UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Dinamika togih teles
Course title:	Rigid body dynamics
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Strojništvo - razvojno raziskovalni program, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0562750
Koda učne enote na članici/UL Member course code:	2013-U

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
45		30			75	6

Nosilec predmeta/Lecturer:	Janko Slavič, Miha Boltežar
Vrsta predmeta/Course type:	Obvezni splošni predmet / Compulsory general course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Izpolnjevanje pogojev za vpis v Univerzitetni študijski program I. stopnje Strojništvo - Razvojno raziskovalni program.	Meeting the enrollment conditions for the Academic study programme of Mechanical Engineering - Research and Development program.

Vsebina:	**Content (Syllabus outline):**
. predavanje - Uvod v predmet, pojasnitev sistema pri predmetu - Dinamika masne točke: osnovni zakoni, Newton, impulz, vztrajnostna sila, impulzni stavek, delo sile 2. predavanje - Gibalna količina, vrtilna količina - Kinetična, potencialna energija, mehanska energija 3. predavanje - Dinamika sistema masnih točk; definicija osnvonih pojmov, zakon o gibanju masnega središča 4. predavanje	1. lecture • Introduction to the course • Dynamics of point mass: basic laws, Newton, impulse, inertia force, work 2. lecture • Linear momentum, angular momentum • Kinetic, potential, mechanical energy 3. lecture

- Zakon o gibalni količini, zakon o vrtilni količini glede na različne točke 5. predavanje - Vrtilna količina pri rotaciji masnega sistema, definicija masnega vztrajnostnega momenta - MVM 6. predavanje - MVM - vzporedni premik osi, zavrtitev osi; glavni masni vztrajnostni momenti 7. predavanje - Dinamika togega telesa, splošno. Dinamika togega telesa v ravnini, sile, momenti, energija 8. predavanje - Vrtenje togega telesa okoli stalne osi, masno uravnotežanje togih rotorjev 9. predavanje - Trk 10. predavanje - Osnove mehanskih nihanj, pogoji za nastanek nihanj, klasifikacija nihanj. Lastna nedušena nihanja sistema z 1. pr. st. 11. predavanje - Lastna dušena nihanja sistema z 1. pr. st. 12. predavanje - Vsiljena nihanja sistema z 1. pr. st. s harmonsko motnjo, resonanca 13. predavanje - Vsiljena nihanja s harmonsko motnjo 14. predavanje - Lastna nihanja sistema z 2 pr. st. 15. predavanje - Vsiljena nihanja sistema z 2 pr. st., primeri iz prakse	• Dynamics of the system of point masses; definition of basic concepts, dynamics of mass center of motion 4. lecture • Linear and angular momentum of a system of point masses 5th lecture • Angular momentum of rigid bodies, definition of mass moment of inertia 6th lecture • Mass moment of inertial in rigid coordinate tranformations 7th lecture • Rigid body dynamics in general and planar motion; forces, moments, energy 8. lecture • Rotation of rigid body around a constant axis, mass balancing of rigid rotors 9th lecture • Impact of rigid bodies 10. lecture • Introduction to mechanical vibrations, classification of vibrations. Free vibration of a single degree of freedom system 11. lecture • Damped vibration of a single degree of freedom system 12. lecture • Forced vibration of a single degree of freedom system 13. lecture • Harmonic excitation of vibration of a single degree of freedom system 14. lecture • Free vibration of a two degree of freedom system 15. lecture Forced vibration of a two degree of freedom system, examples from practice

Temeljna literatura in viri/Readings:

1. Boltežar M: Mehanska nihanja – del, druga izdaja, Fakulteta za strojništvo, 2010

2. Slavič J: Dinamika, mehanska nihanja in mehanika tekočin, 2017
3. Meriam J.L., Kraige L. G., Engineering Mechanics: Dynamics, 2015

Cilji in kompetence:	**Objectives and competences:**
Cilji: 1. Samostojno in skupinsko definiranje dinamskih modelov glede na podani razvojni problem 2. Pravilne razčlenitve dinamskih problemov na podprobleme in njihova nadgradnja z namenom razvoja 3. Kompetentno predstavljanje in zagovarjanje dinamskih problemov 4. Razumeti osnovne dinamske meritve Kompetence: 1. Sposobnost samostojnega in skupinskega definiranja dinamskih modelov glede na tehnični problem (S1-RRP, S2-RRP, S3-RRP, S4-RRP, S5-RRP, S6-RRP, S8-RRP, P6-RRP) 2. Sposobnost pravilne razčlenitve dinamskih problemov (S2-RRP, S3-RRP, P1-RRP, P3-RRP, P5-RRP, P6-RRP) 3. Sposobnost predstavitve dinamskih problemov (P2-RRP, P3-RRP, P4-RRP) 4. Sposobnost osnovnih dinamskih meritev (P2-RRP, P3-RRP)	Objectives: 1. Independent and collaborative definition of dynamic models according to the given development challenge 2. Correct breakdown of dynamic problems into subproblems for the purpose of development 3. Competent presentation and advocacy of dynamic problems 4. Understand basic dynamic measurements Competencies: 1. Ability to independently and grouply define dynamic models according to a technical problem (S1-RRP, S2-RRP, S3-RRP, S4-RRP, S5-RRP, S6-RRP, S8-RRP, P6-RRP) 2. Ability to correctly analyze dynamic problems (S2-RRP, S3-RRP, P1-RRP, P3-RRP, P5-RRP, P6-RRP) 3. Ability to present dynamic problems (P2-RRP, P3-RRP, P4-RRP) 4. Ability to perform basic dynamic measurements (P2-RRP, P3-RRP)

