

## UČNI NAČRT PREDMETA/COURSE SYLLABUS

<b>Predmet:</b>	Tehnično risanje
<b>Course title:</b>	Technical drawing
<b>Članica nosilka/UL Member:</b>	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Ni členitve (študijski program)	1. letnik	1. semester

<b>Univerzitetna koda predmeta/University course code:</b>	0562661
<b>Koda učne enote na članici/UL Member course code:</b>	3006-V

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

<b>Nosilec predmeta/Lecturer:</b>	Andrej Žerovnik, Robert Kunc
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<b>Vrsta predmeta/Course type:</b>	Obvezni splošni predmet /Compulsory general course
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<b>Jeziki/Languages:</b>	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):**

<p>1. Predavanje: Osnove</p> <ul style="list-style-type: none"> <li>- Uvod – vrste tehničnih risb, formati, glave, vrste projekcij, koordinatni sistemi, merila...</li> <li>- Skiciranje in tehnično risanje v merilu</li> <li>- Standardi za tehnično risanje</li> </ul> <p>2. Predavanje: Osnove za ročno in računalniško risanje</p> <ul style="list-style-type: none"> <li>- Programska orodja za računalniško risanje</li> <li>- Ravninsko risanje</li> <li>- Prostorsko modeliranje (3D) in prehod v tehnično risanje (2D)</li> <li>- Skupna načela in pravila za zapis simboličnih</li> </ul>	<p>1. Lecture: Basics</p> <ul style="list-style-type: none"> <li>- Introduction – types of technical drawings, formats, title blocks, projection types, reference frames, scales, etc.</li> <li>- Sketching and technical drawing to scale.</li> <li>- Standards for technical drawing.</li> </ul> <p>2. Lecture: Basics of manual and computer-aided drawing</p> <ul style="list-style-type: none"> <li>- Software for computer-aided drawing.</li> <li>- 2D drawing.</li> <li>- Spatial modelling (3D) and transition to technical</li> </ul>
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<p>informacij na prikaze 3D modelov in na tehnične risbe</p> <p>3. Predavanje: Prikazovanje predmetov na delavniških in sestavnih/glavnih risbah</p> <ul style="list-style-type: none"> <li>- Grafični elementi in simbolična oprema delavniških risb</li> <li>- Elementi in oprema sestavnih oziroma glavnih risb</li> </ul> <p>4. Predavanje: Prikazovanje predmetov na delavniških in sestavnih / glavnih risbah 2</p> <ul style="list-style-type: none"> <li>- Projekcije v tehničnem risanju (TR) po ISO standardih</li> <li>- Večpogledne projekcije po prvi in tretji projekcijski metodi (ISO in drugi standardi)</li> <li>- Nestandardni in posebni pogledi</li> </ul> <p>5. Predavanje: Kotiranje</p> <ul style="list-style-type: none"> <li>- Elementi in pravila kotiranja</li> <li>- Načini kotiranja glede na funkcijo in tehnologijo izdelave</li> <li>- Posebnosti pri kotiranju in pogoste napake</li> </ul> <p>6. Predavanje: Posebnosti pri risanju</p> <ul style="list-style-type: none"> <li>- Prerezi</li> <li>- Detajli oz. podrobnosti</li> <li>- Posebni pogledi</li> </ul> <p>7. Predavanje: Risanje standardiziranih oblik elementov 1 - Navoji in vijačne zveze</p> <ul style="list-style-type: none"> <li>- Vrste in prikaz ter označevanje navojev</li> <li>- Zunanji navoj, notranji navoj, vijačna zveza</li> <li>- Risanje drugih pogostih elementov za zveze</li> </ul> <p>8. Predavanje: Risanje standardiziranih oblik elementov 2 - Risanje osi in gredi</p> <ul style="list-style-type: none"> <li>- Središčne izvrtine</li> <li>- Žlebovi glede na tehnologijo izdelave</li> <li>- Posnetja za montažo ležajev in tesnil</li> <li>- Gredne zveze, utori za zagozde, moznike in vskočnike...