Cracow University of Technology
Course syllabus
binding for the doctoral students of the CUT Doctoral School commencing their studies
in the academic year 2022/2023

Information on the course

Name of the course in Polish	Zjawiska nieliniowe w obwodach magnetycznych
Name of the course in English	Nonlinear phenomena in magnetic circuits
Number of the ECTS points	1
Language of instruction	Polish
Category of the course	Elective
Field of education	Engineering and Technology
Discipline of education	Automatic Control, Electronics and Electrical Engineering
Person responsible for the course Contact	Witold Mazgaj, *doctor habilitatus* in Engineering, prof. of CUT witold.mazgaj@pk.edu.pl

Type of course, number of hours in the study programme curriculum

Semester	Credit type (G / NG)*	Lecture	Practical class	Laboratory	Computer laboratory	Project class	Seminar
2, 3, 4, 5	G	9	0	0	6	0	0

*G – graded credit, NG – non-graded credit

Course objectives

Code	Objective description
Objective 1	Introduction to the problems of nonlinear and anisotropic properties of typical soft magnetic materials
Objective 2	Presentation of ways of taking these phenomena into account in calculations of magnetic field distribution in magnetically soft materials

Learning outcomes

Code	Description of the learning outcome adjusted to the specific characteristics of the discipline	Learning outcome symbol in the CUT DS	Methods of verification
OUTCOMES RELATED TO KNOWLEDGE			
EUW1	The doctoral student knows and understands the theoretical foundations of nonlinear phenomena in soft magnetic materials	E_W01 E_W02	Attendance in class, written test
EUW2	The doctoral student knows and understands methods for testing magnetic materials	E_W01 E_W02	Attendance in class, written test
OUTCOMES RELATED TO SKILLS			

EUU1	The doctoral student is able to take into account nonlinear phenomena in magnetic field distribution calculations	E_U01	A computer laboratory report
	OUTCOMES RELATED TO SOCIAL COMPETENCES		
EUK1	The doctoral student is prepared to critically evaluate methods for taking into account nonlinear phenomena, as presented in the literature, and to emphasise the significance of knowledge in scientific research	E_K01 E_K03	Discussion

Course outline

No.	Contents	Learning outcomes for the course	No. of hours
	LECTURE		
W1	magnetic hysteresis phenomenon, hysteresis losses, anisotropy of soft magnetic materials	EUW1	3
W2	axial and rotational magnetisation reversal of magnetically soft materials, methods of magnetic measurements, demonstration of laboratory measurements of axial and rotational magnetisation reversal	EUW2	3
W3	taking into account nonlinear phenomena in the calculation of magnetic field distribution in magnetically soft materials	EUW1, EUW2	3
	COMPUTER LABORATORY		
Lk1	Modelling of axial and rotational magnetisation reversal of isotropic sheet metal and anisotropic sheet metal.	EUW1, EUW2, EUU1, EUK1	2
Lk2	Determination of magnetic field distribution in isotropic sheet, allowing for hysteresis.	EUW1, EUW2, EUU1, EUK1	2
Lk3	Determination of magnetic field distribution in anisotropic sheet, allowing for hysteresis and anisotropy.	EUW1, EUW2, EUU1, EUK1	2

The ECTS points statement

WORKING HOURS SETTLEMENT	
Type of activity	Average number of hours (45 min.) dedicated to the completion of an activity type
SCHEDULED CONTACT HOURS WITH THE ACADEMIC TEACHER	
Hours allotted in the syllabus	15
Consultations	1
Course credit assignment	2
HOURS WITHOUT THE PARTICIPATION OF THE ACADEMIC TEACHER	
Independent study of the course contents	6
Preparation of a paper, report, project, presentation, discussion	6
ECTS POINTS STATEMENT	
Total number of hours	30

The ECTS points number	1

Preliminary requirements

No.	Requirements
1	Knowledge of the basic laws related to magnetic fields.

Course credit assignment conditions / method of the final grade calculation

No.	Description
	COURSE CREDIT ASSIGNMENT CONDITIONS
1	Attendance in class, passing a test on knowledge covered in the lecture, successful completion of the computer laboratory class
	METHOD OF THE FINAL GRADE CALCULATION
	The final grade is a weighted average of the grade on the test of knowledge covered in the lecture (weight 2) and the grade obtained upon the completion of the computer laboratory class (weight 1)

Additional information

None

The course reading list

1	Soiński M., *Materiały magnetyczne w technice*, Wyd. COSiW, Warszawa 1983
2	Jiles D.C., *Introduction to Magnetism and Magnetic Materials*, Chapman & Hall, London 1998
3	Anuszczyk J., Pluta W, *Ferromagnetyki miękkie w polach obrotowych. Badania i właściwości*, WNT, Warszawa 2009
4	Mazgaj W.: *Wyznaczanie rozkładu pola magnetycznego w materiałach magnetycznie miękkich z uwzględnieniem histerezy i anizotropii*, monograph no. 379, series: Inżynieria Elektryczna i Komputerowa, Kraków 2010
5	Tumanski, S. *Handbook of Magnetic Measurements.* CRC Press, Boca Raton, FL, USA, 2011