UČNI NAČRT PREDMETA / COURSE SYLLABUS

Ime predmeta:	OSNOVE MEHATRONIKE V LOGISTIKI
Course title:	FUNDAMENTALS OF MECHATRONICS IN LOGISTICS

Študijski program in stopnja Study programme and cycle	Študijska smer Study option	Letnik Year of study	Semester Semester
GOSPODARSKA IN TEHNIŠKA LOGISTIKA 1. stopnja		1.	2.
PROFESSIONAL HIGHER EDUCATION STUDY PROGRAMME ECONOMIC AND TECHNICAL LOGISTICS 1st degree		1.	2.

Vrsta predmeta (obvezni ali izbirni) /
Course type (compulsory or elective)

OBVEZNI
COMPULSORY

Univerzitetna koda predmeta / University course code:

VS

Predavanja Lectures	Seminar Seminar	Vaje Tutorial			Klinične vaje Clinical training	Druge oblike študija Other forms of study	Samost. delo Individual work	ECTS
15 e-P 45 a-P		**A-V**	**E-V**	**LV**			90	6
		15	5	10				

Nosilec predmeta / Course coordinator:

DARKO HERCOG

Jeziki /Languages:

	Predavanja / Lectures:	SLOVENSKI/SLOVENE
	Vaje / Tutorial:	SLOVENSKI/SLOVENE

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites for enrolling in the course or for performing study obligations:
Ni pogojev.	No special conditions.

Vsebina (kratek pregled učnega načrta):	Content (syllabus outline):
Statika Sila v kartezijevem koordinatnem sistemu, zunanje in notranje sile, ravnotežje sil, moment, Varignonov teorem, moment dvojice sil, koncentrirane sile ali točkovne obremenitve, kontinuirane obremenitve, trenje na ravni podlagi in na kolutih. Kinematika in kinetika Pot, hitrost, pospešek, enakomerno gibanje, enakomerno pospešeno gibanje, kroženje, kotni pospešek, gibalna količina, delo, moč, energija, trk, gibanje teles spremenljive mase. Mehanika vožnje	Statics Force in the cartesian coordinate system, internal and external forces, the balance of forces, moment, Varignon's theorem, moment of a force couple, concentrated force or point loads, continuous loads, friction at the surface and discs. Kinematics and kinetics Displacement, velocity, acceleration, uniform motion, uniformly accelerated motion, circular motion, angular acceleration, momentum, work, power, energy, collision, motion of bodies with variable mass. Mechanics of driving

Mehanski model vozila, sile in odpori pri gibanju vozila, zavore, vozilo na konveksni in na konkavni podlagi, varovanje tovora proti zdrsu in prevračanju. Elektrostatika Elektrostatično polje, električni potencial in električna napetost, kapacitivnost in kondenzator, energija električnega polja. Enosmerni električni tok Ohmov zakon, Kirchoffova zakona, električna moč in delo, Joulov zakon. Magnetno polje Izvori magnetnega polja, sila na tokovodnik v magnetnem polju, Amperov zakon, magnetilna krivulja in histerezna zanka, induktivnost tuljave, Faradayev zakon elektromagnetne indukcije. Izmenični električni tok Sinusna izmenična napetost, izmenični tokokrogi, enofazni in večfazni sistemi. Električni motorji Motorji na enosmerni in na izmenični tok, sinhronski motorji, asinhronski motorji, servomotorji. Elektronika Elektronska vezja, mikroprocesorji, senzorji, črtna koda, RFID.	Mechanical model of the vehicle, forces and resistances in the movement of the vehicle, brakes, vehicle on the convex and concave surface, protecting cargo against slipping and tipping. Electrostatic Electrostatic field, electric potential and voltage, capacitance and capacitor, energy of the electric field. Direct electric current Ohm's law, Kirchoff's law, electric power and work Joule's law. Magnetic field Origins of the magnetic field, force on a conductor in a magnetic field, Ampere's law, magnetic curve and hysteresis loop, inductance of the coil, Faraday's law of electromagnetic induction. Alternating electric current Sinusoidal alternating voltage, alternating current circuits, single-phase and multi-phase systems. Electric motors Motors on direct and alternating current, synchronous motors, induction motors, servomotors. Electronics Electronic circuits, microprocessors, sensors, bar code, RFID.

Temeljni literatura in viri / Reading materials:

E-gradivo predmeta.

Lerher, T. (2016) Mehatronski sistemi v logistiki. 1, Mehanika. Univerza v Mariboru, Fakulteta za logistiko.

Lerher, T., Potrč, I. (2017) Transportni sistemi v intralogistiki. Univerza v Mariboru, Fakulteta za logistiko.

Rojko, A., Hercog, D. (2010), Uvod v mehatroniko / Introduction to Mechatronics, Univerza v Mariboru, Fakulteta za elektrotehniko računalništvo in informatiko, ISBN 978-961-248-211-4.

Cetinkunt, S. (2015), Mechatronics with Experiments, 2nd Edition, Wiley, ISBN: 978-1118802465.