</li> </ul> <p>9. Predavanje: ISO tolerance in ujemi</p> <ul style="list-style-type: none"> <li>- Načini toleriranja</li> <li>- Tolerance dolžinskih mer in kotov</li> <li>- ISO ujemi in tolerance</li> <li>- Tolerance prostih mer (splošne)</li> </ul> <p>10. Predavanje: Geometrijske tolerance (GT) in kakovost površin</p> <ul style="list-style-type: none"> <li>- Elementi in definicije geometrijskega toleriranja</li> <li>- Vrste geometrijskih toleranc</li> <li>- Zapis geometrijskih toleranc na risbah</li> <li>- Posebnosti pri zapisu GT</li> <li>- Zapis kakovosti površin</li> <li>- Usklajevanje zapisa hrapavosti površin s tolerancami</li> <li>- Obdelovalni postopki in stanje površin (hrapavost)</li> </ul> <p>11. Predavanje: Stanje robov, risanje ležajev in tesnil</p> <ul style="list-style-type: none"> <li>- Označevanje splošnega in posebnega stanja robov</li> <li>- Risanje ležajev in ležajnih mest</li> <li>- Določitev dimenzijskih in geometrijskih toleranc ležajnih mest</li> <li>- Risanje tesnil</li> </ul> <p>12. Predavanje: Risanje varjencev</p>	<p>drawing (2D).</p> <ul style="list-style-type: none"> <li>- Common principles and rules for adding symbol information to 3D models and technical drawings.</li> </ul> <p>3. Lecture: Presenting objects on workshop and assembly/main drawings</p> <ul style="list-style-type: none"> <li>- Graphic elements and symbols on workshop drawings.</li> <li>- Elements and symbolic description of assembly/main drawings.</li> </ul> <p>4. Lecture: Presenting objects in workshop and assembly/main drawings 2</p> <ul style="list-style-type: none"> <li>- Projections in technical drawing in accordance with ISO standards.</li> <li>- Multiview projections based on 1st and 3rd angle projection methods (ISO and other standards).</li> <li>- Non-standard and special projections.</li> </ul> <p>5. Lecture: Dimensioning</p> <ul style="list-style-type: none"> <li>- Elements of and rules for dimensioning.</li> <li>- Methods of dimensioning with regard to the function and production technology.</li> <li>- Specificities in dimensioning and frequent mistakes.</li> </ul> <p>6. Lecture: Specificities in drawing</p> <ul style="list-style-type: none"> <li>- Sections.</li> <li>- Details.</li> <li>- Special projections.</li> </ul> <p>7. Lecture: Drawing standardised forms and elements 1</p> <ul style="list-style-type: none"> <li>- Threads and bolt connections</li> <li>- Types, presentation and marking of threads.</li> <li>- External thread, internal thread, bolt connection.</li> <li>- Drawing other frequent elements for connections.</li> </ul> <p>8. Lecture: Drawing standardised forms and elements 2</p> <ul style="list-style-type: none"> <li>- Drawing axes and shafts</li> <li>- Centre holes.</li> <li>- Reliefs with regard to the production technology.</li> <li>- Chamfers for bearing and seal installation.</li> <li>- Shaft connections, longitudinal and circular grooves, etc.</li> </ul> <p>9. Lecture: ISO tolerances and fits</p> <ul style="list-style-type: none"> <li>- Tolerancing methods.</li> <li>- Tolerances for linear and angular dimensions.</li> <li>- ISO fits and tolerances.</li> <li>- General tolerances of dimensions.</li> </ul> <p>10. Lecture: Geometrical tolerances (GT) and surface quality</p> <ul style="list-style-type: none"> <li>- Elements and definitions of geometrical tolerancing.</li> <li>- Types of geometrical tolerances.</li> <li>- Adding geometrical tolerances to drawings.</li> <li>- Specificities in GT annotations.</li> <li>- Indicating surface quality.</li> <li>- Coordination of surface roughness annotations and tolerances.</li> <li>- Machining processes and state of surfaces (roughness).</li> </ul> <p>11. Lecture: State of edges, drawing bearings and seals</p>
