GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Structural Dynamics, PG_00044015
Field of study	Civil Engineering

Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study 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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment

Conducting unit	Katedra Wytrzymałości Materiałów -> Faculty of Civil and Environmental Engineering

Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Magdalena Rucka
	Teachers	mgr inż. Błażej Meronk dr inż. Łukasz Pachocki dr inż. Dawid Bruski prof. dr hab. inż. Magdalena Rucka dr inż. Tomasz Ferenc

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	15.0	0.0	0.0	45
	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	45	5.0	25.0	75

Subject objectives	The aim of this course is solving of problems of structural dynamics using discrete single and multi-degree of freedom systems.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W05] knows laws of mechanics used in rod constructions in scope of statics and stability, has an elementary knowlege on dynamics	Student designs simple civil engineering structures taking into account vibrations due to initial conditions and harmonic external forces.	
	[K6_U03] can analyze simple rod constructions in scope of: calculations of constructions statically determined and undetermined; determining of modal frequencies; calculations of linear stability and bearing capacity in critical and boundary states	Student creates a dynamic model of simple frames and trusses. Student determines a stiffness matrix and a flexibility matrix of a structure. Student calculates natural frequencies of frame and truss structures.	

Subject contents	LECTURE
	Equation of motions: Hamiltonian principle, d'Alambert's principle, equilibrium of forces. Discrete single and multi degree of freedom systems: matrix equation of motion, free vibrations with and without damping, natural frequencies, response to harmonic excitation, internal dynamic forces. Response to arbitrarily excitation, modal analysis. Design of structures exposed to dynamic loadings. Dynamic systems with distributed mass: stiffness and mass matrices of beam element, 2D frames. Fundamentals of Finite Element Method, consistent mass matrix. Vibrations reductions methods in civil engineering structures.
	TUTORIALS
	Computation of natural frequency of single degree of freedom systems. Computation of systems excited by harmonic force. Computation of systems excited by arbitrary dynamic force. Computation of engineering structures taking into account dynamic excitations. Calculations of frequencies and mode shapes of multi degree of freedom discrete systems.
	LABORATORY
	Analysis of free vibrations of a cantilever beam. Analysis of harmonic vibrations of a portal frame. Computational analysis of multi degree of freedom dynamic systems.
Prerequisites and co-requisites	Courses: Engineering Mechanics, Strength of Materials, Structural Analysis should be completed. Course Computational Methods should be taken.

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Test (theory and exercises)	60.0%	80.0%
	Control tasks (laboratory)	60.0%	20.0%

Recommended reading	Basic literature	1. Rucka M., Wilde K.: Dynamika Budowli z przykładami w środowisku Matlab. Wydawnictwo Politechniki Gdańskiej, Gdańsk 2008
		2. Branicki C., Wizmur M.: Metody macierzowe w mechanice budowli i dynamika budowli. Wydawnictwo Politechniki Gdańskiej. Gdańsk 1980
		3. Chmielewski T., Zembaty Z.: Podstawy dynamiki budowli. Arkady, 1998
		4. Lewandowski R.: Dynamika konstrukcji budowlanych. Wydawnictwo Politechniki Poznańskiej 2006
		5. Chopra A.K.: Dynamics of structures. Upper Saddle River, New Jersey: Prentice Hall 2001
	Supplementary literature	1. Clough R.W., Penzien J.: Dynamics of structures. McGraw-Hill Inc. 1993
		2. Śliwiński A.: Ultradźwięki i ich zastosowania. Wydawnictwa Naukowo-Techniczne Warszawa 2001
		3. Kucharski T.: Systemy pomiarów drgań mechanicznych. Wydawnictwa Naukowo-Techniczne Warszawa 2002
	eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	Calculate natural circular frequency of the frame structure with single degree of freedom.
	Determine the natural vibration period and damping ratio based on the free vibration record.
	Determine natural frequencies and mode shapes of the multi degree of freedom frame system.
Work placement	Not applicable