UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Ime predmeta:	MEHATRONSKI SISTEMI V LOGISTIKI
Course title:	MECHATRONICS SYSTEMS IN LOGISTICS

Študijski program in stopnja Study programme and cycle	Študijska smer Study option	Letnik Year of study	Semester Semester
LOGISTIKA SISTEMOV 1. stopnja		1.	2.
SYSTEM LOGISTICS 1st degree		1.	2.

Vrsta predmeta (obvezni ali izbirni) / Course type (compulsory or elective)	OBVEZNI COMPULSORY
Univerzitetna koda predmeta / University course code:	UN

Predavanja Lectures	Seminar Seminar	Vaje Tutorial			Klinične vaje Clinical training	Druge oblike študija Other forms of study	Samost. delo Individual work	ECTS
45 a-P 15 e-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):**
• Modeli sil, aktivne (bremena) in pasivne (reakcijske) sile, moment dvojice sil, redukcija sil. Težišča teles. Trenje na ravni podlagi in na kolutih. Nosilci, paličja, mešani sistemi. Napetosti in deformacije, Hookov zakon. • Pot, hitrost, pospešek, enakomerno gibanje, enakomerno pospešeno gibanje, kroženje, kotni pospešek. Relativno gibanje. D'Alembertov princip. Izrek o gibanju masnega središča, gibalni in vrtilni količini ter mehanski energiji. Impulzivno gibanje in trk. Dinamika teles spremenljive mase. • Elektrostatika, električna napetost in električni potencial. Kondenzator, kapacitivnost. • Ohmov zakon, ohmska upornost. Kirchhoffova zakona, Joulov zakon, enosmerna električna vezja.	• Force models, active (load) and passive (reaction) forces, moment of a force couple, force reduction. Centres of gravity of bodies. Friction on flat surface and discs. Beams, trusses, mixed systems. Stresses and deformations, Hook's Law. • Displacement, velocity, acceleration, uniform motion, uniformly accelerated motion, circular motion, angular acceleration. Relative motion. D'Alemebrt's Principle. Theorem on motion of mass centre, motion and rotation quantity and mechanical energy. Impulsive motion and collision. Dynamics of bodies with changeable mass. • Electrostatics, electric voltage and electrical potentials. Capacitor, capacitance. • Ohm's Law, ohm resistance. Kirchhoff's Laws, Joule's Law, direct current circuits.

• Magnetno polje premega tokovodnika. Magnetilna krivulja in histerezna zanka. Sila na tokovodnik v magnetnem polju. Induktivnost tuljave. Faradayev zakon elektromagnetne indukcije. • Izmenični tokokrogi. Enofazni in večfazni sistemi. Električne meritve. Električni stroji in transformatorji. Električna oprema in naprave. • Polprevodniki, polprevodniške diode, tranzistorji, tiristorji. Integrirana elektronska vezja. Analogni sistemi. • Digitalni sistemi. Sekvenčna vezja. Družine logičnih vezij. Mikroprocesorji in programirana logična vezja. Senzorji in aktuatorji. Črtna koda in RFID.	• Magnetic field of a linear conductor. Magnetic curve and hysteresis loop. Force on a conductor in a magnetic field. Coil inductivity. Faraday's Law of electromagnetic induction. • Alternating current circuits. Single- and multi-phase systems. Electrical measurements. Electrical engines and transformers. Electrical equipment and devices. • Semiconductors, semiconductor diodes, transistor. Integrated electronic circuits. Analogue systems. • Digital systems. Sequential circuits. Families of logical circuits. Microprocessors and programmed logical circuits. Sensors and actuators. Bar code and 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.
Bolton, W. (2016), Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th Edition, Pearson, ISBN: 978-1292076683.
Cetinkunt, S. (2015), Mechatronics with Experiments, 2nd Edition, Wiley, ISBN: 978-1118802465.
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 s poglobljenimi teoretičnimi znanji s področja mehatronike. Študenti pridobijo znanja, ki jim omogočajo samostojno teoretično reševanje mehatronskih problemov v logistiki.	The objective of this course is to acquaint students with in-depth theoretical knowledge in the field of mechatronics. Students acquire knowledge that enables them to solve theoretical mechatronic problems in logistics.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Po opravljenem izpitu bo študent sposoben: • razumeti in uporabiti fizikalne zakone mehanike in elektrotehnike, • razumeti in podrobneje razložiti delovanje posameznih električnih in mehanskih komponent mehatronskih naprav, • analizirati in reševati teoretične ter praktične mehatronske probleme v logistiki.	Upon passing the exam, students will be able to: • understand and apply the physical laws of mechanics and electrical engineering, • understand and explain in more detail the operation of individual electrical and mechanical components of mechatronic devices, • be able to analyse and solve theoretical and practical 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	Lectures: by 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-

namen didaktično pripravljenih e-gradiv v virtualnem elektronskem učnem okolju). Vaje: pri vajah študent utrdi teoretično znanje in spozna aplikativne možnosti mehatronskih sistemov v logistiki. Vaje se izvajajo na klasični način v predavalnici, v obliki laboratorijskih vaj ter v okviru elektronskega učnega okolja.	conferencing or with the help of specially designed e-material in a virtual electronic learning environment). Tutorials: students enhance their theoretical knowledge and get familiar with the applied opportunities of mechatronics systems in logistics. Tutorials are performed on a classical way in a classroom, in the framework of the laboratory work and in the framework of the 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:

1. 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.
2. 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.
3. 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].
4. 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].
5. 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].