(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: Seminar in English: Mathematical modeling in technical, physical and natural sciences	**2. Course code:** SE
3. Validity of course description: 2019/2020	
4. Level of studies: second cycle of higher education	
5. Mode of studies: intramural studies	
6. Field of study: MATHEMATICS RMS	(FACULTY SYMBOL) RMS
7. Profile of studies: general academic	
8. Programme: all	
9. Semester: III	
10. Faculty teaching the course: Faculty of Applied Mathematics	
11. Course instructor: Professor Władimir Mitiuszew	
12. Course classification: course of limited choice	
13. Course status: elective	
14. Language of instruction: English	

15. Pre-requisite qualifications:

Basic knowledge of calculus and algebra. Skills to operate by mathematical objects: calculation of derivatives and integrals, vector-matrix operations. Communication and project management skills to work in a team. Foundations of programming, theoretical foundations of computer science, mathematics, algorithms and data structures, programming procedures. Basic knowledge of English.

16. Course objectives:

The main objective of this seminar is to teach the students to develop advanced mathematical models applied to various topics of engineering investigations used in different fields of economics and administration. The developed models concern various topics of physics, technology and real world problems of economy, biology and natural sciences. The other goal of this seminar is to teach the students how to use the models, developed by themselves or available in computational platforms, in practical description and simulations of real world problems.

17. Description of learning outcomes:

Student who has completed the subject:

No	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	has general knowledge in the theory of mathematical modeling, basic algorithms and numerical methods	presentation	class seminar	K2A_W03 K2A_W04 K2A_U13
2.	can use the tools of symbolic and numerical computations	presentation	class seminar	K2A_W03
3.	can work out and develop mathematical models of the topics: mechanics, mathematics, physics, technology, economy	presentation	class seminar	K2A_W05 K2A_U12
4.	can prepare a project (document) concerning mathematical models and can perform the corresponding computer simulation	presentation	class seminar	K2A_W14
5.	can present the result of computer simulations in visual form including graphs, animations, can make conclusions on the basis of her/his results and can give practical recommendations	presentation	class seminar	K2A_K05 K2A_K07

6.	can cooperate in a team to prepare a project, can cooperate with a customer (client) who has not the corresponding mathematical and computer knowledge and skills	presentation	class seminar	K2A_K02
7.	can use various courses of information (including networks) to extend her/his knowledge and to get new skills	presentation	class seminar	K2A_W14 K2A_K01 K2A_K06

18. Teaching modes and hours

Lecture	Class	Laboratory	Projekt	Seminar
				30

19. Syllabus description:

1. Numerical and symbolic computations with the package Mathematica.
2. Advanced mathematical models and their computer implementation.
3. Least Square Method. Interpolation and Fitting.
4. Econometric problems. Simulations and on-line analysis of the New York Stock Exchange.
5. Dynamic models. Fourier analysis.
6. Simulation of interactive dynamic maps.

20. Examination: no

21. Primary sources:

1. V. Mityushev, N.Rylko, W. Nawalaniec, Introduction to Mathematical Modeling and Computer Simulations, CRC – Taylor & Francis, Boca Raton, 2018
2. V. Mityushev, W. Nawalaniec N. Ryłko, A. Malevich, *Podstawy matematyki przemysłowej, tom 1 – „Matematyczne modelowanie i symulacje komputerowe”*, *tom 2 – „Zagadnienia wielowymiarowe”, tom 3 – „Podstawy obliczeń, przykłady”*, Wydawnictwo Pracowni Komputerowej Jacka Skalmierskiego, Gliwice, 2010.
3. W. Krauth: Statistical mechanics: algorithms and computations, Oxford, 2006.
4. Z. Artstein, Mathematics and the Real World: The Remarkable Role *of Evolution in the Making of Mathematics*. Prometheus Books, Amherst, New York, 2014.
5. H. Gliński, R. Grzymkowski, A. Kapusta, D. Słota, *Mathematica 8*, Wydawnictwo Pracowni Komputerowej Jacka Skalmierskiego, Gliwice, 2012. (selected parts)

22. Secondary sources:

1. S. Mangano, *Mathematica Cookbook*, O'Reilly Media, 2010.
2. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical Methods for Physics and Engineering, 2006
3. S. Gluzman, V. Mityushev, W. Nawalaniec, Computational Analysis of Structured Media, Elsevier, Amsterdam, 2017
4. H.-J. Bungartz, S. Zimmer, M. Buchholz, D. Pfluger, *Modeling and Simulation. An Application-Oriented Introduction*, Springer-Verlag, New York etc, 2014
5. *Mathematica 8. Handbook*, Wolfram Research, 2006.
6. A. Grinko, A. Karpuk, V. Mityushev (Junior), V. Mityushev, N. Ryłko, *Ekonometria od podstaw z przykładami na EXCELU*, Wydawnictwo Pracowni Komputerowej Jacka Skalmierskiego, Gliwice, 2010.
7. D. Basmadjian, R. Farnood, *The Art of Modeling in Science and Engineering with Mathematica, Second Edition*, Chapman & Hall/CRC, 2006.
8. V. Andrianov, L. I. Manevitch, *Asymptotology: Ideas, Methods, and Applications*, Kluwer Academic Publishers, 2002.
9. A.I. Borisenko, I.E. Tarapov, *Vector and tensor analysis with applications*, Dover, 1979.
10. R. Grzymkowski, D. Słota, *Computational Methods for Integral Equations*. Silesian Technological University Publ., Gliwice, 2015.
11. J. Jost, *Mathematical Methods in Biology and Neurobiology*. Springer-Verlag, London, 2014.
12. V. V. Mityushev; S. V. Rogosin, *Constructive Methods for Linear and Nonlinear Boundary Value Problems for Analytic Functions: Theory and Applications*, Chapman & Hall/CRC Press, Boca Raton, 2000

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	
2	Classes	/
3	Laboratory	/
4	Project	/
5	Seminar	30/60
6	Other	/
	Total number of hours	30/60

24. Total hours: 90	
25. Number of ECTS credits:	3
26. Number of ECTS credits allocated for contact hours:	1
27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 0	
26. Comments: The examination is based on the quality of the developed two projects: Dynamic models of the New York Stock Exchange and Interactive dynamic pollution maps.	

Approved:

…….
(date, Instructor's signature)

……
(*date , the Director of the Faculty Unit signature)*