UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Prenosniki toplote
Course title:	Heat exchangers
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski	Procesno strojništvo (smer)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0566925
Koda učne enote na članici/UL Member course code:	6020-M

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
30		30			65	5

Nosilec predmeta/Lecturer:	Andrej Kitanovski, Iztok Golobič, Jaka Tušek, Jože Kutin
Vrsta predmeta/Course type:	Obvezni strokovni predmet na smeri Procesno strojništvo, ki je izbirni strokovni predmet na ostalih smereh./Compulsory specialised course in the study of Process Engineering, which is an elective specialised course in other fields of study.

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Izpolnjevanje pogojev za vpis v Magistrski študijski program II. stopnje Strojništvo - Razvojno raziskovalni program.	Meeting the enrollment conditions for the Master's study programme of Mechanical Engineering - Research and Development program.

Vsebina:	**Content (Syllabus outline):**
1. Klasifikacija prenosnikov toplote - Glede na proces prenosa toplote, prenosniki toplote z indirektnim kontaktom, prenosniki toplote z direktnim kontaktom - Glede na število fluidov	1. Classification of heat exchangers - With respect to the heat transfer process, indirect contact heat exchangers, direct contact heat exchangers - With respect to the type and number o fluids

- Glede na kompaktnost površine (plin-kapljevina, kapljevina-kapljevina, fazna sprememba) - Glede na konstrukcijo (cevni prenosniki toplote, ploščni prenosniki toplote, razširjene površine, regeneratorji) - Glede na vrsto toka (z enim prehodom, z več prehodi) 2. Metode dimenzioniranja prenosnikov toplote - Eksaktne analitične metode, Aproksimacijske metode, Numerične metode,Ostale metode, - Toplotni in hidravlični preračun, konstruiranje, izdelava in stroški - Faktorji vpliva, Optimalni design - Učinek in učinkovitost prenosnika toplote, razmerje toplotnih kapacitet in število prenosnih enot - Epsilon-NTU razmerja, predstavitev metode LMTD, korekcijski faktor F, korekcijski faktorji za različne oblike toka 3. Posebnosti dimenzioniranja rekuperatorjev in regeneratorjev - Vzdolžna, prečna toplotna prevodnost, ali neuniformna toplotna prevodnost pri rekuperatorjih in regeneratorjih, - Posebnosti razširjenih površin - Posebnosti cevnih prenosnikov - Epsilon NTU0 metoda, Lambda-Pi metoda - Vpliv tlaka in cikličnega zadrževanja tekočin, - vpliva matrice in lastnosti materiala 4. Analiza padca tlaka - Glavni vzroki za padec tlaka, Predpostavke za analize - Padec tlaka pri razširjeni površinah, Padec tlaka v regeneratorjih - Padec tlaka v plošnih prenosnikih toplote - Padec tlaka v cevnih prenosnikih toplote - Padec tlaka in distribucija tekočin 5. Površina, materiali, geometrija prenosnikov toplote in neenaka distribucija tekočin - Cevni prenosniki toplote, Cevno-lamelni prenosniki toplote - Ploščni prenosniki toplote - Razširjene površine - Regeneratorji - Vpliv geometrije, Vpliv vstopnih in izstopnih kanalov, Vpliv karakteristik obratovanja, Rešitve 6. Izboljšan prenos toplote pri prenosnikih toplote - Pasivne, aktivne in sestavljene tehnike izboljšanega prenosa toplote, razvoj generacij tehnik izboljšanega prenosa toplote; - Izboljšan prenos toplote pri naravni in prisilni konvekciji brez in s fazno spremembo. 7. Uparjalniki - Metode določevanja koeficienta toplotne prestopnosti ter kritične gostote toplotnega toka pri vrenju v bazenu, prisilnem konvektivnem vrenju v ceveh in vrenju v mikrokanalih;	- With respect to the compactness of heat exchanger (gas-liquid, liquid-liquid, phase change) - With respect to construction (tube heat exchangers, plate heat exchangers, extended surfaces, regenerators) - With respect to the type of flow (single-pass, multi-pass) 2. Methods for dimensiong of heat exchangers - Exact analytical methods, Approximation methods, Numerical methods, Other types of methods - Thermal and hydraulical analysis, construction, manufacturing and costs - Influential factors, Optimal design - The effectiveness and efficiency of heat exchanger, capacity ration, NTU - Epsilon-NTU, introduction to the LMTD method, correction factor F, correction factors for different types o the flow 3. Spefics in dimensioning of recuperators and regenerators - Longitudinal, transverse thermal conductivity, non-uniform thermal conductivity in recuperators and regenerators, - Specifics of extended surfaces - Specifics of tube heat exchangers - Epsilon NTU0 method, Lambda-Pi method - The influence of pressure and cyclic maintenance of fluids, the influence of matrix and material properties. 4. Pressure drop analysis - Main causes for pressure drop, assumptions for analysis - Pressure drop in extended surfaces, Pressure drop in regenerators, - Pressure drop in plate heat exchangers - Pressure drop in tube heat exchangers - Pressure drop and fluid distribution 5. Surface, mateirals, geometry of heat exchangers, and fluid's maldistribution - Tube heat exchangers, finned coils - Plate heat exchangers - Extended surfaces - Regenerators - The influence of geometry, The influence of entrance and exit, The influence of operating parameters, Solutions 6. Enhanced heat transfer in heat exchangers - Passive, active, and combined techniques for enhanced heat transfer, and development of techniques for enhanced heat transfer; - Enhanced heat transfer for natural and forced convenctions, with and without phase change. 7. Evaporators - Methods for definition of heat transfer coefficient and critical heat flux for pool boiling or evaporation,

