

UČNI NAČRT PREDMETA/COURSE SYLLABUS

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

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
GOSPODARSKA IN TEHNIŠKA LOGISTIKA 1.stopnja		1.	2.
PROFESSIONAL HIGHER EDUCATION STUDY PROGRAMME ECONOMIC AND TECHNICAL LOGISTICS 1 st degree		1.	2.

Vrsta predmeta / Course type: OBVEZNI

Univerzitetna koda predmeta / University course code: VS

Predavanja Lectures	Seminar Seminar	vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
15 e-P 45 a-P		5 e-V 15 a-V	10 I-V		90	6

Nosilec predmeta / Lecturer: TONE LERHER

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: Ni pogojev. Prerequisites: No special conditions.

Vsebina:	Content (Syllabus outline):
<p>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.</p> <p>Trdnost Napetostni vektor na ploskvi, zveza med napetostmi in deformacijami, normalne in tangencialne specifične deformacije, Hookov zakon, modul elastičnosti, strižni modul, osnovne obremenitve, nateg, tlak, ploščinski tlak, upogib, vztrajnostni moment prereza, strig, vzvoj, stabilnostni problemi (uklon, izbočenje).</p> <p>Kinematika in kinetika Pot, hitrost, pospešek, enakomerno gibanje, enakomerno pospešeno gibanje, kroženje, kotni pospešek, gibalna količina, delo, moč, energija, trk, gibanje teles spremenljive mase.</p> <p>Mehanika vožnje Mehanski model vozila, sile in odpori pri gibanju vozila, zavore, vozilo na konveksni in na konkavni podlagi, varovanje tovora proti zdrsu in prevračanju.</p> <p>Hidromehanika</p>	<p>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.</p> <p>Strength Tension vector on the surface, the relationship between stresses and deformations, normal and shear specific deformations, Hooke's law, Young's modulus, shear modulus, base load, tension, pressure, surface pressure, bending, moment of inertia, shear, torsion, stability problems (buckling).</p> <p>Kinematics and kinetics Displacement, velocity, acceleration, uniform motion, uniformly accelerated motion, circular motion, angular acceleration, angular momentum, work, power, energy, collision, motion of bodies with variable mass.</p> <p>Mechanics of driving 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.</p>

Kompresijski modul, viskoznost tekočin, masne in volumske sile, Reynoldsovo število, meritve pri pretakanju, Bernoullijeva enačba, sile pri pretakanju.

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, črna koda, RFID.

Hydromechanics
Compression modulus, viscosity of liquids, mass and volume forces, Reynolds number, measurement of flowing, Bernoulli's equation, forces by flowing.

Electrostatic
Electrostatic field, electric potential and electric tension, 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.

Temeljna literatura in viri / Readings:

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.
Hibbeler, R.C. (2013) Mechanics of Materials, 9th edition, Pearson.
Hibbeler, R.C. (2010) Engineering Mechanics - Dynamics, 12th edition, Pearson.
Fischer, R., Linse, H. (2012) Elektrotechnik für Maschinenbauer: mit Elektronik, elektrischer Messtechnik, elektrischen Antrieben und Steuerungstechnik, 14 Auflage, Springer Vieweg.
Flegel, G., Birnstiel, K., Nerreter, W. (2009) Elektrotechnik für Maschinenbau und Mechatronik, 9 Auflage, Carl Hanser Verlag, München.

Cilji in kompetence:

Cilj predmeta je seznaniti študente s temeljnimi znanji s področja statike, trdnosti, kinematike, dinamike, mehanike vožnje in hidromehanike in osnov elektrotehnike ter elektronike. Prav tako je predmet namenjen pridobitvi praktičnih izkušenj na področju mehanike, merilne tehnike in delovanja električnih naprav ter elektronskih vezij.

Objectives and competences:

The goal of this course is to acquire basic knowledge from the field of statics, strength, kinematics, dynamics, mechanics of driving, hydromechanics and basis of electrical engineering with electronic. Another goal is to acquire practical experience in the field of mechanics, measuring techniques and functioning of electrical devices and electronic circuits.

Predvideni študijski rezultati:

Po opravljenem izpitu iz tega predmeta bo študent sposoben pridobljeno znanje uporabiti pri reševanju industrijskih mehanskih in elektrotehniških problemov v logistiki.

Intended learning outcomes:

Upon passing the exam, students will be able to use the acquired knowledge for solving industrial mechanical and electrical engineering professional problems in logistics.

Metode poučevanja in učenja:

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

Learning and teaching methods:

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

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).

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 %) / Weight (in %)	Assessment:
<ul style="list-style-type: none"> 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 %). 	<p>30 %</p> <p>50 %</p> <p>20%</p>	<ul style="list-style-type: none"> Successful completion 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 / Lecturer's references:

- Lerher, T., Borovinšek, M., Ficko, M., Palčič, I. (2017). Parametric study of throughput performance in SBS/RS based on simulation. International journal of simulation modelling, Vol. 16, No. 1, 96-107, doi: 10.2507/IJSIMM16(1)8.372.
- Lerher, T., Ekren, B. Y., Sari, Z., Rosi. B. (2016). Method for evaluating the throughput performance of shuttle based storage and retrieval systems. Technical Gazette, Vol. 23, No. 3, 715-723.
- Lerher, T., Ekren, B. Y., Sari, Z., Rosi. B. (2015). Simulation Analysis of Shuttle Based Storage and Retrieval Systems. International Journal of Simulation Modelling, Vol. 14, No. 1, 48-59. doi: 10.2507/IJSIMM14(1)5.281.
- LERHER, Tone, EDL, Milan, ROSI, Bojan. Energy efficiency model for the mini-load automated storage and retrieval systems. Int. j. adv. manuf. technol., August 2013, doi: 10.1007/s00170-013-5253-x.
- LERHER, Tone, ŠRAML, Matjaž, POTRČ, Iztok. Simulation analysis of mini-load multi-shuttle automated storage and retrieval systems. Int. j. adv. manuf. technol., 2011, vol. 54, no. 1/4, str. 337-348, doi: 10.1007/s00170-010-2916-8.
- LERHER, Tone, POTRČ, Iztok, ŠRAML, Matjaž, TOLLAZZI, Tomaž. Travel time models for automated warehouses with aisle transferring storage and retrieval machine. Eur. J. oper. res.. [Print ed.], Sep. 2010, vol. 205, iss. 3, str. 571-583, doi: 10.1016/j.ejor.2010.01.025.
- LERHER, Tone, ŠRAML, Matjaž, POTRČ, Iztok, TOLLAZZI, Tomaž. Travel time models for double-deep automated storage and retrieval systems. Int. J. Prod. Res., June 2010, vol. 48, no. 11, str. 3151-3172, doi: 10.1080/00207540902796008.