

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Strojni elementi 2 - PAP
Course title:	MACHINE ELEMENTS 2 - PAP
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Konstruiranje strojev in naprav (smer)	2. letnik	2. semester

Univerzitetna koda predmeta/University course code: 0563423

Koda učne enote na članici/UL Member course code: 3042-V

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30		30			40	4

Nosilec predmeta/Lecturer: Jernej Klemenc, Marko Nagode

Vrsta predmeta/Course type: Izbirni strokovni predmet /Elective specialised course

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: **Prerequisites:**

Izpolnjevanje pogojev za vpis v Visokošolski strokovni študijski program I. stopnje Strojništvo - Projektno aplikativni program.	Meeting the enrollment conditions for the MECHANICAL ENGINEERING - Project Oriented Applied Programme.
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Vsebina:

Content (Syllabus outline):

<ol style="list-style-type: none"> Predavanje: Vzmeti: <ul style="list-style-type: none"> Volumski izkoristek in vrednotenje izbranih vzmeti. Predavanje: Fizikalne osnove kovičenja: <ul style="list-style-type: none"> Oblikovanje in vrednotenje kovičenih spojev. Predavanje: Sorniki in zatiči: <ul style="list-style-type: none"> Vrste sornikov in zatičev. Vrednotenje sornikov in zatičev. Predavanje: Zveze gredi in pesta: <ul style="list-style-type: none"> Stožčasti nased in spenjalna zveza. Predavanje: Tesnila in prirobnične zveze: <ul style="list-style-type: none"> Vrste tesnil. 	<ol style="list-style-type: none"> Lecture: Springs: <ul style="list-style-type: none"> Volumetric efficiency and evaluation of selected springs. Lecture: Physical basis of riveting: <ul style="list-style-type: none"> Design and evaluation of riveted joints. Lecture: Bolts and pins: <ul style="list-style-type: none"> Types of bolts and pins. Evaluation of bolts and pins. Lecture: Shaft-hub connections: <ul style="list-style-type: none"> Cone connection and clamping connection. Lecture: Washers and flange connections:
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<ul style="list-style-type: none"> - Fizikalne osnove prirobnih zvez. - Izbira tesnil in oblikovanje prirobnih zvez. <p>6. Predavanje: Izravnalne sklopke:</p> <ul style="list-style-type: none"> - Kardanski in homokinetični zglob. <p>7. Predavanje: Zagonska sklopka.</p> <p>8. Predavanje: Torna gonila:</p> <ul style="list-style-type: none"> - Fizikalne osnove tornih gonil. - Razmere pri nakotaljevanju in prestavno razmerje. <p>9. Predavanje: Torna gonila:</p> <ul style="list-style-type: none"> - Koeficient sojemanja in zdrs. - Vrednotenje tornih gonil. <p>10. Predavanje: Jermenska gonila:</p> <ul style="list-style-type: none"> - Vrste in zgradba jermenov in jermenic. - Dolžina jermena. - Sila prednapetja. - Eitelweinova enačba. - Sila v jermenu zaradi centrifugalne sile. <p>11. Predavanje: Jermenska gonila:</p> <ul style="list-style-type: none"> - Vpliv obodne sile na sile v jermenu. - Napetosti v jermenu. - Vrednotenje jermenskih gonil in prednapenjanje jermena. <p>12. Predavanje. Verižna gonila:</p> <ul style="list-style-type: none"> - Vrste in zgradba verig in verižnih koles. - Poligonski efekt. <p>13. Predavanje. Verižna gonila:</p> <ul style="list-style-type: none"> - Sile v verigi. - Oblikovanje in vrednotenje verižnih gonil. <p>14. Predavanje: Zobniška gonila:</p> <ul style="list-style-type: none"> - Osnovni pojmi. - Osnovni zakon ozobja. <p>15. Predavanje: Zobniška gonila:</p> <ul style="list-style-type: none"> - Konstrukcija protiboka in ubirnice ter dolžina ubirnice. 	<ul style="list-style-type: none"> - Types of washers. - Physical backgrounds of flange connections. - Selection of washers and design of flange connections. <p>6. Lecture: Position aligning couplings:</p> <ul style="list-style-type: none"> - Cardan and homokinetic joint. <p>7. Lecture: Starting coupling.</p> <p>8. Lecture: Friction drives:</p> <ul style="list-style-type: none"> - Physical backgrounds of friction drives. - Rolling contact problem and speed ratio. <p>9. Lecture: Friction drives:</p> <ul style="list-style-type: none"> - Coefficient of friction and slip ratio. - Evaluation of friction drives. <p>10. Lecture: Belt drives:</p> <ul style="list-style-type: none"> - Types and design of belts and pulleys. - Belt length. - Pretension force. - Eitelwein equation. - Forces in belt due to centrifugal force. <p>11. Lecture: Belt drives:</p> <ul style="list-style-type: none"> - Influence of tangential force on forces in belt. - Stresses in belt. - Evaluation of belt drives and belt tensioning. <p>12. Lecture. Chain drives:</p> <ul style="list-style-type: none"> - Types of chains and design of chains and sprockets. - Polygon effect. <p>13. Lecture. Chain drives:</p> <ul style="list-style-type: none"> - Forces in chain. - Design and evaluation of chain drives. <p>14. Lecture: Gear drives:</p> <ul style="list-style-type: none"> - Basic definitions. - The law of gearing. <p>15. Lecture: Gear drives:</p> <ul style="list-style-type: none"> - Design of opposite tooth profile and the line of action and determination of the line of action length.
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Temeljna literatura in viri/Readings:

