badania kompatybilności elektromagnetycznej urządzeń elektrycznych i elektronicznych, Wydawnictwa Politechniki Wrocławskiej, Wrocław, 2001.(in Polish)
3. Machczyński W.: Wprowadzenie do kompatybilności elektromagnetycznej, Wydawnictwo Politechniki Poznańskiej, Poznań, 2004.(in Polish)
4. Kempski A. Elektromagnetyczne zaburzenia przewodzone w układach napędów przekształtnikowych, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, Zielona Góra, 2005 (in Polish).

## Notes

Modified by dr hab. inż. Adam Kempski, prof. UZ (last modification: 24-04-2019 14:31)