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<ul style="list-style-type: none"> <li>- Značilnosti risb varjencev</li> <li>- Prikaz varjencev na delavniških in sestavnih risbah</li> <li>- Risanje zvarov in označevanje zvarov</li> <li>- Tolerance prostih mer in geometrijske tolerance varjencev</li> </ul> <p>13. Predavanje: Risanje ulitkov</p> <ul style="list-style-type: none"> <li>- Predstavitev glavnih geometrijskih značilnosti ulitkov</li> <li>- Prikaz ulitkov na delavniških risbah</li> <li>- Označevanje posebnosti (delilne ravnine, nagibi, brada, srh, livarski zamik...) na risbah</li> <li>- Tolerance prostih mer ulitkov in dodatki za mehansko obdelavo po ulivanju</li> </ul> <p>14. Predavanje: Tehnična dokumentacija na 3D geometrijskih modelih</p> <ul style="list-style-type: none"> <li>- Simbolika zahtev TR na 3D modelih in 2D geometrijskih modelih ter risbah</li> <li>- Posebnosti, novosti iz standardov</li> <li>- Prednosti in slabosti</li> </ul> <p>15. Predavanje: Tehnična dokumentacija na 3D geometrijskih modelih in računalniška izdelava tehnične dokumentacije</p> <ul style="list-style-type: none"> <li>- Primeri GSP in prednosti ter slabosti</li> <li>- Načini računalniške izdelave tehnične dokumentacije in pravila pri računalniško podprtem risanju</li> </ul>	<ul style="list-style-type: none"> <li>- Marking a general and special state of edges.</li> <li>- Drawing bearings and bearing seats.</li> <li>- Determining dimensional and geometrical tolerances of bearing seats.</li> <li>- Drawing seals.</li> </ul> <p>12. Lecture: Drawing welded workpieces</p> <ul style="list-style-type: none"> <li>- Characteristics of welded workpiece drawings.</li> <li>- Presenting welded workpieces in workshop and assembly drawings.</li> <li>- Drawing and marking welds.</li> <li>- General tolerances of dimensions and geometrical tolerances of welded workpieces.</li> </ul> <p>13. Lecture: Drawing casted workpieces</p> <ul style="list-style-type: none"> <li>- Presentation of the main geometrical characteristics of castings.</li> <li>- Presenting castings in workshop drawings.</li> <li>- Marking specificities (parting planes, drafts, flash, burr, moulding mismatch, etc.) in drawings.</li> <li>- General tolerances of castings and machining allowances for mechanical treatment after the casting.</li> </ul> <p>14. Lecture: Technical documentation on 3D geometrical models</p> <ul style="list-style-type: none"> <li>- Symbols of technical drawing requirements on 3D models and 2D geometrical models and in drawings.</li> <li>- Specificities, novelties in standards.</li> <li>- Advantages and deficiencies.</li> </ul> <p>15. Lecture: Technical documentation on 3D geometrical models and computer-aided design of technical documentation</p> <ul style="list-style-type: none"> <li>- Examples of GSP, advantages and deficiencies.</li> <li>- Methods of computer-aided design of technical documentation and rules of computer-aided drawing.</li> </ul>
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#### Temeljna literatura in viri/Readings:

