GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00057305		
Field of study	Ocean Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Part-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Ocean Engineering and Ship Technology -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Cezary Żrodowski	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	9.0	0.0	0.0	18.0	0.0	27
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	27	7.0	66.0	100

Subject objectives

Presented methods belong to the modern, interdisciplinary branch of engineering known as Computer Aided Geometric Design (CAGD). They constitute the theoretical basis of most modern, professional computer systems used in the ship and yacht building industry, as well as in sister industries (car, aviation, etc.). The indirect goal is a practical familiarization fo students with modern, advanced techniques of shape modeling and their theoretical foundations, allowing for a conscious selection of modeling methods, optimal for given problems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W02] has a widened knowledge in the range of modelling technological processes, including knowledge necessary to describe and assess the functioning of selected elements of ocean technology objects and systems	The student is able to choose the proper CAD program for the implementation of a predefined geometric task.	[SW3] Assessment of knowledge contained in written work and projects
[K7_U03] can conduct a detailed analysis of the obtained results and present them in the form of a technical report or presentation, also in English	The student uses tools to analyze the curvature of curves and surfaces and interprets the results correctly	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K7_W05] has an organized, widened knowledge on design, construction and operation of ocean technology objects and systems	The student is able to choose the optimal method of modeling curves and surfaces for a given shape of the hull.	[SW3] Assessment of knowledge contained in written work and projects
[K7_U04] can apply mathematical methods and models and computer simulations to analyse, design, and assess the functioning of ocean technology objects and systems and their elements	The student is able to model the surface shape of the ship's hull, maintaining the tightness and continuity of the G2 class (A class surface).	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Subject contents	1. Computer geometry objects: curves, surfaces, solids. Review of modeling objects in ship design (hulls of surface and submarines, smooth and non-smooth, pear-shaped prows, rudder and stabilizing blades, propellers, etc.). Multi-criteria classification of geometric modeling of ship forms (objects, goals, phases, attributes of analytical models) and objects: curves and surfaces (topology, geometry, representation, generation modes and techniques, continuity, etc.). The process of modeling curves and surfaces: selection of representations, data, parametrization, generation, geometric quality assessment (fluidity), shape definition. Transformations of 3D objects in matrix representation: simple (translations, scaling, rotations) and complex. 2. Basics of the theory of curves in parametric representation. Parametric, polynomial representations of curves, the concept of the basis. Examples of elementary curves (Lagrange, Hermita, Bezier) and non-elementary curves (splines). Polynomial (Theilheimer, de Boor) and rational (NURBS) splines. Measures and techniques for visualizing the smoothness of curves. 3. Fundamentals of surface theory in parametric representation. Division of the surface into flaps, smoothness of gluing the flaps: parametric (Cn) and geometric (Gn). Basic parametric representations of airfoils: two-line type: tensor product, lofted, blended *, sweeping type: translational, axisymmetric, complex. Free, rectangular and expandable panels. Curves on the surface. Measures and techniques for visualization of surface flowability. 4. Practical implementation of design tasks on examples of selected hull types in the Siemens NX program, including: • modeling of the hull of a sailing yacht (smooth single lobe) • modeling the hull of a motor yacht (sewing the sheets together) • modeling a typical, simple shape of a merchant ship (bow without a bow bulb, cylindrical midship, GRID curves) • modeling the modern shape of a commercial vessel (bow and stern bulb, double screw) • modelling of parametric propeller series, eg. B-Wageningen • techniques for linear and non-linear rescaling of existing shapes • hull shape exchange between equal CAD programs.
Prerequisites and co-requisites	1. Required completed lectures on descriptive geometry and higher mathematics, in particular: analytical geometry, linear algebra and mathematical analysis. 2. Recommended skill to use the Siemens NX program.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
A control test covering theoretical issues	50.0%	20.0%
4 practical projects	50.0%	80.0%

Recommended reading

Basic literature	1.Nowacki H., Bloor M.I.G., Oleksiewicz B. (edyt.), Dekanski C.W., Michalski J., Wilson M.J.: Computational Geometry for Ships. World Scientific Publishing Co.Pte.Ltd., London, 1995. 2. Jankowski M.: Elementy grafiki komputerowej. WNT, Warszawa 1990. 3. Kiciak P.: Podstawy modelowania krzywych i powierzchni. WNT, Warszawa 2000.
Supplementary literature	1. User manual for Siemens NX program 2. Resources of the Siemens e-Learning portal "Advantage learning"
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Explain the concept of explicit, implicit and parametric representation of curves
2. Explain the concept of a base in the analytical representation of polynomial curves
3. Explain the difference between the algebraic and geometric basis in the analytical representation of curves
4. What are elementary and non-elementary curves? Give some examples.
5. Explain the essence of splins and hence their wide application in geometric modeling of shapes.
6. List the basic types of surface lobe representations used in geometric modeling of the ship's hull
7. Make a model of the hull of the sailing / motor yacht according to the provided drawings
8. Make the merchant ship hull model according to provided drawings
9. Make a parametric model of the serial propeller
10. Perform the conversion of the hull shape of the merchant ship between different CAD systems

Work placement	Not applicable