Fakulteta za industrijski inženiring
Faculty of Industrial Engineering

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Eksperimentalne metode
Course title:	Experimental methods

Študijski program Study programme and level	Študijska smer Study field	Letnik Academic Year	Semester Semester
Inženiring in avtomobilska industrija		Prvi	Drugi
Engineering and automotive industry		First	Second

Vrsta predmeta / Course type	obvezni/obligatory
Univerzitetna koda predmeta / University course code:	**MAG_21005**

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30			**45**		**135**	**7**

Nosilec predmeta / Lecturer:	**Doc. dr. Anatolij Nikonov**

Jeziki / Languages:	**Predavanja / Lectures:**	Slovenski / Slovenian
	Vaje / Tutorial:	Slovenski / slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
– vpis v prvi letnik študija, – pred izpitom mora študent(ka) uspešno opraviti praktične vaje.	– inscription in the first year of study, – before the exam, a student must successfully complete practical exercises

Vsebina:	**Content (Syllabus outline):**
– Osnovni koncepti eksperimentalne analize mehanskih sistemov, elektronski inštrumenti, osnovno znanje o električnih komponentah, inženirska analiza, nadzor postopka, eksperimentalne napake. Zajemanje in vrednotenje merilnih rezultatov. – Digitalni sistemi za zajem signalov v adaptroniki: digtalno kodiranje, pretvorba signalov, D/A in A/D pretvorba, digitalni	– The basic concepts of experimental analysis of mechanical systems, electronic instrument system, basic electrical components, engineering analysis, process control, experimental errors. Capturing and evaluation of the measurement results. – Digital recording systems in adaptronics: digital codes, conversion process, D/A and A/D converters, digital voltmeters and oscilloscopes,

votmetri in osciloskopi, sistemi za zbiranje podatkov, aliasing. – Vezje za kondicioniranje signalov: potenciometri, Wheatston-ov mostiček, ojačevalniki, filtri. – Pretvorniki za merenje tlaka: pretvorniki na osnovi merenja pomikov, membranski pretvorniki, piezoelektrični pretvorniki. – Merilniki pomikov, hitrosti in pospeškov: seizmični model, seizmični merilniki pomikov, piezoelektrični merilniki sile, kalibracija pospeškomerov, dinamična kalibracija merilnika sile, meritve hitrosti. – Meritve temperature: metode ekspanzije za merenje temperature, uporovni termometri, termoelementi, metode kalibracije.	data-logging systems, data-acquisition systems, aliasing. – Signal conditioning circuit: potenciomemter circuit, Wheatstone bridge, amplifiers, filters. – Pressure measurement transducers: displacement-type, diaphragm-type and piezoelectric-type pressure transducers. – Displacement, veleocity and acceleration measurement sensors: the seismic transducer model, seismic motion transducers, piezoelectric force trancducers, accelerometer calibration, dynamic calibration of force transducers, velocity measurements. – Temperature measurements: expansion methods for measuring temperature, resistance thermometers, thermocouples, calibration methods.

Temeljni literatura in viri / Readings:

- Holman, J. P., Experimental Methods for Engineers, 7 th Edition, McGraw Hill, 2001
- M.J. Korsten,W.Otthius,F.van der Hejden, Measurement Science for Engineers, Elsevier (2004)
- Dally J.W., Riley W.R., Instrumentation for engineering measurements, John Wiley & Sons, 1984. ISBN: 0-471-55192-9.
- Suryanarayana, C., Experimental techniques in materials and mechanics, Boca Raton ; London ; New York : CRC, cop. 2011

Priporočljiva literatura / Recomended Textbooks

- Herman, H., Experimental Methods, New York : Academic Press, 1980
- Handbook on experimental mechanics, Ed. by Kobayashi A.S., Prentice-Hall Inc., 1987. ISBN 0-13-377706-5.
- Experimental methods in polymer science : modern methods in polymer research and technology, Ed. by Toyoichi Tanaka, San Diego [etc.] : Academic, 2000, 0-12-683265-X

Cilji in kompetence: **Objectives and competences:**

Cilji – Seznanitev z osnovnimi pristopi pri snovanju eksperimentov. – Seznanitev z metodami načrtovanja in izvedbe meritev ter njihovega vrednotenja. ***Kompetence*** Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc: – sposobnost evidentiranja problema in njegove analize,	***Objectives*** – Acquaintance with the basic approaches in the design of experiments. – Introduction of methods of planning and execution of measurements and their evaluation. ***Competences*** The learning unit contributes mainly to the development of generic and specific competences: – the ability of the recording of the problem and its analysis,

– sposobnost obvladanja standardnih razvojnih metod, postopkov in procesov, – sposobnost uporabe pridobljenega teoretičnega znanja v praksi, – avtonomnost v strokovnem delu s področja merilnih tehnologij in sistemov, – sposobnost razumevanja in uporabe sodobnih teorij s področja tehniških, tehnoloških in naravoslovnih ved, – sposobnost matematičnega razumevanja tehničnih problemov in uporaba matematike pri reševanju le-teh, – sposobnost stalne uporabe informacijske in komunikacijske tehnologije na svojem strokovnem področju.	– he ability to manage the standard research methods, procedures and processes, – the ability to apply theoretical knowledge in practice, – autonomy in professional work in the field of measurement technologies and systems, – ability to understand and use modern theories in the field of engineering, technical and natural sciences, – mathematical ability to understand technical problems and use mathematics in solving them, – the ability of continuous use of information and communication technologies in the professional field.