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanja: Z1: Poglobljeno teoretično in praktično znanje na področju dinamike in vibracij podprto s širšo teoretično in metodološko osnovo. Spretnosti: 1. S1: sistematični pristop k definiranju mehanskih modelov. 2. S1.2: izvajanja osnovnih mehanskih meritev 3. S1.3: razčlenitev inženirskega problema na poenostavljenega	Knowledge: Z1: In-depth theoretical and practical knowledge of dynamics and vibration supported by a broader theoretical and methodological basis. Skills: 1. S1.1: A systematic approach to defining mechanical models. 2. S1.2: performing basic mechanical measurements 3. S1.3: breakdown of the engineering problems into simplified ones

Metode poučevanja in učenja:	**Learning and teaching methods:**
P1 Avditorna predavanja z reševanjem izbranih za področje značilnih teoretičnih in praktično uporabnih primerov. P3 Avditorne vaje, kjer se teoretično znanje spredavanj podkrepi z računskimi primeri. P4 Laboratorijske vaje z namenskimi didaktičnimi	P1 Lectures with solving of selected theoretical and practical examples. P3 Practical classes where theoretical knowledge of the lessons is supported by computational examples. P4 Laboratory exercises with dedicated teaching aids: collision analysis, balancing device, pendulum.

pripomočki: analiza trka, balansirna naprava, nihalo. P6 Interaktivna predavanja P10 Uporaba anket v realnem času P12 Individualizirane domače naloge v spletni učilnici P13 Individualizirani kolokviji in izpiti s samodejnim popravljanjem P14 Virtualni eksperimenti P15 Uporaba video vsebin kot priprava na predavanja in vaje	P6 Interactive Lectures P10 Use of instant real-time surveys P12 Individualized online homeworks P13 Individual examinations and exams with automatic evaluation P14 Virtual Experiments P15 Use video content

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
sodelovanje pri laboratorijskih vajah (vsaj 80%)	5,00 %	laboratory work (at least 80%)
preizkus iz vaj / seminarsko delo (vsaj 50%)	45,00 %	exam / seminar work (at least 50%)
preizkus iz teorije (vsaj 50%)	50,00 %	theory exam (at least 50%)
Ustni zagovor predloga ocene.		Oral defense of the proposed grade.

Reference nosilca/Lecturer's references:

Miha Boltežar

1. SLAVIČ, Janko, KNEZ, Luka, **BOLTEŽAR, Miha**. The importance of harmonic versus random excitation for a human finger. *International journal of mechanical sciences*. [Online ed.], Oct. 2017, vol. 131/132, str. 507-515, ilustr.
2. KRANJC, Tadej, SLAVIČ, Janko, **BOLTEŽAR, Miha**. An interface force measurements-based substructure identification and an analysis of the uncertainty propagation. *Mechanical systems and signal processing : MSSP*, ISSN 0888-3270. [Tiskana izd.], May 2015, vol. 56/57, str. 2-14, ilustr.
3. 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.

Janko Slavič

1. ARH, Matic, **SLAVIČ, Janko**, BOLTEŽAR, Miha. Experimental identification of the dynamic piezoresistivity of fused-filament-fabricated structures. *Additive manufacturing*, ISSN 2214-8604. [Print ed.], Dec. 2020, vol. 36, str. 1-10. [COBISS.SI-ID 27578883].
2. CAPPONI, Lorenzo, **SLAVIČ, Janko**, ROSSI, Gianluca, BOLTEŽAR, Miha. Thermoelasticity-based modal damage identification. *International journal of fatigue*, ISSN 0142-1123, 2020, vol. 137, str. 1-9. [COBISS.SI-ID 13602307].
3. LISITANO, Domenico, **SLAVIČ, Janko**, BONISOLI, Elvio, BOLTEŽAR, Miha. Strain proportional damping in Bernoulli-Euler beam theory. *Mechanical systems and signal processing*, ISSN 0888-3270, 2020, vol. 145, str. 1-15. [COBISS.SI-ID 13592835].
4. OGRINEC, Primož, **SLAVIČ, Janko**, ČESNIK, Martin, BOLTEŽAR, Miha. Vibration fatigue at half-sine impulse excitation in the time and frequency domains. *International journal of fatigue*, ISSN 0142-1123, Jun. 2019, vol. 123, str. 308-317. [COBISS.SI-ID 16539419].
5. GORJUP, Domen, **SLAVIČ, Janko**, BOLTEŽAR, Miha. Frequency domain triangulation for full-field 3D operating-deflection-shape identification. *Mechanical systems and signal processing*, ISSN 0888-3270, Nov. 2019, vol. 133, str. 1-13. [COBISS.SI-ID 16751899].