Bolton, W. (2016), Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th Edition, Pearson, ISBN: 978-1292076683.

Hibbeler, R.C. (2013) Mechanics of Materials, 9th edition, Pearson, ISBN: 978-0133254426.

Hibbeler, R.C. (2010) Engineering Mechanics - Dynamics, 12th edition, Pearson, ISBN: 978-0136077916.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je seznaniti študente z osnovnimi teoretičnimi in praktičnimi znanji s področja mehatronike. Študenti pridobijo znanja in veščine, ki jim omogočajo samostojno reševanje osnovnih mehatronskih problemov v praksi.	The objective of this course is to acquaint students with basic theoretical and practical knowledge in the field of mechatronics. Students acquire knowledge and skills that enable them to solve basic mechatronic problems in practice.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Po opravljenem izpitu bo študent sposoben: • razumeti osnovne fizikalne zakone statike, dinamike, kinematike in elektrotehnike, • razumeti osnovno delovanje električnih in mehanskih komponent mehatronskih naprav,	Upon passing the exam, students will be able to: • understand the basic physical laws of statics, dynamics, kinematics and electrical engineering, • understand the basic operation of electrical and mechanical components of mechatronic devices,

• pridobljeno znanje uporabiti pri reševanju praktičnih mehatronskih problemov v logistiki.	• use the acquired knowledge for solving professional mechatronic problems in logistics.

Metode poučevanja in učenja:

Learning and teaching methods:

Predavanja: pri predavanjih študent spozna teoretične vsebine predmeta. Del predavanj se izvaja na klasični način v predavalnici, del pa v obliki e-predavanj (e-predavanja se lahko izvajajo na videokonferenčni način ali s pomočjo posebej v ta namen didaktično pripravljenih e-gradiv v virtualnem elektronskem učnem okolju). Vaje: pri vajah študent utrdi teoretično znanje in spozna aplikativne možnosti. Del vaj se izvaja na klasični način v predavalnici, del pa v obliki e-vaj (e-vaje se lahko izvajajo na videokonferenčni način ali s pomočjo posebej v ta namen didaktično pripravljenih e-gradiv v virtualnem elektronskem učnem okolju).	Lectures: students understand the theoretical frameworks of the course. Part of the lecture course is in a classroom while the rest is in the form of e-learning (e-lectures may be given via video-conferencing or with the help of specially designed e-material in a virtual electronic learning environment). Tutorials: Students enhance their theoretical knowledge and are able to apply it. Part of the seminar is in a classroom while the rest is in the form of e-learning (e-tutorials may be given via video-conferencing or with the help of specially designed e-material in a virtual electronic learning environment).

Načini ocenjevanja:	Delež (v %) / Share (in %)	Assessment methods:
• Opravljene obveznosti e-predavanj in e-vaj so pogoj za pristop k izpitu. • Pisni izpit, • ustni izpit, • laboratorijske vaje (za uspešno opravljen predmet je potrebno, da so vsi trije deli izpita ocenjeni več kot 50 %).	 30% 50% 20%	• Successful competition of e-lectures and e-tutorials is a prerequisite for entering the exam. • Written exam, • oral exam, • laboratory work (to successfully pass the exam, all three parts of the exam needs to be evaluated above 50 %).

Reference nosilca / Course coordinator's references:

Članki v revijah / Journal articles

• D. Hercog and B. Gergič, "A Flexible Microcontroller-Based Data Acquisition Device," Sensors, vol. 14, no. 6, pp. 9755-9775, 2014. [Online]. Available: http://www.mdpi.com/1424-8220/14/6/9755.
• B. Gergič and D. Hercog, "Design and implementation of a measurement system for high-speed testing of electromechanical relays." Measurement, vol. 135, pp. 112-121, 2019.
• ZÜRCHER, Thomas, ROJKO, Andreja, HERCOG, Darko. Education in industrial automation control by using remote workplaces. V: exp.at'15 : conference proceedings. [S. l.]: IEEE. 2015, str. 17-21. [COBISS.SI-ID 18946838].
• ROJKO, Andreja, ŠPANER, Marijan, HERCOG, Darko. Sustainable energy education : hybrid electric vehicles. V: *11th International conference on remote engineering and virtual instrumentation (REV), Porto, Portugal from 26-28 February, 2014 : [proceedings]*, International Conference on Remote Engineering and Virtual Instrumentation, Porto, Portugal from 26-28 February, 2014. Piscataway: IEEE. cop. 2014, str. 332-338. [COBISS.SI-ID 17699606], [WoS do 10. 4. 2017: št. citatov (TC): 1, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.33, Scopus do 27. 11. 2018: št. citatov (TC): 5, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 1.00].
• ROJKO, Andreja, ŠPANER, Marijan, HERCOG, Darko. Drivetrain and combined energy storage system for electric hybrid vehicle : SustEner learning module. V: BAUER, Pavol (ur.), VITEK, Ondrej (ur.), ROJKO,

Andreja (ur.). *Teaching energy for sustainable world SustEner : SustEner learning modules*. Brno: MSD. 2014, str. 181-251. [COBISS.SI-ID 18440470].