- Dimenzioniranje uparjalnika. 8. Prenosniki toplote s kondenzacijo - Metode določevanja koeficienta toplotne prestopnosti pri laminarni, laminarni valoviti in turbulentni filmski kondenzaciji ter kapljičasti kondenzaciji; - Dimenzioniranje kondenzatorja. 9. Toplotna cev - Toplotna cev in dvofazni zaprti termosifon, princip delovanja, vrste toplotnih cevi; - Omejitve v delovanju, toplotna karakteristika toplotne cevi, prenosnik toplote s toplotnimi cevmi, tehnologija izdelave. 10. Ploščni prenosniki toplote in prenos toplote v mikroelektronskih komponentah - Vizualizacija hidrodinamičnih tokov v ploščnem prenosniku in infrardeča termografija dinamike delovanja ploščnega prenosnika toplote; - Mehanizmi nastajanja oblog na površinah prenosnikov toplote; izboljšan prenos toplote v mikroelektronskih komponentah. 11. Tehnične zahteve za preskušanja prenosnikov toplote - Pregled tehničnih zahtev - Standardi in druga priporočila glede preskušanja prenosnikov - Izbira metod in postopkov preskušanja 12. Tlačni preskusi prenosnikov toplote - Tlačni preskusi in preskusi tesnosti: pregled metod - Merjenje pretoka puščanja po metodi tlačne spremembe, ugotavljanje netesnosti s helijevim detektorjem - Eksperimentalno določanje lastnih tlačnih izgub prenosnika 13. Merjenje pretoka tekočine in temperaturnega stanja v prenosniku toplote - Izhodišča merjenja pretoka tekočin, izbira ustrezne merilne metode - Izhodišča merjenja temperature in temperaturne razlike, izbira ustrezne merilne metode 14. Merjenje toplotnega toka, toplotne energije - Izhodišča merjenja toplotnega toka, toplotne energije - Izbira ustrezne merilne opreme - Merilno-tehnične zahteve in kontrola meroslovnih lastnosti 15. Določanje učinkovitosti prenosnikov toplote - Eksperimentalno določanje učinkovitosti prenosnika toplote - Dobre prakse glede izvedbe merilnega sistema - Vplivni dejavniki na kakovost meritve učinkovitosti prenosnika toplote	flow boiling or and evaporation in micro-channels; - Dimenzioniranje uparjalnika. 8. Condensers - Methods for definition of heat transfer coefficient for laminar, laminar-wavy, and turbulent film or droplets condensation; - Dimensioning of condenser. 9. Heat pipe - Heat pipe and two-phase closed thermosiphon, principle of operation, types of heat pipes; - Limitations in operation, thermal characteristics of heat pipes, heat pipe heat exchanger, manufacturing technologies. 10. Plate heat exchanger and heat transfer in micro-electronic components - Visualization of hydrodinamic fllows in plate heat exchangers and infrared thermography of dynamic operation of plate heat exchanger; - Mechanisms and fouling in heat exchangers; enhanced heat transfer in micro-elecronic components. 11. Technical requirements for testing of heat exchangers - Review of technical requirements - Standards and other recommendations regarding testing of heat exchangers - Selection of testing methods and procedures 12. Pressure testing of heat exchangers - Pressure testing and leak tightness testing: review of methods - Measurement of leak flow rate by pressure decay method, leak detection by helium detector - Experimetal determination of the exchanger’s own pressure loss 13. Measurement of fluid flow rate and temperature conditions in heat exchanger - Fundamentals of flow rate measurement, selection of proper measurement method - Fundamentals of measurement of temeperature and temperature difference, selection of proper measurement method 14. Measurement of heat flow rate, thermal energy - Fundametals of measurement of heat flow rate, thermal energy - Selection of proper measurement equipment - Measurement-technical requirements and verification of metrological characteristics 15. Determination of heat exchanger efficiency - Experimental determination of heat exchanger efficiency - Best practices for realization of measurement system - Influence parameters on quality of measurements of heat exchanger efficiency