1. PREBIL, Ivan, KUNC, Robert. Opisna geometrija : potrebna znanja za pravilno risanje - osnove tehničnega risanja. 4. izd. Piran: STRI svetovanje, 2011.
  2. PREBIL, Ivan, ZUPAN, Samo. Tehnična dokumentacija. 2. izd. Ljubljana: Stri svetovanje, 2011
  3. KRAUT, Bojan, Krautov strojniški priročnik, 17. slovenska popravljena izd., predelana, 1. Natis; Ljubljana: Univerza v Ljubljani, Fakulteta za strojništvo, 2019
- Dodatna:
4. GLODEŽ, Srečko. Tehnično risanje. 1. natis. Ljubljana: Tehniška založba Slovenije, 2005.

#### Cilji in kompetence:

##### Cilji:

Pridobiti teoretično in praktično znanje s področja tehničnega risanja.

Spoznati uporabo specializiranih programskih orodij za tehnično risanje.

Spoznati ključne veljavne standarde s področja tehnične dokumentacije.

#### Objectives and competences:

##### Objectives:

Gaining theoretical and practical knowledge of technical drawing.

Learning to use specialised software tools for technical drawing.

Understanding key applicable standards in the field of

<p><b>Kompetence:</b></p> <p>S1-PAP: Sposobnost uporabe pridobljenega znanja v praksi.</p> <p>S10-PAP: Sposobnost strokovnega sporazumevanja in pisnega izražanja.</p> <p>S11-PAP: Sposobnost uporabe informacijsko-komunikacijske tehnologije.</p> <p>P3-PAP: Obvlada temeljna strokovna znanja s področja strojništva (tehniška dokumentacija).</p>	<p>technical documentation.</p> <p><b>Competences:</b></p> <p>S1-PAP: The ability to use the attained knowledge in practice.</p> <p>S10-PAP: The ability to communicate professionally and express oneself in writing.</p> <p>S11-PAP: The ability to use the information and communications technology.</p> <p>P3-PAP: Mastering the fundamental specialised knowledge in the field of mechanical engineering (technical documentation).</p>
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#### **Predvideni študijski rezultati:**

<p><b>Znanja:</b></p> <p>Z1: Poglobljeno strokovno teoretično in praktično znanje na področju tehničnega risanja, podprto s širšo teoretično in metodološko osnovo.</p> <p><b>Spretnosti:</b></p> <p>S1.1 Izvajanje kompleksnih operativno-strokovnih opravil, ki vključujejo tudi uporabo metodoloških orodij:</p> <p>Branje tehničnih risb in razumevanje prostorskih oblik na osnovi 2D risb.</p> <p>Izdelava tehničnih risb na osnovi prostorskih modelov.</p> <p>Uporaba veljavnih standardov pri opremljanju tehničnih risb</p>	<p><b>Intended learning outcomes:</b></p> <p><b>Knowledge:</b></p> <p>Z1: In-depth professional theoretical and practical knowledge in the field of technical drawing, supported by a wide theoretical and methodological basis.</p> <p><b>Skills:</b></p> <p>S1.1 Performance of complex operational and specialist tasks, including the use of methodological tools:</p> <p>Reading technical drawings and understanding spatial forms based on 2D drawings.</p> <p>Designing technical drawings based on 3D models.</p> <p>Use of applicable standards in creating symbolic description for technical drawings.</p>
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#### **Metode poučevanja in učenja:**

<p>P1 Avditorna predavanja z reševanjem izbranih - za področje značilnih - teoretičnih in praktično uporabnih primerov.</p> <p>P2 Obravnava snovi po urejeni in vnaprej razloženi sistematiki.</p> <p>P4 Laboratorijske vaje tehničnega risanja z namenskimi didaktičnimi pripomočki:</p> <p>Računalniške delovne postaje s programskimi paketi za izdelavo tehničnih risb.</p> <p>P8 Izdelava in predstavitev aplikativnih seminarskih nalog.</p> <p>P12 Individualizirane domače naloge v spletni učilnici.</p> <p>P14 Virtualne predstavitve.</p> <p>P15 Uporaba video vsebin kot priprava na predavanja in vaje.</p>	<p><b>Learning and teaching methods:</b></p> <p>P1 Auditory lectures with solving selected and typical theoretical and practical examples.</p> <p>P2 Presentation of subject matter based on the arranged and previously explained scheme.</p> <p>P4 Laboratory work in technical drawing with didactic tools.</p> <p>Computer workstations with software tools for design of technical drawings.</p> <p>P8 Creation and presentation of applicative seminar assignments.</p> <p>P12 Individual homework assignments in a virtual classroom.</p> <p>P14 Virtual presentations.</p> <p>P15 Use of video contents as preparation for lectures and tutorials</p>
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**Načini ocenjevanja:****Delež/Weight****Assessment:**

