



FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises + project
NUMBER OF HOURS: 30+15+0	ECTS: 3
SEMESTER: winter	CLASS LEVEL: intermediate

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: knowledge of maths and physics at an advanced level

CONTENTS: (1) Introduction. Classification of vibrations, positive and negative effects of vibrations. Modelling of real systems, discrete and continuous systems. Stiffness and damping Characteristics. (2) Free vibrations. Natural frequency, differential equation of motion of linear systems. Equivalent stiffness of springs connected in parallel and series. Longitudinal, torsional and transverse vibration. (3) Dumped vibrations. Differential equation of motion, frequency of damped vibration with viscous damping. (4) Forced vibration. Forced vibrations of linear systems with viscous damping. Mechanical resonance. (5) Dumped vibrations with dry friction. Properties of models with dry friction. (6) Forced vibration by periodic and non-periodic forces. Fourier transformation, beating phenomenon. (7) Vibration isolation. Strategies for vibration isolation. (8) Free vibration of lumped mass systems with multi degrees of freedom. Problem formulation and vibration frequencies. (9) Free vibration of lumped mass systems with multi degrees of freedom. Vibrations frequencies and modes, eigenvalue problem. (10) Forced oscillations of a two degree of freedom forced system. Resonance and anti-resonance effect. Dynamical vibration absorber. (11) Vibrations of continuous systems. Longitudinal and torsional vibrations of rods. (12) Transverse vibrations of beams. (13) Plate vibrations. Equation of motion, frequencies and modes of vibration. (14) Parametric vibrations. Mathieu's and Hill's equation. (15) Nonlinear vibrations. Duffing equation.

EFFECTS OF EDUCATION PROCESS: Students should gain an intermediate abilities to identify and to solve problems of mechanical vibrations

LITERATURE (OPTIONAL):

(a) Meirovitch L., Fundamentals of Vibrations, McGraw-Hill international Ed., 2001. (b) Rao S.R., Mechanical Vibrations, 5th Ed., Prentice Hall, 2004.

TEACHING METHODS: classical and multimedial lectures + problem solving exercises under the teacher's guidance + self-contained problems consulted with the teacher

ASSESSMENT METHODS: lecture: final exam, classroom exercises: two written tests in a semester;

TEACHER (NAME, EMAIL CONTACT): Prof. DSc. PhD. Eng. Jerzy Warminski: j.warminski@pollub.pl | DSc. PhD. Eng. Rafal Rusinek, r.rusinek@pollub.pl | DSc. PhD. Eng. Krzysztof Keck, k.keck@pollub.pl | PhD. Eng. Marek Borowiec, m.borowiec@pollub.pl | MSc. Eng. Zofia Szmít, z.szmít@pollub.pl