Wittel H., Jannasch D., Vossiek J., Spura C. Roloff/Matek Maschinenelemente - 23. Auflage. Springer Vieweg, 2017. Izbrana poglavja

Decker K.H. Decker Maschinenelemente - 20 Auflage. Carl Hanser Verlag, 2018. Izbrana poglavja

Ren Z., Glodež S. Strojni elementi I. del. Založništvo Fakultete za strojništvo, Maribor, 2003. Izbrana poglavja

Ren Z., Glodež S. Strojni elementi, Uvod v gonila, torna, jermenska in verižna gonila. Založništvo Fakultete za strojništvo, Maribor, 2005.

Flašker J., Glodež S., Ren Z. Zobniška gonila. Založba Pasadena, 2010. Izbrana poglavja.

Cilji in kompetence:

Cilji:

Spoznati fizikalne in matematične osnove izbranih strojnih elementov.

Objectives and competences:

Objectives:

Gain fundamental knowledge of selected machine

<p>Spoznati osnovne principe vrednotenja izbranih strojnih elementov na statično nosilnost, utrujanje in obrabo.</p> <p>Spoznati dobre in slabe prakse oblikovanja izbranih strojnih elementov.</p> <p>Spoznati programska orodja za oblikovanje in vrednotenje strojnih elementov in komponent.</p> <p>Spoznati osnovne principe povezovanja strojnih elementov v komponente in izdelke.</p> <p>Kompetence:</p> <p>S1-PAP: Sposobnost uporabe pridobljenega znanja s področja strojnih elementov v praksi.</p> <p>S4-PAP: Sposobnost razčlenitve lažjih strokovnih nalog na podnaloge.</p> <p>P1-PAP: Razume fizikalne zakone in pojave, na katerih temelji funkcija izbranih strojnih elementov.</p> <p>P3-PAP: Obvlada temeljna strokovna znanja s področja strojnih elementov in bistvenih komplementarnih ved.</p>	<p>elements pertaining to physics and mathematics.</p> <p>Gain basic evaluation principles of selected machine elements pertaining to the static load-bearing ability, fatigue and wear.</p> <p>Gain knowledge of good and bad design of selected machine elements.</p> <p>Gain knowledge of computer software to design and evaluate machine elements and components.</p> <p>Gain knowledge of fundamental principles to assemble machine elements into components and products.</p> <p>Competences:</p> <p>S1-PAP: The ability to use the attained knowledge of machine elements in the practice.</p> <p>S4-PAP: The ability to break down professional tasks of lesser complexity into subtasks.</p> <p>P1-PAP: Understanding the laws of physics and the phenomena behind the operating principles of selected machine elements.</p> <p>P3-PAP: Mastering the fundamental specialised knowledge in the field of machine elements and the fundamental complementary sciences.</p>
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Predvideni študijski rezultati:

<p>Znanja:</p> <p>Z1: Poglobljeno strokovno teoretično in praktično znanje na določenem področju, podprto s širšo teoretično in metodološko osnovo.</p> <p>- Poglobljeno strokovno teoretično in praktično znanje s področij vzmeti, kovic, sornikov in zatičev, zvez gredi in pesta, tesnil in prirobničnih zvez, sklopk, tornih, jermenskih, verižnih in zobniških gonil.</p> <p>Spretnosti:</p> <p>S1.1 Izvajanje kompleksnih operativno -strokovnih opravil, ki vključujejo tudi uporabo metodoloških orodij.</p> <p>- Izvajanje vrednotenj strojnih elementov skladno s sodobno literaturo in veljavnimi standardi.</p> <p>S1.2 Obvladovanje zahtevnih, kompleksnih delovnih procesov ob samostojni uporabi znanja v novih delovnih situacijah.</p> <p>- Obvladovanje analitičnih in preprostih numeričnih orodij za oblikovanje in vrednotenje strojnih elementov, komponent in izdelkov.</p>

Intended learning outcomes:

<p>Knowledge:</p> <p>Z1: In-depth professional theoretical and practical knowledge of a certain field, supported by a broader theoretical and methodological fundament.</p> <p>- In-depth professional theoretical and practical knowledge of springs, rivets, bolts and pins, shaft-hub connections, washers and flange connections, clutches, friction drives, belt drives, chain drives and gear drives.</p> <p>Skills:</p> <p>S1.1 Performance of complex operational-professional tasks which include the use of methodological tools.</p> <p>- Evaluation of machine elements in accordance with contemporary literature and latest standards.</p> <p>S1.2 Mastering of demanding, complex operational processes and autonomous use of knowledge in new professional circumstances.</p> <p>- Mastering analytical and simple numerical tools for design and evaluation of machine elements, components and products.</p>
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Metode poučevanja in učenja:

