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| module title: SELECTED PROBLEMS OF MACHINE DYNAMICS MODELLING | | |
| field of study: Mechanical Engineering | type of study: full-time | course code: S6_2-6 |
| course: Modelling & Simulation in Mechanics | degree: Master (MSc) | year: I semester: II |
| type of classes: lecture, laboratory | hours per week: 1L, 2Lab | No of ECTS credits: 5 |

MODULE DESCRIPTION

TARGETS

- T1.** Provide creation of physical and mathematical models, identification of model parameters and methods of formulation and solution of the problems concerning the chosen real objects.
- T2.** Provide advance knowledge concerning the calculation methods and operation of calculation and graphical computer systems.
- T3.** To acquire capabilities to solve the similar problems by oneself

PREREQUISITES & ADDITIONAL REQUIREMENTS

- R1.** Fundamentals of mechanics and mechanical vibration theory.
- R2.** Fundamentals of finite element method and capability of using COSMOS/M package.
- R3.** Fundamentals of computer operating.
- R4.** Capability of using computer, including COSMOS/M package.
- R5.** Knowledge of safety principles in using computers.

LEARNING OUTCOMES

- LO1.** Knowledge on methodology of formulation and solution of problems concerning creation of physical and mathematical models, identification of model parameters with reference to chosen real objects, including machine elements.
- LO2.** Ability to create by oneself the calculation model and to perform free vibration analysis continuous-discrete models of machine elements of defined geometry.
- LO3.** Ability to draw up conclusions on bases of free vibration analysis of machine elements important for its construction and exploitation.
- LO4.** owns consciousness of importance of proper construction of machines, including its dynamic properties, for improving the society live comfort.
- LO5.** Ability to cooperate in small teams.

TEACHERS

module coordinator: prof. Bogdan Posiadała - bogdan.p@imipkm.pcz.pl
 academic teachers:
 - prof. Bogdan Posiadała - bogdan.p@imipkm.pcz.pl
 - dr Dawid Cekus, assoc. prof. - cekus@imipkm.pcz.pl
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MODULE CONTENT

| LECTURE | hours |
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| L1 - Literature. General principles of creation of vibration model for one, two or more degree of freedom. | 1 |
| L2-4 – Problems concerning modelling of dynamics of elements and unit of machines. Dynamic model of continuous structure: calculation model of frame and dynamic model of continuous-discrete structure: calculation model of frame with harmonic oscillator. | 3 |
| L6-7 – Solutions of free vibration problems of discrete systems – illustration of system response to chosen forces by using Phaser computer program. | 2 |
| L8-10 – Free vibration problems of systems consisted of rod, beam or plate connected with discrete elements. Formulation and solution by using Lagrange multiplier method. | 3 |
| L11-15 – Modelling problems of kinematics and dynamics of mechanical systems. The case of machines: truck crane with carried load or forest crane with carried load. | 5 |

| LABORATORY | hours |
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| Lab 1-9 – Creation of the calculation models of: frame and frame connected with harmonic oscillator by using finite element method. Static and free vibration analysis of the systems on the basis of created models. | 9 |
| Lab 10-18 – Creation of the discrete reduction model representing the frame connected with harmonic oscillator. Two or more degree of freedom models, identification of model parameters, solution of the initial problem by using fourth order Runge-Kutta method. | 9 |
| Lab 19-27 – Creation of the calculation model and vibration analysis of beam connected with discrete elements. Formulation and solution by using Lagrange multiplier method. | 9 |
| Lab 28-30 –Tasks for testing the level of knowledge concerning methodology of formulation and solution of vibration problems of mechanical systems. | 3 |

TEACHING TOOLS

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| 1 - lecture with the use of multimedia presentations and computer equipped with the proper software, including COSMOS/M and PHASER packages. |
| 2 - computers equipped with the proper software, including COSMOS/M and PHASER packages |
| 3 – sample standard reports on the realised laboratory exercises |

SOURCE LITERATURE

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| 1. Skalmierski B.: Mechanics and Strength of Materials, Warszawa, PWN, 1979 |
| 2. Marciniak A., Gregulec D, Kaczmarek J.: Basic numerical procedures in Turbo Pascal for Your PC, Wydawnictwo Nakom, Poznań, 1991. |
| 3. COSMOS/M - Finite element analysis system, version 1.75, Structural Research & Analysis Corporation, 1995. |
| 4. Posiadała B.: Use of Lagrange multiplier formalism to analyze free vibrations of combined dynamical systems, Journal of Sound and Vibration 176(4), 1994, 563-572. |
| 5. Posiadała B.: Influence of crane support system on motion of the lifted load, Mechanism and Machine Theory 32(1), 1997, 9-20. |