GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | , PG_00056114 | | |
| Field of study | Mechatronics | | |
| Date of commencement of studies | October 2021 | Academic year of realisation of subject | 2023/2024 |
| Education level | first-cycle studies | Subject group | |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 3 | Language of instruction | Polish |
| Semester of study | 6 | ECTS credits | 2.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Department of Mechanics and Mechatronics -> Faculty of Mechanical Engineering and Ship Technology | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | prof. dr hab. inż. Krzysztof Kaliński | |
| | Teachers | prof. dr hab. inż. Krzysztof Kaliński | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 0.0 | 0.0 | 0.0 | 0.0 | 30 |

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 | 30 | 0.0 | 0.0 | 30 |

**Subject objectives**

Acquiring methods of modelling and simulation of dynamic phenomena in machine tools together with accompanying production processes.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_W08] knows and understands design and production processes of elements and simple mechatronic devices | Student identifies method for counteracting negative dynamical effects in machine tools | [SW3] Assessment of knowledge contained in written work and projects |
| [K6_W10] has a basic knowledge about development trends in terms of engineering and technical sciences and scientific disciplines: Mechanical Engineering, Automation, Electronics and Electrical Engineering, adequate for Mechatronics curse | Student analyse tool-workpiece vibration using selected models of cutting dynamics | [SW3] Assessment of knowledge contained in written work and projects |
| [K6_U06] is able to identify and formulate specification of simple, practical engineering tasks, distinctive for mechatronics | Student solves problems of machine tool dynamics and milling processes on the basis of computer simulations | [SU4] Assessment of ability to use methods and tools |
| [K6_U05] is able to use properly choosen tools to compare design solutions of elements and mechatronics systems according to given application and economic crtierions (e.g. power demand, speed, costs) | Student chooses optimal parameters of machining process according to a selected criteria. | [SU3] Assessment of ability to use knowledge gained from the subject |

**Subject contents**

LECTURES. Introduction: Free vibration. Forced vibration. Self-excited vibration. Modelling methods in dynamics of machine tools and machining processes: Rigid finite element method. Mixed method of finite elements. Stationary systems and systems whose configuration changes with time. Dynamics of the machine tool main driving system: Steady and unsteady states. Transverse, torsion and transverse-torsion vibration. Dynamics of the machine tool carrying system: Rigid and flexible structures of machine tools. Flexibility of constructional and slideway joints. Dynamics of the feed drive: The stick-slip self-excited vibration. Dynamics of cutting process: Proportional model. Kudinov model. Tobias-Fishwick-Das model. Nosyrieva-Molinari model. Jemielniak model. Inner and outer modulation of the cutting zone thickness. Tool-workpiece relative vibration: Self-excited chatter vibration. Turning. Flat surface milling. Curved surface machining. Dynamic problems of the metal high speed machining: Flexible end milling of rigid details. Milling of flexible details. Methods of vibration surveillance in time and frequency domain.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">Knowledge on subject Mechanics. Knowledge in scope of the mechanical vibration problems. Knowledge and experience in subject Fundamentals of automatic control. Knowledge on subject Modern machine tools and production processes. Knowledge and experience in subject Programming of Computer Systems. Skills of defining and solving the problems of mechatronic design .</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>3 team projects</td><td>100.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">1. Marchelek K.: Dynamics of machine tools (in Polish). 2nd edition. Warszawa: WNT 1991.<br>2. Tomków J.: Vibrostability of machine tools (in Polish). Warszawa: WNT 1997.<br>3. Jemielniak K.: Cutting machining (in Polish). Warszawa: Publishing Annexe of Warsaw University of Technology 1998.<br>4. Kaliński K.: Vibration surveillance of mechanical systems which are idealised discretely (in Polish). Series Monographs no 22. Gdańsk: The GUT Publishing House 2001.<br>5. Galewski M., Kaliński K.: Vibration surveillance at high speed slender milling with a use of changing spindle speed (in Polish). Gdańsk: The GUT Publishing House 2009.<br>6. Kaliński K. J.: A surveillance of dynamic processes in mechanical systems (in Polish). Gdańsk: The GUT Publishing House 2012.</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">1. Bodnar A.: Diagnostics of self-excited vibration of a system machine tool cutting process (in Polish). Scientific Publications of Szczecin University of Technology 2006, No 595, Institute of Mechanical Production 18.<br>2. Powałka B.: Methodology of forming vibrostability of a system machine tool cutting process (in Polish). Scientific Publications of Szczecin University of Technology 2007, No 586, Institute of Mechanical Production 17.<br>3. Metal Cutting and High Speed Machining (red. Dudzinski D., Molinari A. Schulz H). New York: Kluwer Academic/Plenum Publishers 2001.</td></tr>
<tr><td>eResources addresses</td><td colspan="2">Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">1. Determination of natural frequencies and normal modes of discrete model of a machine tool.<br>2. Determination of a stability lobe in case of one-dimensional cutting process model.<br>3. Computer simulations of vibration during chosen machining processes.</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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