



Subject card

Subject name and code	Structural dynamics, PG_00041521						
Field of study	Civil Engineering						
Date of commencement of studies	October 2023	Academic year of realisation of subject			2023/2024		
Education level	second-cycle studies	Subject group			Optional subject group		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	1	Language of instruction			English		
Semester of study	2	ECTS credits			3.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Mechanics of Materials and Structures -> Faculty of Civil and Environmental Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Tomasz Ferenc				
	Teachers		dr inż. Tomasz Ferenc dr inż. Błażej Meronk				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	0.0	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 the course is to solve the problems of Structural Dynamics using discrete models with one and n degrees of freedom.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_U03] can perform classic statical and dynamical analysis of rod structures stability (trusses, frames and ties), both statically determined and undetermined as well as surface structures (plates, membranes and shells)	Student builds a dynamic model of frame and truss systems. It determines the stiffness and flexibility matrix of the system. It determines the frequency of natural vibration of frame and truss structures.			[SU1] Assessment of task fulfilment		
	[K7_U09] is able to design railway tracks of complex geometry on sections and stations, both newly designed and renovated; can make a plan and perform diagnostic of railway track and to interpret its results, propose conclusions; can evaluate durability and reliability of railroad elements	Student can plan and conduct experimental dynamic analysis which allow to asses mode shapes and corresponding natural frequencies			[SU1] Assessment of task fulfilment		
	[K7_U08] Is able to evaluate technical conditio of a road, to design its pavement and choose proper construction technology using mechanistic methods and material investigations	Student can conduct experiment that allow to obtain properties of studied material			[SU1] Assessment of task fulfilment		
	[K7_U01] can evaluate and list any loads acting on constructions	Student can assess and compute external load that can act on analyzed structure			[SU1] Assessment of task fulfilment		
[K7_W03] has knowledge of Continuum Mechanics, knows rules of static analysis, stability and dynamics of complex rod, shell and volume structures, both in linear and basic nonlinear regime	The student designs simple engineering structures including vibrations forced by initial conditions and harmonic excitations.			[SW1] Assessment of factual knowledge			

Subject contents	<p>Introduction. Basic definitions. Modelling of dynamic systems</p> <p>Basic dynamics laws. Forces in dynamic systems. Equation of motion. Introduction to MATLAB</p> <p>Free undamped (natural) vibrations of 1-DOF systems</p> <p>Free damped vibrations of 1-DOF systems</p> <p>Forced vibrations of 1-DOF systems: harmonic loading</p> <p>Forced vibrations of 1-DOF systems: periodic and impulse loading</p> <p>Forced vibrations of 1-DOF systems: arbitrary loading</p> <p>Design of 1-DOF system under dynamic loading</p> <p>Free undamped (natural) vibrations of N-DOF systems</p> <p>Free damped vibration of N-DOF systems.</p> <p>Forced vibrations of N-DOF systems</p> <p>Vibration measurement technology. Vibrations reduction systems in engineering structures</p> <p>Experimental dynamic analysis</p> <p>Introduction. Basic definitions. Modelling of dynamic systems</p>		
Prerequisites and co-requisites	<p>Determination of internal forces in statically determinate structures (beams, frames, trusses, mixed frame-truss schemes) Determination of internal forces in statically indeterminate structures (beams, frames, trusses, mixed frame-truss schemes using the force method or the displacement (stiffness) method) Determination of displacements using principle of virtual work Determination of geometric properties of area (centroid, moment of inertia) Determination of stresses and strains (in bending) Matrix analysis of structures (stiffness matrix, flexibility matrix) Programming in MATLAB/FreeMat</p>		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Test	60.0%	100.0%

Recommended reading	Basic literature	<p>Chopra A.K.: Dynamics of structures. Upper Saddle River, New Jersey: Prentice Hall 2001</p> <p>Rucka M., Wilde K.: Dynamika Budowli z przykładami w środowisku Matlab. Wydawnictwo Politechniki Gdańskiej, Gdańsk 2008</p> <p>Branicki C., Wizmur M.: Metody macierzowe w mechanice budowli i dynamika budowli. Wydawnictwo Politechniki Gdańskiej. Gdańsk 1980</p> <p>Chmielewski T., Zembaty Z.: Podstawy dynamiki budowli. Arkady, 1998</p> <p>Lewandowski R.: Dynamika konstrukcji budowlanych. Wydawnictwo Politechniki Poznańskiej 2006</p>
	Supplementary literature	<p>Clough R.W., Penzien J.: Dynamics of structures. McGraw-Hill Inc. 1993</p> <p>Śliwiński A.: Ultradźwięki i ich zastosowania. Wydawnictwa Naukowo-Techniczne Warszawa 2001</p> <p>Kucharski T.: Systemy pomiarów drgań mechanicznych. Wydawnictwa Naukowo-Techniczne Warszawa 200</p>
	eResources addresses	Adresy na platformie eNauczenie:
Example issues/ example questions/ tasks being completed	<p>Determine the natural frequency of a frame system with one dynamic degree of freedom.</p> <p>Determine the damping ratio based on the measured displacement of free vibrations.</p> <p>Determine the frequencies and mode shapes of the frame system with n-dynamic degrees of freedom.</p>	
Work placement	Not applicable	

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