

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	DINAMIKA IN VIBRACIJE
Course title:	DYNAMICS AND VIBRATIONS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Strojništvo, tretja stopnja, doktorski	Konstruktivno mehanske inženirske znanosti (smer)		Celoletni

Univerzitetna koda predmeta/University course code:

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
90					160	10

Nosilec predmeta/Lecturer:

Izvajalci predavanj:	Miha Boltežar
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type:

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina, Angleščina
	Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Veljajo splošni pogoji za doktorski študij.	General prerequisites for the third level studies.

Vsebina:

Nihanja linearnih sistemov z več prostostnimi stopnjami. Modalna transformacija. Odziv sistemov v glavnih koordinatah.
Nihanja zveznih sistemov, analitične in približne metode. Osnove nihanj nelinearnih sistemov. Vibracijska testiranja.
Eksperimentalni pristop pri obvladovanju vibracij. Analiza dinamskih spremenljivk v časovnem in frekvenčnem prostoru.
Kriteriji stabilnosti gibanja.
Dinamika rotorjev, izračun kritičnih vrtilnih hitrosti.
Masno uravnotežanje rotorjev.
Dinamika batnih strojev.
Preračun vibroizolacije elastično podprtih motorjev.
Torzijska nihanja gredi. Osnove nihanj plošč, nihanje rotirajočih palic.
Slučajna nihanja linearnih sistemov. Obdelava in vrednotenje izmerjenih slučajnih nihanj. Interakcija

Content (Syllabus outline):

Vibrations of linear systems with several degrees-of-freedom. Modal transformation. The response of the system in modal coordinates.
Vibrations of continuous systems, analytical and approximate methods. The basic principles of nonlinear vibrations.
Vibration testing.
Experimental work in vibrations. Analysis of measured variables in the time and frequency domains.
Dynamic stability.
Rotor dynamics, determination of critical speed of rigid and flexible rotors. Mass balancing of rotors.
Dynamics of reciprocating engines.
Vibroisolations of elastically mounted engines.
Torsional vibrations of shafts. Basics of vibrations of plates, vibrations of rotating bars.
Random vibrations, theoretical and experimental aspects.
Human response to vibrations.

človek – vibracije.	
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Temeljna literatura in viri/Readings:

<p>[1] Rao, S.S.: Mechanical vibrations.- 3rd ed.- Reading etc.: Addison-Wesley Publishing Company, cop. 1995.</p> <p>[2] Rao, J.S.: Dynamics of plates.- New York; Basel; Hong Kong: M. Dekker; New Delhi etc.: Narosa, cop. 1999.</p> <p>[3] Frolov, K.V., Furman, F.A.: Applied theory of vibration isolation systems.- New York etc.: Hemisphere, 1990.</p> <p>[4] McConnell, K.G.: Vibration testing: theory and practice.- New York etc.: John Wiley & Sons, cop. 1995.</p> <p>[5] Lee, Chong-Won: Vibration analysis of rotors.- Dordrecht; Boston; London: Kluwer Academic, cop. 1993.- (Solid mechanics and its applications; vol. 21)</p> <p>[6] Newland, D.E.: An introduction to random vibrations: spectral and wavelet analysis, 3rd ed.- Longman, 1997. - Izbrana poglavja</p> <p>[7] Griffin, M.J.: Handbook of human vibration – 2nd ed.- London etc.: Academic Press, 1994, cop. 1990. - Izbrana poglavja</p>

Cilji in kompetence:

