COURSE DESCRIPTION CARD

BIALYSTOK UNIVERSITY OF TECHNOLOGY		**Faculty of Electrical Engineering**	
Field of study	Electrical and Electronics Engineering	**Level and form of study**	Master's degree, full time
A group of modules /specialty		**Education profile**	General-academic
Course name	Electromagnetic compatibility	**Course code**	IS-FEE-20014W
		Course type	*Elective*
Course form(s) and number of hours	**L C LC P SW FW S** 15 30	**Semester**	**Winter**
		ECTS credits	**4**
The programme is valid from	2024/2025		
Introductory courses	circuit theory, electromagnetic field theory		

Course objectives

To acquaint students with the sources of electromagnetic disturbances, how they affect technical objects and electronic and electrical equipment and systems, and the hazards they pose. To acquaint students with the legal requirements as well as the resulting technical recommendations in electromagnetic compatibility (EMC) of electrical and electronic equipment placed on the market. To familiarize students with selected EMC testing methods and equipment. To develop the skills of conducting selected basic and suplementary EMC tests and working with basic testing apparatus. To develop students' skills of proper elaboration, analysis and evaluation of the results of performed tests.

Framework programme content

Lecture: Introduction to EMC (electromagnetic compatibility), technical law, product certification and EMC standards. Sources of electromagnetic disturbances, their characteristics and hazards they pose. Rules of disturbing effects of various signals, electromagnetic couplings. Testing of immunity of electronic and electrical equipment to electromagnetic disturbances. Testing of emissions from electronic and electrical equipment. Practical aspects of electromagnetic compatibility.
Laboratory class: Surge generators. Attenuation effectiveness of electromagnetic shielding. Travelling wave phenomena in electrically long lines. Couplings between wire systems. Electromagnetic compatibility of TV-sets. Electrostatic discharge. Testing of radiated and conducted emissions from equipment.

Other information about the course

content of the course refers to the principles of sustainable development
the course is related to the scientific activity conducted at the University

Calculation:

Student workload related to:	**Total number of hours**	**including contact**	**including practical**
participation in lectures	15	15	
participation in other forms of activities	30	30	30
participation in an examination	0	0	
participation in consultations	4	4	3
completion of professional training	0	0	0
preparation for passing a lecture/an examination	5		
preparation for practical classes	16		16
preparation of reports from laboratory classes	24		24
preparation a presentation on a specific topic	6		6
			0
			0
			0
			0
Total number of hours:	**100**	**49**	**79**
Total number of ECTS credits:	**4**	**2,0**	**3,1**

Expected discipline learning outcomes

Knowledge	Skills	Social competence

Objectives and framework content prepared by	Assoc. Prof. Renata Markowska, DSc PhD Eng.	Date:

Implementation in the academic year **2024/2025**

Programme content

	Lecture
1	Introduction to electromagnetic compatibility (EMC), basic EMC problems, recommended literature.
2	The procedure for assessing the compliance with the EMC Directive, EMC standards.
3	Sources of electromagnetic disturbances, main parameters characterizing the disturbing signals.
4	The threats posed by various sources of electromagnetic disturbances.
5	The principles of the interfering effects of various signals, electromagnetic couplings.
6	Testing of immunity of electrical and electronic equipment to electromagnetic disturbances (principles, stands, levels).
7	Testing of immunity of electrical and electronic equipment to electromagnetic disturbances (principles, stands, levels).
8	Testing of immunity of electrical and electronic equipment to electromagnetic disturbances (principles, stands, levels).
9	Testing of immunity of electrical and electronic equipment to electromagnetic disturbances (principles, stands, levels).
10	Testing of electromagnetic emission from electrical and electronic equipment (principles, stands, levels).
11	Testing of electromagnetic emission from electrical and electronic equipment (principles, stands, levels).
12	Testing of electromagnetic emission from electrical and electronic equipment (principles, stands, levels).
13	Testing of electromagnetic emission from electrical and electronic equipment (principles, stands, levels).
14	Shielding and equipotential bonding, practical aspects of electromagnetic compatibility.
15	Students presentations on the specific topics.
	Laboratory classes
1	Introduction, regulations of laboratory work, rules of safety and hygiene of work. - 3 hours
2	Surge generators - part 1. - 3 hours
3	Surge generators - part 2. - 3 hours
4	Testing the attenuation of various types of shields. - 3 hours