Learning and teaching methods:

P1: Avditorna predavanja z reševanjem izbranih teoretičnih in praktično uporabnih primerov.	P1: Auditory lectures including solution procedures for selected theoretical and practical examples.
P3: Avditorne vaje, kjer se teoretično znanje s predavanj podkrepi z računskimi primeri.	P3: Auditory exercises where theoretical knowledge gained at auditory lectures is substantiated by numerical examples.
P4: Laboratorijske vaje, kjer se teoretično znanje s predavanj podkrepi z laboratorijskimi preskusi.	P4: Laboratory exercises where theoretical knowledge gained at auditory lectures is substantiated by laboratory experiments.
P15: Video predavanja in vaje z diskusijo	P15: Video lectures and exercises with discussion.

Načini ocenjevanja:	Delež/Weight	Assessment:
- Teoretične vsebine (predavanja).	50,00 %	- Theoretical knowledge (lectures).
- Samostojno delo na vajah.	20,00 %	- Individual work at exercises.
- Delo na laboratorijskih vajah (vključno s poročili).	20,00 %	- Work at laboratory exercises (including reports).
- Seminar.	10,00 %	- Seminar.

Reference nosilca/Lecturer's references:

Marko Nagode:

OKORN, Ivan, **NAGODE, Marko**. Analysis of energy efficiency of a test rig for air springs. Strojniški vestnik, ISSN 0039-2480, Jan. 2015, vol. 61, no. 1, str. 53-62, SI 9, ilustr., doi: 10.5545/sv-jme.2014.2143. [COBISS.SI-ID 13857051]

ZALETELJ, Henrik, HAESEN, Vik, DEDENE, L., FAJDIGA, Gorazd, **NAGODE, Marko**. High cycle fatigue of welded joints with aging influence. Materials & design, ISSN 0264-1275, Mar. 2013, vol. 45, str. 190-197, ilustr., doi: 10.1016/j.matdes.2012.08.059. [COBISS.SI-ID 12456731]

ZALETELJ, Henrik, FAJDIGA, Gorazd, **NAGODE, Marko**. Low cycle fatigue of welded joints with aging influence. Materials Science & Engineering. A, Structural materials: Properties, Microstructure and Processing, ISSN 0921-5093. [Print ed.], Mar. 2013, vol. 564, str. 478-484, ilustr., doi: 10.1016/j.msea.2012.11.101. [COBISS.SI-ID 12558875]

FRANKO, Mitja, PANIĆ, Branislav, **NAGODE, Marko**. Damage based reliability prediction of dynamically loaded components. V: ČEPIN, Marko (ur.), BRIŠ, Radim (ur.). Safety & reliability : theory and applications : proceedings of the 27th European Safety and Reliability Conference, ESREL 2017, Portorož, Slovenia, 18-22 June 2017. Boca Raton: CRC Press; London: Taylor & Francis. 2017, str. 2053-2058, ilustr. [COBISS.SI-ID 15537179]

OMAN, Simon, **NAGODE, Marko**. Non-marking handling of production pipes with crank mechanism tool : research study. Ljubljana: Faculty of Mechanical Engineering, LASEM, 2019. 11 f., ilustr. [COBISS.SI-ID 16441115]

Jernej Klemenc:

TOMAŽINČIČ, Dejan, SEDLAČEK, Marko, PODGORNIK, Bojan, **KLEMENC, Jernej**. Influence of different micro-imprints to fatigue life of components. Materials performance and characterization, str. 79-95, doi: 10.1520/mpc20160024. [COBISS.SI-ID 1292714]

KLEMENC, Jernej, RUPP, Andreas, FAJDIGA, Matija. Dynamics of a clapper-to-bell impact. International Journal of Impact Engineering, Jun. 2012, vol. 44, iss. 6, str. 29-39, doi: 10.1016/j.ijimpeng.2011.12.006. [COBISS.SI-ID 12166171]

KLEMENC, Jernej, WAGNER, Andrej, FAJDIGA, Matija. Modeling the S-N curves of polyamide PA66 using a serial hybrid neural network. Journal of engineering materials and technology : Transactions of the ASME, Jul. 2011, vol. 133, iss. 3, 031005-1-031005-14, doi: 10.1115/1.4004054. [COBISS.SI-ID 11844123]

BIŽAL, Ana, **KLEMENC, Jernej**, ROSA, Uroš, FAJDIGA, Matija. Numerical simulation of crash test for the vehicle student roadster. V: The future of automobiles and mobility : FISITA 2008 : student congress papers. [Munich]: Association of German Engineers. 2008, str. [202-209], ilustr. [COBISS.SI-ID 11069211]

OKORN, Ivan, **KLEMENC, Jernej**. Analiza poškodb zobnikov stiskalnice Helmerding KDH 250. Ljubljana: Fakulteta za strojništvo, Katedra za strojne elemente in razvojna vrednotenja, 2017. 13 f., ilustr. [COBISS.SI-ID 16100123]