GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	VIBROACOUSTIC DIAGNOSTICS OF ELECTRIC MACHINES AND DRIVES, PG_00057623		
Field of study	Electrical Engineering		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2022/2023
Education level	second-cycle studies	Subject group	
Mode of study	Part-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Electrical Engineering of Transport -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Dariusz Karkosiński	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	10.0	0.0	10.0	0.0	0.0	20

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	20	10.0	45.0	75

Subject objectives

Learning to perform vibroacoustic diagnostic measurements of machines and electric drives and assessing their technical condition.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_W01	The student is able to perform a spectral analysis of diagnostic signals obtained by measuring transducers of vibrations, noise and current.	[SW3] Assessment of knowledge contained in written work and projects
K7_U03	Based on the literature studies of the latest Polish and European publications, the student updates the normative requirements for the assessment of the condition of machines and electric drives using the estimates of vibroacoustic parameters	[SU2] Assessment of ability to analyse information
K7_W02	The student configures measuring instrumentation to determine vibroacoustic characteristics of machines and electric drives. The student assesses the environmental conditions of the tests and carries out a series of vibration and acoustic diagnostic tests of the above-mentioned devices and assesses their technical condition.	[SW2] Assessment of knowledge contained in presentation
K7_U02	The student discusses selected issues related to vibroacoustic diagnostics of machines and electric drives	[SU1] Assessment of task fulfilment

<table>
<tr><td>Subject contents</td><td>Types and course of diagnostic tests of electrical machines. Methods of describing mechanical vibrations: degrees of freedom, kinematic models, equations of motion of vibrating systems. The causes of vibrations and the forms of vibrational deformation of the stators of electric machines. Parameters and estimates of vibration signals. Sensors and systems for measuring mechanical vibrations. Methods of analyzing vibration and noise signals. Types of damage and degradation of the condition of electric machines diagnosed on the basis of vibration and noise measurements. Causes of vibrations and noise of electric drives. Types of acoustic fields: ideal and real. Assessment parameters and methods for measuring the noise level of converter electric drives. Technological aspects of the dispersion of vibroacoustic parameters of machines and electric drives.

Lab:

1. Examination of vibrations and evaluation of the vibrational state of an asynchronous motor when supplied from the mains and from an inverter
2. Tests of acoustic power and directional characteristics of an asynchronous motor with mains and inverter supply 3. Determination of the spectrum of vibrations and noise of an asynchronous motor with mains and inverter supply 4. Determination of the spectrum of vibrations and noise of a drive with a permanent magnet synchronous motor at variable speed and load
5. Diagnostic vibrational examination of bearing systems 6. Determination of the directional characteristics of engine noise and the level of acoustic power of the engine.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Theory of electrical machines</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Assessment of laboratory reports</td><td>50.0%</td><td>40.0%</td></tr>
<tr><td>Test of the content of the lectures</td><td>50.0%</td><td>60.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>D. Karkosiński, Zjawiska wibroakustyczne w asynchronicznych silnikach klatkowych. Monografie nr 69, Politechnika Gdańska 2006

R. Łączkowski, Wibroakustyka maszyn i urządzeń. WN-T Warszawa 1983</td></tr>
<tr><td>Supplementary literature</td><td>J. Morel. Drgania maszyn i diagnostyka ich stanu technicznego. PTDT 1997

R.B.Randall, Frequency analysis. Bruel&Kjaer 1987

J.F.Gieras, Ch.Wang, J.Ch. Lai, Noise of polyphase electric motors. CRC Press, Taylor&Francis Group, New York 2006

Z.Q.Zhu, Noise and vibration in variable-speed electrical machine of drives. University of Sheffield, UK 2002

P.L.Timar, Noise and vibration of electrical machines. Akademiai Kiado, Budapest 1989</td></tr>
<tr><td>eResources addresses</td><td>Uzupełniające
Adresy na platformie eNauczanie:</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. List the mechanical and magnetic causes of vibrations and noise of electric machines.
2. Present the forms of radial vibration patterns of induction motor hulls.
3. Specify the frequency of at least two harmonic components of the vibrations of a 4-pole squirrel-cage motor supplied from the mains with a frequency of 60 Hz.
4. What is the natural frequency of the stator structure?
5. What is the resonant frequency of the stator structure?
6. Discuss the method of diagnosing vibrational condition of bearings.
7. What parasitic physical quantities may be the source of measurement errors when measuring vibrations of the body of induction motors with piezoelectric transducers?
8. Non-axial mounting of the induction motor rotor causes uneven distribution of induction in the gap. How can this condition be diagnosed by analyzing the stator voltage and current?
9. What estimates of vibration signals are analyzed and how are they analyzed during the supervision (monitoring) of the motor rolling element bearings?
10. Discuss the acoustic conditions requirements in order to assess the noise level emitted by the machine.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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