

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	RAZVOJ TRAJNOSTNIH IZDELKOV STORITEV IN PROCESOV
<b>COURSE TITLE:</b>	DEVELOPMENT OF SUSTAINABLE PRODUCTS, SERVICES AND PROCESSES

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Varstvo okolja in ekotehnologije, 1. stopnja		2., 3.	
Environmental Protection and Eco-technologies, 1st level		2 <sup>nd</sup> , 3 <sup>rd</sup>	

**Vrsta predmeta / Course type** Temeljni / Compulsory

**Univerzitetna koda predmeta / University course code:** TRIP

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
25		20			100	7

**Nosilec predmeta / Lecturer:** doc. dr. Gašper Gantar / Assist. Prof. Dr. Gašper Gantar

<b>Jeziki / Languages:</b>	<b>Predavanja / Lectures:</b>	Slovenski / Slovenian
	<b>Vaje / Tutorial:</b>	Slovenski / Slovenian

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

Računalništvo (osnovno znanje CAD)

**Prerequisites:**

Computing (basic knowledge of CAD)

**Vsebina:**

- **Postopek konstruiranja** (osnovni pojmi, tolmačenje naloge, koncipiranje, snovanje, razdelava, uporaba kreativnih metod iskanja in vrednotenja rešitev, metode naprednega konstruiranja).
- **Osnove inženirskih materialov** (osnovni pojmi, pridobivanje, lastnosti).
- **Osnove industrijskih procesov** (osnovni pojmi, najpogostejši konvencionalni in nekonvencionalni postopki izdelave in spajanja).
- **Vrednotenje okoljskih vidikov proizvodov in tehnologij** (predstavitev ključnih orodij – LCA analize, ogljičnega odtisa, okoljskega odtisa – in metodologij za ovrednotenje okoljskih vplivov).
- **Metode ekodizajna** (optimiranje funkcije proizvoda, izbira materialov z manjšim okoljskim vplivom, zmanjšanje snovnih tokov, optimizacija proizvodnih tehnik, optimizacija distribucijskega sistema, načrtovanje za dolgo življenjsko dobo, načrtovanja konca življenjske dobe).

**Content (Syllabus outline):**

- **Design procedure** (basic concepts, design requirements, conceptualization, detailed design, use of creative methods of search and evaluation of solutions, methods of advanced design).
- **Basics of engineering materials** (basic concepts, acquisition, properties).
- **Basics of industrial processes** (basic concepts, the most common conventional and unconventional manufacturing and joining processes).
- **Evaluation of products and technologies from the environmental aspect** (presentation of key tools - LCA analysis, carbon footprint, environmental footprint - and methodologies for evaluating environmental impacts).
- **Ecodesign methods** (optimisation of product's function, selecting materials with lesser environmental impact, reducing material flows, optimisation of production techniques, optimisation of distribution system, designing for long service life, end-

of-life planning).

### Temeljni literatura in viri / Textbooks:

#### Obvezna / Required:

1. Dolšak, B. (2006). Konstruiranje za proizvodnjo. Maribor: Fakulteta za strojništvo.
2. Kuzman, K., 2010. Moderno proizvodno inženirstvo. Grosuplje: Grafis trade.
3. Kranjc, D., (2014). Eko-dizajn. Maribor: Fakulteta za kemijo in kemijsko tehnologijo.

#### Priporočena / Recommended:

1. Hlebanja (2003). Metodika konstruiranja, Ljubljana, Fakulteta za strojništvo.
2. ISO 14040

### Cilji in kompetence:

#### Predmetno specifični cilji in kompetence:

- študenta seznaniti s postopkom razvoja izdelkov in z metodami naprednega konstruiranja,
- študenta seznaniti z značilnostmi najpogosteje uporabljenih inženirskih materialov,
- študente seznaniti z najpogosteje uporabljenimi proizvodnimi tehnologijami,
- študenta usposobiti za samostojno načrtovanje preprostih izdelkov z upoštevanjem metod ekodizajna,
- študenta usposobiti za vrednotenje okoljskih vplivov enostavnih izdelkov, procesov, storitev ali dogodkov s pomočjo namenskega računalniškega programa in izbiro optimalne rešitve.