Predvideni študijski rezultati: **Intended learning outcomes:**

Znanje in razumevanje: *Študent/študentka:* – pozna in razume osnove merilne tehnike in izrazoslovja, – pozna osnovno delitev in postopke meritve mehanskih in električnih veličin, – pozna postopke in metode vrednotenja in razvrščanja merilnih rezultatov, • zna načrtovati, uporabiti standarde, uporabiti literaturo.	Knowledge and understanding: *Student:* – knows and understands the basics of measurement techniques and terminology, – knows the basic division and procedures of measuring mechanical and electrical quantities, – familiar with the procedures and methods of evaluation and classification of measurement results, – be able to plan, apply standards use the literature.

Metode poučevanja in učenja: **Learning and teaching methods:**

– predavanja z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, reševanje nalog) ob pomoči sodobnih pedagoških pripomočkov, – avditorne vaje za poglabljanje teoretičnih osnov, – laboratorijske vaje, ki potekajo v ustrezno opremljenem laboratoriju.	– lectures with active attendance of students (explanation, discussion, answers on the questions and solving of exercises) with the help of modern teaching aids, – tutorials with deepening of theoretical background, – laboratory work, which take place in a properly equipped laboratory.

Načini ocenjevanja: **Delež (v %) / Weight (in%)** **Assessment:**

Pogoj za pristop k pisnemu izpitu so opravljene laboratorijske vaje in seminar. – pisni izpit – ustni izpit Končna ocena izpita je utežno povprečje obeh delov izpita.	 40% 60%	Prerequisite for the written examination are completed laboratory work and seminar. – written exam – oral exam The final grade is the weighting sum of all two parts of the exam.

Reference nosilca / Lecturer's references:

1. NIKONOV, Anatolij, ŠUŠTERŠIČ, Ema. The effect of composite powders on mechanical behavior of modified asphalt binders = Vpliv kompozitnih prahov na mehansko vedenje modificiranih asfaltnih veziv. V: CROITORESCU, Valerian, GORENC ZORAN, Annmarie. Technology in the era of sustainable development : scientific monograph = Tehnologije v dobi trajnostnega razvoja : znanstvena monografija. Novo mesto: Fakulteta za industrijski inženiring: = Faculty of Industrial Engineering, 2016, str. 47-58.
2. NIKONOV, Anatolij, EMRI, Igor. Acoustic characterization of lightweight materials using nonstandard measuring setup. V: 32nd Danubia-Adria Symposium on Advances in Experimental Mechanics, Starý Smokovec - High Tatras, Slovakia, September 22 - 25, 2015. Danubia Adria Slovakia. Žilina: EDIS, 2015, str. 126-127.
3. BURNIK, Stojan, VUČER, Matevž, NIKONOV, Anatolij, EMRI, Igor. Lastnosti vrvi : vpliv različne mase plezalca na odziv plezalnih vrvi pri padcu. Planinski vestnik, ISSN 0350-4344, 2015, letn. 115, [št.] 5, str. 58-61.
4. NIKONOV, Anatolij, BURNIK, Stojan, ROTOVNIK, Bojan, EMRI, Igor. Jolt - new criterium of safety in climbing. V: GOLOBIČ, Iztok (ur.), CIMERMAN, Franc (ur.). Engineering - development and innovations for new employments 2014 : proceedings of the 4th AMES International Conference, Ljubljana, Slovenia, October 23th, 2014. 1st ed. Ljubljana: Association of Mechanical Engineers of Slovenia - AMES, 2015, str. 199-204.
5. EMRI, Igor, ZUPANČIČ, Barbara, NIKONOV, Anatolij Viktorovič, GERGESOVA, Marina, SAPRUNOV, Ivan. Experimental and numerical methods for characterization of time-dependent materials. V: RŮŽIČKA, Milan (ur.), DOUBRAVA, Karel (ur.), HORÁK, Zdenék (ur.). Proceedings of the 50th annual conference on experimental stress analysis : EAN 2012, June 4-7, 2012, Tábor, Czech Republic. Prague: Czech technical university, Faculty of mechanical engineering, 2012, str. 53-60.
6. NIKONOV, Anatolij Viktorovič, ZUPANČIČ, Barbara, BURNIK, Stojan, EMRI, Igor. New methodology for testing climbing ropes. V: EMRI, Igor (ur.). 15th International Workshop on Advances in Experimental Mechanics, August 14-20, 2011, Grand Hotel Bernardin, Portorož, Slovenia, (Series on advances in experimental mechanics, vol. 15). Ljubljana: ISIT [i. e.] Center for Experimental Mechanics, Faculty of Mechanical Engineering, 2011.
7. NIKONOV, Anatolij Viktorovič, SAPRUNOV, Ivan, ZUPANČIČ, Barbara, EMRI, Igor. Influence of moisture on functional properties of climbing ropes. International Journal of Impact Engineering, ISSN 0734-743X. [Print ed.], Nov. 2010, vol. 38, iss. 11, str. 900-909.
8. NIKONOV, Anatolij Viktorovič, BURNIK, Stojan, EMRI, Igor. Examination of the time-dependent behaviour of climbing ropes under impact loading = Preiskava časovno odvisnega vedenja plezalnih vrvi pri impulznih obremenitvah. Kinesiologia Slovenica, ISSN 1318-2269. [Print ed.], 2010, vol. 16, no. 3, str. 7-13.
9. EMRI, Igor, NIKONOV, Anatolij Viktorovič, ZUPANČIČ, Barbara, FLORJANČIČ, Urška. Time-dependent behavior of ropes under impact loading : a dynamic analysis. Sports technology, ISSN 1934-6190. [Online ed.], 2008, vol. 1, no. 4/5, str. 208-219.
10. NIKONOV, Anatolij Viktorovič, DAVIES, A.R., EMRI, Igor. The determination of creep and relaxation functions from a single experiment. Journal of rheology, ISSN 0148-6055, 2005, letn. 49, št. 6, str. 1193-1211.