# course syllabus and course requirements academic year 2022/2023 semester 1

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| Course title | Electromagnetic Compatibility |
| **Course Code** | **IVB458ANVM** |
| **Hours/Week: le/pr/lab** | **2-0-0** |
| **Credits** | **3** |
| **Degree Programme** | **Basic Program of Electrical Engineering (BSc/K)** |
| **Study Mode** | **Full time training** |
| **Requirements** | **Mid-term** |
| **Teaching Period** | **5 (Autumn)** |
| **Prerequisites** | - |
| **Department(s)**  **Course Director** | **Department of Electric Networks**  **György Elmer PhD** |
| **Teaching Staff** | **György Elmer PhD** |
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# course description

*A short description of the course (max. 10 sentences).*

*Neptun: Instruction/Subjects/Subject Details/Basic data/Subject description*

Students learn the goal, terminology and topics of the electromagnetic compatibility (EMC), the electromagnetic environment, arts of coupling of electromagnetic disturbances and arts of interferences, the Electrostatic discharge/damage (ESD), electromagnetic pulse (EMP), fundamentals of over-voltage protection, low frequency interference (LFI), harmonics, voltage disturbances, network reactions, filters, shielding, radio frequency interferences (RFI), conductive and wireless signal transmission, EMC calculations, measurements, measuring devices, modeling, simulation, the EMC directive, regulation and standards.

# syllabus

*Neptun: Instruction/Subjects/Subject Details/Syllabus*

## **goals and objectives**

*Goals, student learning outcome.*

*Neptun: Instruction/Subjects/Subject Details/Syllabus/Goal of Instruction*

Main aim of this course is to make the students familiar with the topics of the EMC, arts of coupling of electromagnetic disturbances and arts of interferences, the ESD, EMP, fundamentals of over-voltage protection, the LFI, harmonics, voltage disturbances, network reactions, filters, shielding, the RFI, conductive and wireless signal transmission, EMC calculations, measurements, measuring devices, modeling, simulation, the EMC directive, regulation and standards.

## **course content**

*Neptun: Instruction/Subjects/Subject Details/Syllabus/Subject content*

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|  | TOPICS |
| LECTURE | 1. Overview of the goal, terminology and topics of the electromagnetic compatibility, the electromagnetic environment, arts of coupling of electromagnetic disturbances and arts of interferences*.* 2. Causes of the electrostatic charge and discharge/damage. Measurement of ESD sensitivity. ESD models, tests and preventive measures, ESD protective areas, antistatic materials, ionizers. 3. Characteristics of electromagnetic pulses, working principle of the most important overvoltage protective devices – spark gap, varistor, Zener diode – principle of the overvoltage protection zones. 4. Low voltage interferences, harmonics, voltage disturbances, network reactions, their harmful effects, preventive measures, filters, disturbances of current converters. Earthing systems. 5. Radio frequency interferences, shielding, conductive and wireless signal transmission, optical cables, signal integrity. 6. EMC calculations, measurements, measuring devices, modeling, simulation, the EMC directive, regulation and standards. |
| PRACTICE | - |
| laboratory practice | - |

