Subject (course) name: **Modelling in Electrical Engineering**		
Field of study: **Electrical Engineering** Specialization:		Subject code: **E2S_5K**
		Title graduate: **Master of Science**
Type of course: **optional**	Course level: **second-cycle studies**	Year: **II** Semester: **II** Semester: **autumn**
Form of classes: **Lectures, Classes, Labs, Seminar, Project**	Number of hours per week: **2L, 0, 2Lab, 0, 0**	Credit points: **5 ECTS**

GUIDE TO SUBJECT

SUBJECT OBJECTIVES

C1. Transfer the knowledge to students about the general principles of modelling in physics

C2 Transferring the knowledge to students on modelling in electrical engineering

C3 Transferring the knowledge on computer methods

SUBJECT REQUIREMENTS

1. knowledge on electrical engineering – circuit theory
2. knowledge on electrical engineering – electromagnetic field theory
3. basic information on mathematical methods in physics

LEARNING OUTCOMES

EK1– student classifies models of physical phenomena

EK2 – student knows mathematical models of physical phenomena

EK3 – student understands the mapping of electrical phenomena on mathematical and numerical models

SUBJECT CONTENT

Form of classes - lectures

Topic	Hours
W 1 – history of modelling in the phenomena of natural and social science	**2**
W 2 – methodology of modelling	**2**
W 3 – analog model	**2**
W 4 –description of mathematical	**2**
W 5 – features of mathematical model – verification of its correctness	**2**
W 6 – correctness of the mathematical model – uniqueness, coherence, stability	**2**
W 7 – mathematical electrotechnics in the light of bulk parameters (circuit theory)	**2**
W 8 – mathematical electrotechnics in the light of distributed parameters (theory of electromagnetic field, circuits with distributed parameters) parameters	**2**
W 9 – introduction to the simulation software on the example of SPICE package	**2**
W 10 – circuit analysis – methods based on 2nd Kirchoff's law	**2**
W 11 – circuit analysis – methods based on 1st Kirchoff's	**2**
W 12 – introduction to the vector analysis and differential equations	**2**
W 13 – methods of numerical analysis of electromagnetic field based on approximation of differential operator	**2**
W 14 – methods of numerical analysis of electromagnetic field based on approximation of function	**2**
W 15 – boundary-integral methods	**2**
Total	**30**

Form of classes – laboratory

Topic	Hours
Lab 1, 2, 3, 4, 5 – solving problems of vector analysis and integration of differential equations	**10**
Lab 6, 7,8 – presenting specialized	**6**
Lab 9, 10 – solving the problems by means of the approximation of the differential	**4**
Lab 11, 12, 13 – solving the problems by means of the approximation of the function	**6**
Lab 14, 15 – application of boundary-integral methods	**4**
Total	**30**

STUDY METHODS

1. lecture with the multi-media presentation
2. laboratory – solving given problems

EDUCATIONAL TOOLS

1. audio-visual media
2. software Matlab

METHODS OF ASSESMENT (F – Forming, P – Summary)

P1. Lecture – test
P2. Laboratory – reports

STUDENT WORKLOAD

Form of activity	Averaged workload (hours)		
	[h]	∑ [h]	ECTS
Participation in class activities lecture laboratory	30 30	60	2
Preparation to laboratory	10	40	2
Mastering reports/projects	10		
Literature studies	10		
Introductory work to credits of lecture and laboratory	10		
Total		**100**	**5**

A. BASIC READING

1..Krawczyk A., Tegopoulos J.A., Numerical Modelling of Eddy Currents, Clarendon Press, Oxford, 1993

B. FURTHER READING

1. Beeteson J.S. Visualizing Magnetic Fields, Academic Press, 2001

Learning objectives	In relation to the learning outcomes specified for the field of study	Subject objectives	Study methods	Methods of assessment
EK1	KE2A_W02	C1, C2	Lecture	P1
EK2	KE2A_W02	C2, C3	Lecture	P1
EK3	KE2A_W02	C3	Laboratory	P2

II. EVALUATION

Grade	Outcome
EK1	**Student classifies and characterises the model of physical phenomena, and also describes mathematical models of physical phenomena, in particular electric phenomena**
2 (F)	Student is not able to classify the models
3 (E)	Student classifies the models
3.5 (D)	Student classifies and characterises the models of physical phenomena

4 (C)	Student classifies and characterises the models of physical phenomena and gives the incomplete description of mathematical models
4.5 (B)	Student describes mathematical models of physical phenomena with their properties
5 (A)	Student describes mathematical models of physical, in particular electric, phenomena with their properties
EK2	**student knows mathematical models of physical phenomena**
2 (F)	Student does not know any mathematical model of physical phenomena
3 (E)	student is able to give few mathematical models of physical phenomena
3.5 (D)	Student describes very few mathematical models of physical phenomena
4 (C)	Student know the majority of the models of physical phenomena.
4.5 (B)	Student describes mathematical models
5 (A)	Student gives the mathematical models for thr majority of physical phenomena and is able to algebrize
EK3	**Student classifies and recognize the numerical models of electric phenomena**
2 (F)	Student does not know numerical any numerical models
3 (E)	Student knows the names of the methods but without their
3.5 (D)	Student knows the characterics of particular methods.
4 (C)	Student is able to apply the selected numerical methods with real electric problem
4.5 (B)	Student is able to evaluate the effectiveness of particular
5 (A)	Student is able to evaluate the effectiveness of particular method and range of its applicability

III. OTHER USEFUL INFORMATION

1. All information for students on the schedule are available on the notice board and on the website: https://we.pcz.pl/
2. Information on the consultation shall be provided to students during the first lecture and will be placed on the website https://we.pcz.pl/
3. Terms and conditions of credit courses will be provided to students during the first lecture