#### Splošne kompetence:

- sposobnost identifikacije in reševanja tehničnih problemov,
- sposobnost zbiranja in interpretiranja podatkov, kritične analize ter vrednotenja rezultatov,
- sposobnost obvladovanja raziskovalnih in razvojnih metod s področja razvoja izdelkov, storitev in tehnologij.

### Objectives and competences:

#### Specific competences:

- Students get acquainted with product development process and methods of advanced design,
- Students get acquainted with the characteristics of the most frequently used engineering materials,
- Students get acquainted with the most frequently used production technologies,
- Qualify the student for independent designing of simple products by taking into account eco-design methods,
- Qualify the student to evaluate environmental impacts of simple products, processes, services or events by using a dedicated computer program and for selecting an optimal solution.

#### General competences:

- Ability to identify and solve technical problems,
- Ability to collect and interpret data, to critically analyse and evaluate results,
- Ability to master research and development methods in the field of product, service and technology development.

### Predvideni študijski rezultati:

#### Znanje in razumevanje:

Študent bo ob zaključku tega predmeta sposoben:

- razumevanja postopek razvoja izdelka ali tehnologije,
- razumevanja značilnosti najbolj pogosto uporabljenih inženirskih materialov,
- poznavanja proizvodnih postopkov,
- samostojno sistematično razviti in skonstruirati

### Intended learning outcomes:

#### Knowledge and Understanding:

The student will be at the completion of this course able to:

- Understand the process of developing a product or technology,
- Understand characteristics of the most commonly used engineering materials,
- Demonstrate knowledge of production processes,
- Independently systematically develop and

<p>preprost izdelek z upoštevanjem metod ekodizajna,</p> <ul style="list-style-type: none"> <li>- uporabiti namenski računalniški program za vrednotenje okoljskih vplivov enostavnih izdelkov, procesov, storitev ali dogodkov.</li> </ul> <p><b><u>Prenesljive/ključne spretnosti in drugi atributi:</u></b></p> <ul style="list-style-type: none"> <li>- uporaba domačih in tujih zbirk tehnoloških podatkov,</li> <li>- zbiranje in kritično interpretiranje tehnoloških podatkov in rezultatov,</li> <li>- pisno in ustno poročanje o tehnoloških rešitvah.</li> </ul>
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<p>construct a simple product, by taking into account eco-design methods,</p> <ul style="list-style-type: none"> <li>- Use the dedicated computer program to evaluate the environmental impacts of simple products, processes, services, or events.</li> </ul> <p><b><u>Transferable/Key Skills and other attributes:</u></b></p> <ul style="list-style-type: none"> <li>- Use of domestic and international databases of technical data,</li> <li>- Gathering and critical interpretation of technical data and results,</li> <li>- Written and oral reporting about technological solutions.</li> </ul>
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**Metode poučevanja in učenja:**

<p><b><u>Oblike dela:</u></b></p> <ul style="list-style-type: none"> <li>- predavanja</li> <li>- laboratorijske vaje v računalniški učilnici</li> <li>- samostojno delo študentov/tk</li> </ul> <p><b><u>Metode dela:</u></b></p> <ul style="list-style-type: none"> <li>- razlaga</li> <li>- dialog, diskusija</li> <li>- preučevanje praktičnih primerov</li> <li>- aktivno skupinsko delo</li> <li>- ogledna vaja v industrijski praksi</li> <li>- vključevanje strokovnjakov za posamezna področja</li> <li>- priprava, predstavitev in zagovor seminarske naloge</li> </ul>
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**Learning and teaching methods:**