Teoretični izpit (pisno/ustno)	50,00 %	Theory examination (written/oral)
Delo na laboratorijskih vajah (vključno z izdelki)	20,00 %	Practical examination in laboratory (written/oral)
Projektna naloga (pisno)	30,00 %	Project work (written)

**Reference nosilca/Lecturer's references:****Robert Kunc**

**KUNC, Robert**, OMEROVIĆ, Senad, AMBROŽ, Miha, PREBIL, Ivan. How to protect the tunnel side wall in the event of vehicle impact. V: RAFALSKI, Leszek (ur.), ZOFKA, Adam (ur.). Transport Research Arena TRA2016. [S. l.]: Elsevier, 2016. Vol. 14, f. 1305-1314, ilustr. Transportation research procedia (Online). ISSN 2352-1465.

ZUPAN, Samo, **KUNC, Robert**, ŠUŠTERŠIČ, Gašper, ŽEROVNIK, Andrej, NOVAK, Aleksander, PREBIL, Ivan. Maloserijska izdelava električnih kolesnih motorjev : poročilo LAMEKa za raziskovalni vavčer. Ljubljana: Fakulteta za strojništvo, Katedra za modeliranje v tehniki in medicini, 2014. 27 str.

**KUNC, Robert**, OMEROVIĆ, Senad, AMBROŽ, Miha, PREBIL, Ivan. Comparative study of european tunnel emergency-stop-area-wall protection measures. Accident analysis and prevention. [Print ed.]. Feb. 2014, vol. 63, str. 9-21, ilustr. ISSN 0001-4575. DOI: 10.1016/j.aap.2013.10.020. [COBISS.SI-ID 13216027]

**KUNC, Robert**, ŽEROVNIK, Andrej, ŽVOKEJ, Matej, PREBIL, Ivan. Numerical determination of the carrying capacity of rolling rotational connections = Numerična določitev nosilnosti vrtljivih kotalnih zvez. Materiali in tehnologije. [Tiskana izd.]. mar./apr. 2007, letn. 41, št. 2, str. 73-76. ISSN 1580-2949.

**KUNC, Robert**, ZUPAN, Samo, AMBROŽ, Miha, KRAŠNA, Simon, ŽEROVNIK, Andrej, ŠUŠTERŠIČ, Gašper, OMEROVIĆ, Senad, NOVAK, Aleksander, PREBIL, Ivan. Izdelava dokumentacije za izvedbo razpisa za blažilnike trkov za zavarovanje stene SOS - predorske niše : končno poročilo. Ljubljana: Fakulteta za strojništvo, 2012. 27 str..

**Andrej Žerovnik**

**ŽEROVNIK, Andrej**, PEPEL, Vili, PREBIL, Ivan, KUNC, Robert. *The yield-point phenomenon and cyclic plasticity of the uniaxially loaded specimens*. Materials & design, ISSN 0264-1275, Feb. 2016, vol. 92, str. 971-977

**ŽEROVNIK, Andrej**, PREBIL, Ivan, KUNC, Robert. *The yield-point phenomenon and cyclic plasticity of the console beam*. Strojniški vestnik, ISSN 0039-2480, Sep. 2017, vol. 63, no. 9, str. 479-488

ZUPAN, Samo, KUNC, Robert, ŠUŠTERŠIČ, Gašper, **ŽEROVNIK, Andrej**, NOVAK, Aleksander, PREBIL, Ivan. Maloserijska izdelava električnih kolesnih motorjev : poročilo LAMEKa za raziskovalni vavčer. Ljubljana: Fakulteta za strojništvo, Katedra za modeliranje v tehniki in medicini, 2014. 27 str.

KUNC, Robert, ZUPAN, Samo, AMBROŽ, Miha, KRAŠNA, Simon, **ŽEROVNIK, Andrej**, ŠUŠTERŠIČ, Gašper, OMEROVIĆ, Senad, NOVAK, Aleksander, PREBIL, Ivan. Izdelava dokumentacije za izvedbo razpisa za blažilnike trkov za zavarovanje stene SOS - predorske niše : končno poročilo. Ljubljana: Fakulteta za strojništvo, 2012. 27 str.