	5	Travelling wave phenomena in electrically long lines. - 3 hours
	6	Electromagnetic couplings between cable systems. - 3 hours
	7	Electrostatic discharge. - 3 hours
	8	Electromagnetic compatibility of television sets. - 3 hours
	9	Measurement of radiated and conducted emission of electromagnetic disturbances. - 3 hours
	10	Final assessment. - 3 hours
	11	
	12	
	13	
	14	
	15	
Teaching methods (on-site classes)	L	Information lecture with multimedia presentation
	LC	Laboratory experiments
	-	
	-	
Teaching methods (online classes)	-	
	-	
	-	
	-	
Forms of crediting	L	Written or oral exam with open questions; presentation on a specific topic
	LC	Tests of preparation for exercises; students reports; observation of students work on exercises
	-	
	-	
Conditions of crediting	L	Positive assessment of each task of the exam; positive assessment of the presentation. Final grade is the arithmetic mean of partial grades.
	LC	Attendance to the classes; positive grades of the tests; positive grades of the reports. Final grade is the arithmetic mean of partial grades.
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Outcome symbols	**Expected learning outcomes**	**Expected learning outcomes defined for the field of study**		
		Knowlegde	Skills	Social competence
	Knowledge: the student knows and understands			
E1	the phenomena related to generation, propagation and effects of electromagnetic disturbances on electronic and electrical equipment and systems			
E2	the general requirements in the area of electromagnetic compatibility (EMC) of electrical and electronic equipment and systems; selected methods of EMC testing with relation to legal acts and technical standards			
	Skills: the student can			
E3	plan and perform selected basic and complementary tests in the area of EMC; develop technical documentation on the implementation of these tests, including interpretation of the results			
E4	work individually and in a team, keeping the schedule and observing the rules of health and safety of work			
	Social competence: the student is ready to			
E5	student is ready to work in a team, including coordinating the work of the team and the protection of intangible and legal property, as well as the expectations of the social environment			

Outcome symbols	**Methods of verification of learning outcomes**	**Course form subject to verification**
E1	Written or oral exam with open questions; presentation on a specific topic; tests of preparation for exercises; students reports;	L, LC
E2	Written or oral exam with open questions; presentation on a specific topic; tests of preparation for exercises; students reports;	L, LC
E3	Tests of preparation for exercises; students reports; observation of students work on exercises; presentation on a specific topic	LC, L
E4	Students reports; observation of students work on exercises; presentation on a specific topic	LC, L
E5	Students reports; observation of students work on exercises	LC

Basic references	1	Sroka J.; Compendium on electromagnetic compatibility; Oficyna Wydawnicza Politechniki Warszawskiej; Warszawa, 2021.
	2	Ott H. W.; Electromagnetic compatibility engineering; NJ: Wiley; Hoboken, 2009.
	3	Williams T.; EMC for systems and installations; Newnes; Oxford, 2000.
	4	Williams T.; EMC for product designers: (meeting the European EMC directive); Newnes; Oxford, 2000.
	5	Kodali V. P.; Engineering electromagnetic compatibility: principles, measurements, technologies and computer models; The Institute of Electrical and Electronics Engineers; New York, 2000.
	1	Vijayaraghavan G., Brawn M.; Grounding, Bonding, Shielding and Surge Protection; Newnes, 2004.

Supplementary references	2	Keller R. B.; Design for Electromagnetic compatibility – In a Nutshell; Springer Nature, Cham 2023.
	3	Giri D. V., Hoad R., Sabath F.; High-power electromagnetic effects on electronic systems; Artech House, Norwood 2020.
	4	Vered U.; Intersystem EMC analysis, interference, and solutions; Artech House, Norwood 2018.
	5	Sevgi L.; A practical guide to EMC engineering; Artech House, Norwood 2017.
	6	Baker D. G.; Electromagnetic compatibility: Analysis and case studies in transportation; John Wiley & Sons, Incorporated; Hoboken 2015.
	7	Costa F., Laboure E., Revol B., Gautier C.; Electromagnetic compatibility in power electronics; Wiley; Hoboken, NJ London 2014.
	8	Ramahi O. M., Archambeault B. R., Brench C.; EMI/EMC computational modeling handbook; Springer 2012.
	9	Smolenski R.; Conducted electromagnetic interference (EMI) in smart grids; Springer London, London 2012.
	10	Ogunsola A., Mariscotti A.; Electromagnetic compatibility in railways: Analysis and management; Springer-Verlag, Berlin Heidelberg 2013.
Course coordinator	Assoc. Prof. Renata Markowska, DSc PhD Eng.	**Date:** 23.02.2024