<p><b><u>Forms of teaching:</u></b></p> <ul style="list-style-type: none"> <li>- In-class lectures</li> <li>- Laboratory courses</li> <li>- Individual work of students</li> </ul> <p><b><u>Teaching methods:</u></b></p> <ul style="list-style-type: none"> <li>- Explanation</li> <li>- Discussion, debate</li> <li>- Practical demonstration</li> <li>- Teamwork</li> <li>- Practice in the industry</li> <li>- Involvement of experts in the specific fields</li> <li>- preparation, presentation of a seminar paper</li> </ul>
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	Delež (v %) / Weight (in %)	<b>Assessment:</b>
<p><b>Načini ocenjevanja:</b></p> <p><b>Način (pisni izpit, ustno izpraševanje, naloge, projekt)</b></p> <ul style="list-style-type: none"> <li>- pisni izpit</li> <li>- priprava, predstavitev in zagovor seminarske naloge</li> </ul> <p>Na vajah je obvezna vsaj 90-odstotna prisotnost. Študent mora izdelati poročila o vajah, potem lahko pristopi h končnemu pisnemu izpitu</p> <p>Ocenjevalna lestvica:</p> <ul style="list-style-type: none"> <li>- zadostno 6: 60-67%</li> <li>- dobro 7: 68-75%</li> <li>- prav dobro 8: 76-83%</li> <li>- prav dobro 9: 84-90%</li> <li>- odlično 10: 91-100%</li> </ul>	<p>70%</p> <p>30%</p>	<p><b>Type (examination, oral, coursework, project):</b></p> <ul style="list-style-type: none"> <li>- written exam</li> <li>- preparation, presentation and defence of seminar paper</li> </ul> <p>At least 90% attendance at lab work is required. Students must first draw up report on their lab work, which is a prerequisite for final written examination.</p> <p>Grading system:</p> <ul style="list-style-type: none"> <li>- Sufficient D (6): 60-67%</li> <li>- Good C (7): 68-75%</li> <li>- Very good B (8): 76-83%</li> <li>- Very good B+ (9): 84-90%</li> <li>- Excellent A (10): 91-100%</li> </ul>

**Materialni pogoji za izvedbo predmeta :**

- predavalnica z multimedijsko opremo
- računalniška učilnica s programom za CAM in LCA analize

**Material conditions for subject realization:**

- classroom with the multimedia equipment
- computer classroom with software for CAD and LCA

**Obveznosti študentov:**

- Obvezna udeležba na vajah
- Izdelana seminarska naloga

**Student's commitments:**

- Compulsory attendance at lab work
- Seminar paper

**Reference nosilca predmeta:****(1) Pedagoško delo:**

- nosilec in izvajalec predmetov na dodiplomskem študiju (Sodobne izdelovalne tehnologije – VŠPI Celje, Izdelava in vzdrževanje orodij – VŠPI Celje) in podiplomskem študiju (Konstruiranje izdelkov – FTPO)
- mentor in somentor diplomantom na dodiplomskem študiju ter magistrantom na podiplomskem študiju

**(2) Raziskovalno delo:**

- več kot 300 industrijskih projektov
- finančni koordinator projekta 6. okvirnega programa: New product development guidance system (PDGS) for complex injection moulded plastic parts by enhanced injection moulding simulation and material data measurement applicable by SMEs (Pro4Plast)
- predsednik Usmerjevalnega odbora in finančni vodja projekta 6. okvirnega programa: Magnesium forged components for structural lightweight transport applications (MagForge)
- finančni vodja projekta 7. okvirnega programa: Tools for Innovative Product-Service-Systems for Global Tool and Die Networks (TIPSS)
- Application Manager projekta Margintech: Lifelong Learning Programme (action Grundtvig).

**Pomembnejša raziskovalna dela:**

- GANTAR, Gašper, GLOJEK, Andrej, MORI, Mitja, NARDIN, Blaž, SEKAVČNIK, Mihael. Resource efficient injection moulding with low environmental impacts. Strojniški vestnik, ISSN 0039-2480, Mar. 2013, vol. 59, no. 3, str. 193-200, SI 35,
- PETEK, Aleš, GANTAR, Gašper, PEPELNJAK, Tomaž, KUZMAN, Karl. Economical and ecological aspects of single point incremental forming versus deep drawing technology. V: MICARI, F. (ur.). Proceedings of the 12th International Conference on Sheet Metal,

**Lecturer's references:****(1) Teaching:**

- Lecturer of subjects at undergraduate level (Modern Production Technologies – VŠPI Celje, Moulds Production and Maintenance – VŠPI Celje) and postgraduate studies (Product design – FTPO)
- Mentor and co-mentor to graduate and post-graduate students

**(2) Research work:**

- More than 300 industrial projects;
- Financial coordinator of the project within 6th Framework Programme: New product development guidance system (PDGS) for complex injection moulded plastic parts by enhanced injection moulding simulation and material data measurement applicable by SMEs (Pro4Plast);
- President of the Steering Committee and Exploitation Manager of the project within 6th Framework Programme: Magnesium forged components for structural lightweight transport applications (MagForge);
- Exploitation manager of the project within 7th Framework Programme: Tools for Innovative Product-Service-Systems for Global Tool and Die Networks (TIPSS);
- Application Manager for the project Margintech, Lifelong Learning Programme (action Grundtvig), concluded 2011.

