| UČNI NAČRT PREDMETA/COURSE SYLLABUS | |
|---|---|
| Predmet: | OSNOVE MEHATRONIKE V LOGISTIKI |
| Course title: | FUNDAMENTALS OF MECHATRONICS IN LOGISTICS |

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

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| Vrsta predmeta / Course type | OBVEZNI |
| Univerzitetna koda predmeta / University course code: | VS |

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

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| Nosilec predmeta / Lecturer: | DARKO HERCOG |
| Jeziki / Languages: Predavanja / Lectures: | SLOVENSKI / SLOVENE |
| Vaje / Tutorial: | SLOVENSKI / SLOVENE |

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

| Vsebina: | Content (Syllabus outline): |
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| Statika<br>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.<br>Trdnost<br>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).<br>Kinematika in kinetika<br>Pot, hitrost, pospešek, enakomerno gibanje, enakomerno pospešeno gibanje, kroženje, kotni pospešek, gibalna količina, delo, moč, energija, trk, gibanje teles spremenljive mase.<br>Mehanika vožnje<br>Mehanski model vozila, sile in odpori pri gibanju vozila, zavore, vozilo na konveksni in na konkavni podlagi, varovanje tovora proti zdrsu in prevračanju.<br>Elektrostatika | Statics<br>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.<br>Strength<br>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).<br>Kinematics and kinetics<br>Displacement, velocity, acceleration, uniform motion, uniformly accelerated motion, circular motion, angular acceleration, momentum, work, power, energy, collision, motion of bodies with variable mass.<br>Mechanics of driving<br>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. |

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| Elektrostatično polje, električni potencial in električna napetost, kapacitivnost in kondenzator, energija električnega polja.<br>Enosmerni električni tok<br>Ohmov zakon, Kirchoffova zakona, električna moč in delo, Joulov zakon.<br>Magnetno polje<br>Izvori magnetnega polja, sila na tokovodnik v magnetnem polju, Amperov zakon, magnetilna krivulja in histerezna zanka, induktivnost tuljave, Faradayev zakon elektromagnetne indukcije.<br>Izmenični električni tok<br>Sinusna izmenična napetost, izmenični tokokrogi, enofazni in večfazni sistemi.<br>Električni motorji<br>Motorji na enosmerni in na izmenični tok, sinhronski motorji, asinhronski motorji, servomotorji.<br>Elektronika<br>Elektronska vezja, mikroprocesorji, senzorji, črtna koda, RFID. | Electrostatic<br>Electrostatic field, electric potential and voltage, capacitance and capacitor, energy of the electric field.<br>Direct electric current<br>Ohm's law, Kirchoff's law, electric power and work Joule's law.<br>Magnetic field<br>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.<br>Alternating electric current<br>Sinusoidal alternating voltage, alternating current circuits, single-phase and multi-phase systems.<br>Electric motors<br>Motors on direct and alternating current, synchronous motors, induction motors, servomotors.<br>Electronics<br>Electronic circuits, microprocessors, sensors, bar code, RFID. |

Temeljni 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.
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.
Fischer, R., Linse, H. (2012) Elektrotechnik für Maschinenbauer: mit Elektronik, elektrischer Messtechnik, elektrischen Antrieben und Steuerungstechnik, 14 Auflage, Springer Vieweg, ISBN 978-3-8348-8304-9.

| Cilji in kompetence: | Objectives and competences: |
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| 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 iz tega predmeta bo študent sposoben pridobljeno znanje uporabiti pri reševanju industrijskih mehanskih in elektrotehniških problemov v logistiki. | 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: | 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). | 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). |

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

Reference nosilca / Lecturer's references:

Članki v revijah / Journal articles


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. D. Hercog, B. Gergič, S. Uran, and K. Jezernik, "A DSP-based Remote Control Laboratory," IEEE Transactions on Industrial Electronics, vol. 54, no. 6, pp. 3057-3068, Dec 2007.
3. Hercog, D.; Rojko, A.; Čurkovič, M.; Gergič, B.; Jezernik, K. Embedded platform for rapid implementation of local and remote motion control experiments. Przeglad Elektrotechniczny (Electrical Review) 2011, 87, 73-76.
4. D. Hercog and K. Jezernik, "Rapid Control Prototyping using MATLAB/Simulink and a DSP-based Motor Controller," International Journal of Engineering Education, vol. 21, no. 4, pp. 596-605, 2005. [Online]. Available: http://www.ijee.ie/articles/Vol21-4/1649.pdf
5. D. Hercog, A. Kapun, and K. Jezernik, "Implementation and usage of a freely available real-time operating system on an embedded robot controller," Elektrotehniški vestnik - Electrotechnical Review, vol. 75, no. 3, pp. 136-142, 2008. [Online]. Available: http://ev.fe.uni-lj.si/3-2008/Hercog.pdf
6. A. Rojko, D. Hercog, and K. Jezernik, "Power Engineering and Motion Control Web Laboratory: Design, Implementation and Evaluation of Mechatronics Course," IEEE Transactions on Industrial Electronics, vol. 57, no. 10, pp. 3343-3354, 2010.
7. A. Rojko, D. Hercog, K. Jezernik, “E-training in mechatronics using innovative remote laboratory.” Math. comput. Simul., vol. 82, no. 3, pp. 508-516, 2011.


Knjige in poglavja v knjigah / Books and books chapters


8. A. Rojko, D. Hercog, "Uvod v mehatroniko / Introduction to mechatronics", Univerza v Mariboru, Fakulteta za elektrotehniko računalništvo in informatiko, 2010.
9. A. Rojko, D. Hercog, T. Zürcher, and R. Stebler, "Implementation of Remote Laboratories for Industrial Education,". V: AZAD, Abul K. M. (ur.), AUER, Michael E. (ur.), HARWARD, V. Judson (ur.). Internet accessible remote laboratories : scalable E-learning tools for engineering and science disciplines, (Premier reference source). Hershey: IGI Global: Engineering Science Reference, cop. 2012, pp. 84-107.
10. A. Rojko and D. Hercog, "Teaching of robot control with remote experiments," in Web-Based Control and Robotics Education. vol. 38, S. G. Tzafestas, Ed.: Springer Netherlands, 2009, pp. 171-194.