

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	RAZVOJ TRAJNOSTNIH IZDELKOV STORITEV IN PROCESOV
COURSE TITLE:	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	/	3.	1.
Environmental Protection and Eco-technologies, 1 st level	/	3 rd	1 st

Vrsta predmeta / Course type Obvezni predmet / Obligatory subject

Univerzitetna koda predmeta / University course code: RTI

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
25	/	20	/	/	100	5

Nosilec predmeta / Lecturer: doc. dr. Gašper Gantar

Jeziki / Predavanja / Lectures: Slovenski / Slovenian
Languages: Vaje / Tutorial: 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 konstruirati preprost izdelek z upoštevanjem metod ekodizajna,

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 construct a simple product, by taking into account eco-design methods,

<ul style="list-style-type: none"> - uporabiti namenski računalniški program za vrednotenje okoljskih vplivov enostavnih izdelkov, procesov, storitev ali dogodkov. <p><u>Prenesljive/ključne spretnosti in drugi atributi:</u></p> <ul style="list-style-type: none"> - uporaba domačih in tujih zbirk tehnoloških podatkov, - zbiranje in kritično interpretiranje tehnoloških podatkov in rezultatov, - pisno in ustno poročanje o tehnoloških rešitvah.
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<ul style="list-style-type: none"> - Use the dedicated computer program to evaluate the environmental impacts of simple products, processes, services, or events. <p><u>Transferable/Key Skills and other attributes:</u></p> <ul style="list-style-type: none"> - Use of domestic and international databases of technical data, - Gathering and critical interpretation of technical data and results, - Written and oral reporting about technological solutions.

Metode poučevanja in učenja:

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

<p><u>Forms of teaching:</u></p> <ul style="list-style-type: none"> - In-class lectures - Laboratory courses - Individual work of students <p><u>Teaching methods:</u></p> <ul style="list-style-type: none"> - Explanation - Discussion, debate - Practical demonstration - Teamwork - Practice in the industry - Involvement of experts in the specific fields - preparation, presentation of a seminar paper

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt)	Delež (v %) / Weight (in %)	Type (examination, oral, coursework, project):
<ul style="list-style-type: none"> - pisni izpit - priprava, predstavitev in zagovor seminarske naloge <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"> - zadostno 6: 60-67% - dobro 7: 68-75% - prav dobro 8: 76-83% - prav dobro 9: 84-90% - odlično 10: 91-100% 	<p>70%</p> <p>30%</p>	<ul style="list-style-type: none"> - written exam - preparation, presentation and defence of seminar paper <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"> - Sufficient D (6): 60-67% - Good C (7): 68-75% - Very good B (8): 76-83% - Very good B+ (9): 84-90% - Excellent A (10): 91-100%

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*, Palermo, Italy, April 1-4, 2007, (Key Engineering

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 International Conference on Sheet Metal*, Palermo, Italy, April

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

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
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(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