<p>Cilji: Cilji predmeta so nagradnja znanj iz druge stopnje na področju dinamike ter vibracij za dosego sposobnosti samostojnega reševanja specialne problematike, tako v fazi razvoja izdelkov, njihovi izdelavi kot tudi pri transportu ter vzdrževanju.</p> <p>Kompetence: Študent postane sposoben identifikacije, modeliranja ter merjenja tipičnih dinamskih pojavov v strojništvu. To so predvsem nihanja realnih sistemov z več prostostnimi stopnjami, zagotavljanje ustrezne vibroizolacije za zaščito naprav ter okolice, razumevanje problematike vibracijskih testiranj.</p>	<p>Objectives and competences:</p> <p>Goals: The aim of the course is to upgrade the previously learned knowledge in the field of dynamics and vibrations in order to achieve the level of independent researcher in the design phase of the products, manufacturing phase as well as at transport and maintenance.</p> <p>Competences: The student acquires specific knowledge of identification, modelling and experimentation of typical dynamic phenomena in mechanical engineering, connected to mechanical vibrations. This includes specifically vibrations of multi-degree-of-freedom systems, vibroisolation to protect machinery and environment and understanding of vibration testing.</p>
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Predvideni študijski rezultati:

<p>Študent postane sposoben identifikacije, modeliranja ter merjenja tipičnih dinamskih pojavov v strojništvu. To so predvsem nihanja realnih sistemov z več prostostnimi stopnjami, zagotavljanje ustrezne vibroizolacije za zaščito naprav ter okolice, razumevanje problematike vibracijskih testiranj.</p>	<p>Intended learning outcomes: The student acquires specific knowledge of identification, modelling and experimentation of typical dynamic phenomena in mechanical engineering, connected to mechanical vibrations. This includes specifically vibrations of multi-degree-of-freedom systems, vibroisolation to protect machinery and environment and understanding of vibration testing.</p>
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Metode poučevanja in učenja:

<p>Predavanja, laboratorijske vaje, seminarsko delo, e-izobraževanje, konzultacije. Seminarsko delo v čim večji meri navezuje se na področje doktorskega raziskovanja. Študij z uporabo priporočene literature.</p>	<p>Learning and teaching methods: Lectures, laboratory practice & seminar work, e-education, consulting. The seminar work is related, as much as possible, to the student's doctoral research field. Study on a recommended literature basis.</p>
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Načini ocenjevanja:

<p>Ustni izpit (50%), poročilo o seminarskem delu (50%). Pogoji za opravljanje ustnega izpita je uspešno izdelano in pozitivno ocenjeno seminarsko delo.</p>	<p>Delež/Weight</p>	<p>Assessment: Oral exam (50%), report on seminar work (50%). The condition for admission to oral exam is successful completion of seminar work, rewarded with a passing grade.</p>
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Reference nosilca/Lecturer's references:

<p>prof. dr. Miha BOLTEŽAR RAZPOTNIK, Matej, BISCHOF, T., BOLTEŽAR, Miha. The influence of bearing stiffness on the vibration properties of statically overdetermined gearboxes. Journal of sound and vibration, ISSN 0022-460X. [Print ed.], Sep. 2015, vol. 351,</p>

str. 221-235, ilustr., doi: 10.1016/j.jsv.2015.04.021.

SLAVIČ, Janko, BOLKA, Špela, BRATUŠ, Vitoslav, BOLTEŽAR, Miha. A novel laboratory blanking apparatus for the experimental identification of blanking parameters. *Journal of materials processing technology*, ISSN 0924-0136. [Print ed.], Feb. 2014, vol. 214, iss. 2, str. 507-513, ilustr., doi: 10.1016/j.jmatprotec.2013.10.006.

JAVORSKI, Matija, ČEPON, Gregor, SLAVIČ, Janko, BOLTEŽAR, Miha. A generalized magnetostrictive-forces approach to the computation of the magnetostriction-induced vibration of laminated steel structures. *IEEE transactions on magnetics*, ISSN 0018-9464, 2013, vol. 49, no. 11, str. 5446-5453, doi: 10.1109/TMAG.2013.2269316.

ŠKOFIC, Jan, BOLTEŽAR, Miha. Numerical modelling of the rotor movement in a permanent-magnet stepper motor. *IET electric power applications*, ISSN 1751-8660, 2014, vol. 8, iss. 4, str. 155-163, ilustr. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6786889>, doi: 10.1049/iet-epa.2013.0274.