**Selected research publications:**

- GANTAR, Gašper, GLOJEK, Andrej, MORI, Mitja, NARDIN, Blaž, SEKAVČNIK, Mihael. Resource efficient injection moulding with low environmental impacts. Strojniški vestnik, ISSN 0039-2480, Mar. 2013, vol. 59, no. 3, str. 193-200, SI 35,
- PETEK, Aleš, GANTAR, Gašper, PEPELNJAK, Tomaž, KUZMAN, Karl. Economical and ecological aspects of single point incremental forming versus deep drawing technology. V: MICARI, F. (ur.). Proceedings of the 12th

Palermo, Italy, April 1-4,2007, (Key Engineering materials, ISSN 1013-9826, Vol. 344, 2007). Aedermansdorf: Trans Tech Publications. 2007, vol. 344, str. 931-938.

- HANČIČ, Aleš, GANTAR, Gašper. Bioplastika, material prihodnosti. IRT 3000 : inovacije, razvoj, tehnologije, ISSN 1854-3669.
- GANTAR, Gašper, BREZNIKAR, Igor, NARDIN, Blaž. Environmental impacts of production processes used in tool and die manufacturing. V: HANČIČ, Aleš (ur.), et al. Conference proceedings, 9th International Conference on Industrial Tools and Material Processing Technologies [also] ICIT & MPT, Ljubljana, Slovenia, April 9th - 11th 2014. Celje: TECOS, Slovenian Tool and Die Development Centre. 2014, str. 365-369
- MORI, Mitja, DROBNIČ, Boštjan, GANTAR, Gašper, SEKAVČNIK, Mihael. Life cycle assessment of supermarket carrier bags and opportunity of bioplastics. V: KROPE, Jurij (ur.), OLABI, Abdul Ghani (ur.), GORIČANEC, Darko (ur.). Conference proceedings, 6th International Conference on Sustainable Energy and environmental protection, SEEP 2013, 20th - 23rd of August 2013, Maribor. Maribor: Faculty of Chemistry and Chemical Engineering. 2013

(3) Strokovno delo:

- direktor in kasneje svetovalec direktorja Tehnološkega centra orodjarstva Slovenije TECOS, ki se ukvarja z razvojem izdelkov in tehnologij

(4) Priznanja in sodelovanje v mednarodnih organizacijah:

- TRIMO raziskovalna nagrada za doktorsko disertacijo
- Član International Committee for Environment and Manufacturing – ICEM

International Conference on Sheet Metal, Palermo, Italy, April 1-4,2007, (Key Engineering materials, ISSN 1013-9826, Vol. 344, 2007). Aedermansdorf: Trans Tech Publications. 2007, vol. 344, str. 931-938.

- HANČIČ, Aleš, GANTAR, Gašper. Bioplastika, material prihodnosti. IRT 3000 : inovacije, razvoj, tehnologije, ISSN 1854-3669.
- GANTAR, Gašper, BREZNIKAR, Igor, NARDIN, Blaž. Environmental impacts of production processes used in tool and die manufacturing. V: HANČIČ, Aleš (ur.), et al. Conference proceedings, 9th International Conference on Industrial Tools and Material Processing Technologies [also] ICIT & MPT, Ljubljana, Slovenia, April 9th - 11th 2014. Celje: TECOS, Slovenian Tool and Die Development Centre. 2014, str. 365-369
- MORI, Mitja, DROBNIČ, Boštjan, GANTAR, Gašper, SEKAVČNIK, Mihael. Life cycle assessment of supermarket carrier bags and opportunity of bioplastics. V: KROPE, Jurij (ur.), OLABI, Abdul Ghani (ur.), GORIČANEC, Darko (ur.). Conference proceedings, 6th International Conference on Sustainable Energy and environmental protection, SEEP 2013, 20th - 23rd of August 2013, Maribor. Maribor: Faculty of Chemistry and Chemical Engineering. 2013

(3) Professional work:

- Managing director and consultant of managing director of Slovenia Tool and Die Development Centre TECOS.

(4) Awards and participation in international organizations:

- TRIMO award for Ph.D. thesis
- Member of International Committee for Environment and Manufacturing – ICEM