GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling and prediction methods in biomedical processes, PG_00064440		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Optional subject group Specialty subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Biomedical Engineering -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Artur Poliński	
	Teachers	dr inż. Artur Poliński dr Tomasz Neumann	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						

Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
	Number of study hours	30	3.0	20.0	53

Subject objectives	The aim of the course is present the methods of modeling and prediction in biomedical apllications

Learning outcomes	<table><tr><th>Course outcome</th><th>Subject outcome</th><th>Method of verification</th></tr><tr><td>[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of study, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of study, including computer simulations, interpret the obtained results and draw conclusions</td><td>The student has knowledge of modeling and prediction in biomedical applications</td><td>[SU1] Assessment of task fulfilment</td></tr><tr><td>[K7_W02] knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the field of study</td><td>The student has knowledge of modeling and prediction in biomedical applications</td><td>[SW1] Assessment of factual knowledge</td></tr><tr><td>[K7_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study by: - appropriate selection of source information and its critical analysis, synthesis, creative interpretation and presentation, - application of appropriate methods and tools</td><td>The student has knowledge of numerical modeling of processes and signal prediction in biomedical applications</td><td>[SU1] Assessment of task fulfilment</td></tr><tr><td>[K7_W01] knows and understands, to an increased extent, mathematics to the extent necessary to formulate and solve complex issues related to the field of study</td><td>The student has knowledge of modeling and prediction in biomedical applications</td><td>[SW1] Assessment of factual knowledge</td></tr></table>
Subject contents	The least squares method (LS). Examples of using the LS in modeling. Examples of phenomena modeled by ordinary differential equations. Numerical solution of ordinary differential equations (Euler and Rungge-Kutta methods) Examples of problems modeled by partial differential equations. Numerical solving of partial differential equations by the finite difference method Numerical solving of partial differential equations using the finite element method Numerical solution of partial differential equations by the boundary element method Monte Carlo method and its application in simulation Examples of signal prediction methods Autoregressive models in prediction The use of the finite element method and the boundary element method in modeling. Modeling of the electromagnetic field. Heat transfer modeling. Modeling of acoustic phenomena.
Prerequisites and co-requisites	Advanced mathematics
Assessment methods and criteria	<table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>lecture</td><td>51.0%</td><td>40.0%</td></tr><tr><td>laboratory</td><td>51.0%</td><td>60.0%</td></tr></table>

Recommended reading	Basic literature	Analiza danych, Metody statystyczne i obliczeniowe, 1998, Siegmund Brandt, PWN Monte Carlo Methods for Radiation Transport, 2017, Oleg N.Vassiliev, Springer Fortuna Z., Macukow B., Wąsowski J., Metody numeryczne, WNT 2006 Stoer J.,Bulirsch R., Wstęp do analizy numerycznej, PWN 1987 Ralston A., Wstęp do analizy numerycznej, PWN 1983 Björck Å., Dahlquist G., Metody numeryczne, PWN 1983 Zienkiewicz O. C., Metoda elementów skończonych, Arkady 1972 Beer G., Watson J. O., Introduction to finite and boundary element methods for engineers, John Wiley 1994 Ciarlet P. G, Lions J. L. red. Finite difference methods (Part 1) ; Solution of equations in R (Part 1),Amsterdam : North-Holland, 1990. Allen M. B. III, Isaacson E. L., Numerical analysis for applied science, John Wiley, 1997 Metoda elementów skończonych w dynamice konstrukcji, praca zbiorowa, Warszawa Arkady 1984 Grandin H. T., Fundamentals of the finite element method, New York : Macmillan ; London : Collier Macmillan, 1986. Björck Å., Numerical methods for least squares problems, SIAM, Philadeplhia, 1996 Bettes P., Infinite Elements, Penshaw Press, Sunderland, UK, 1992
	Supplementary literature	Jankowscy J. i M., Przegląd metod i algorytmów numerycznych. Cz. 1, WNT 1988 Dryja M., Jankowska J., Jankowski M., Przegląd metod i algorytmów numerycznych. Cz. 2, WNT 1988 Golub G., Van Loan C., Matrix Computations. Johns Hopkins University Press, 1996 Biran A., Breiner M., MATLAB 5 for engineers, Harlow, England : Addison-Wesley, 1999 Kruszewski J. red., Metoda sztywnych elementów skończonych, Warszawa : Arkady, 1975.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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