### **DETAILED SYLLABUS AND COURSE SCHEDULE**

### *academic holidays included*

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| LECTURE | | | | |
| week | **Topic** | **Compulsory reading; page number**  **(from … to …)** | **Required tasks (assignments, tests, etc.)** | **Completion date, due date** |
| 1. | Definition, main terminology and topics of the electromagnetic compatibility. Disturbance sources and sinks. EMC levels, electromagnetic environment. | EMCa\_01\_Termino | Test 1 | Week 8/15 |
| 2. | Coupling arts of disturbances. Common and differential mode disturbances. | EMCa\_014\_Coupling | Test 1 | Week 8/15 |
| 3. | Physical causes of the electrostatic charge and discharge/damage. Discharges in gases. Harmful effects of ESD. ESD sensitivity. ESD models, tests. Calculation problem. | EMCa\_021\_ESD\_Causes | Test 1 | Week 8/15 |
| 4. | Measurement and calculation of electrostatic charging. Protection against ESD, electrostatically dissipative materials, equipment. ESD protected areas, ionizers. | EMCa\_022\_ESD\_SensiMeas;  EMCa\_025\_ESD\_Prot | Test 1 | Week 8/15 |
| 5. | Characteristics of electromagnetic pulses, working principle of the most important overvoltage protective devices – spark gap, varistor, Zener diode – principle of the overvoltage protection zones. Calculation problem. | EMCa\_031\_EMP\_Overvolt;  EMCa\_031\_SEMP | Test 1 | Week 8/15 |
| 6. | Low voltage conducted disturbances (LFI). Conducted disturbances on electricity networks, harmonics, their sources and effects. Disturbances of current converters. | EMCa\_041\_LFI | Test 1 | Week 8/15 |
| 7. | Interferences, harmonics, voltage disturbances, network reactions, their harmful effects, preventive measures, filters. | EMCa\_042\_HARM | Test 1 | Week 8/15 |
| 8. | Test 1 | EMCa\_01-042 |  | Week 8 |
| 9. | EMC issues of power networks, power lines, transformers and switching devices. |  | Test 2 | Week 14/15 |
| 10. | Earthing systems and their EMC considerations. Filter circuits, preventive measure against conducted disturbances. EMC protections of frequency converters. | EMCa\_043\_Earth | Test 2 | Week 14/15 |
| 11. | Radio frequency interferences, shielding, conductive and wireless signal transmission, optical cables, signal integrity. | EMCa\_05\_RFI | Test 2 | Week 14/15 |
| 12. | EMC calculations, measurements, measuring devices, modeling, simulation. | EMCa\_052\_Meas | Test 2 | Week 14/15 |
| 13. | EMC directive, regulation and standards. | EMCa\_053\_Dir | Test 2 | Week 14/15 |
| 14. | Test 2 | EMCa\_042-08 | Test 2 | Week 14 |
| 15. | Summary and semester closure. | EMCa\_01-08 | Test Retake | Week 15 |

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| PRACTICE, LABORATORY PRACTICE | | | | |
| week | **Topic** | **Compulsory reading; page number**  **(from … to …)** | **Required tasks (assignments, tests, etc.)** | **Completion date, due date** |
| 1. |  |  |  |  |
| 2. |  |  |  |  |
| 3. |  |  |  |  |
| 4. |  |  |  |  |
| 5. |  |  |  |  |
| 6. |  |  |  |  |
| 7. |  |  |  |  |
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| 9. |  |  |  |  |
| 10. |  |  |  |  |
| 11. |  |  |  |  |
| 12. |  |  |  |  |
| 13. |  |  |  |  |
| 14. |  |  |  |  |
| 15. |  |  |  |  |

## **assessment and evaluation**

*(Neptun: Instruction/Subjects/Subject Details/Syllabus/Examination and Evaluation System)*

##### **Attendance**

*In accordance with the Code of Studies and Examinations of the University of Pécs, Article 45 (2) and Annex 9. (Article 3) a student may be refused a grade or qualification in the given full-time course if the number of class absences exceeds 30% of the contact hours stipulated in the course description.*

***Method for monitoring attendance*** *(e.g.: attendance sheet / online test/ register, etc.)*

Attendance sheet.

##### **assessment**

*Cells of the appropriate type of requirement is to be filled out (course-units resulting in mid-term grade or examination). Cells of the other type can be deleted.*

Course resulting in mid-term grade (PTE TVSz 40§(3))

**Mid-term assessments, performance evaluation and their ratio in the final grade** (The samples in the table to be deleted.)

|  |  |  |
| --- | --- | --- |
| **Type** | **Assessment** | **Ratio in the final grade** |
| *e.g..: Test 1* | *max 100 points* | *eg. 50 %* |
| *e.g.: Test 2* | *max 100 points* | *eg. 50 %* |
| *e.g.: home assignment (project documentation)* | *…* | *…* |
| *…* | *…* | *…* |

**Opportunity and procedure for re-takes** (PTE TVSz 47§(4))

*The specific regulations for improving grades and resitting tests must be read and applied according to the general Code of Studies and Examinations. E.g.: all tests and assessment tasks can be repeated/improved at least once every semester, and the tests and home assignments can be repeated/improved at least once in the first two weeks of the examination period.*

15th week for the tests.

**Grade calculation as a percentage**

based on the aggregate performance according to the following table

|  |  |
| --- | --- |
| **Course grade** | **Performance in %** |
| excellent (5) | 85 % … |
| good (4) | 70 % ... 85 % |
| satisfactory (3) | 55 % ... 70 % |
| pass (2) | 40 % ... 55 % |
| fail (1) | below 40 % |

The lower limit given at each grade belongs to that grade.

## **Specified literature**

*In order of relevance. (In Neptun ES: Instruction/Subject/Subject details/Syllabus/Literature)*

##### **compulsory reading and availability**

[1.] EMCa\_I\_\* electronic textbook written by György ELMER PhD. Available from the lecturer onto an own pendrive of the student.

[2.] -

##### **recommended literature and availability**

[3.] -