Temeljna literatura in viri/Readings:

1. S. Kakaç, H. Liu, A. Pramuanjaroenkij, Heat Exchangers : Selection, Rating, and Thermal Design, Third Edition, 2012
2. Ramesh K. Shah, Dusan P. Sekulic, Fundamentals of Heat Exchanger Design, 2003
3. Donatello Annaratone, Handbook for Heat Exchangers and Tube Banks design, 2010
4. Eric M. Smith, Advances in thermal design of heat exchangers a numerical approach direct-sizing, step-wise rating, a transients, 2006
5. Dawid Taler, Numerical Modelling and Experimental Testing of Heat Exchangers, 2018
6. J.E. Hesselgreaves, R. Law, D. Reay, Compact Heat Exchangers. Selection, Design and Operation, 2016
7. Tropea, C., Yarin, A.L., Foss, J.F. (ur.): Springer handbook of experimental fluid mechanics. Springer, 2007.
8. VDI Gesellschaft, VDI Heat Atlas. 2nd Edition, Springer, 2010.
9. Zohori, B., Functionality, Advancements and Industrial Applications of Heat Pipes. Academic Press, 2020.
10. Santos, H. A., Liu, D., Zhang, H. ,Microfluidics for Pharmaceutical Applications: From Nano/Micro Systems Fabrication to Controlled Drug Delivery. William Andrew, 2018.
11. Baker, R. C.: Flow Measurement Handbook. Cambridge University Press, 2016
12. OIML R 75-1:2002 Heat meters: General requirements
13. OIML R 75-2:2002 Heat meters: Type approval tests and initial verification tests

Cilji in kompetence:

Cilji:

Cilj predmeta je podati študentu znanja s področja prenosnikov toplote na vseh področjih njihove uporabe. Z znanjem s področja prenosnikov toplote študent:

- pridobi temeljna znanja za obvladovanje dimenzioniranja in preračuna prenosnikov toplote;
- pridobi znanja za pravilno izbiro in vključitev prenosnikov toplote v procesne in energetske sisteme;
- pridobi sposobnosti, ki jih potrebuje za zniževanje rabe energije v procesni in energetski tehniki s pravilno izbiro prenosnikov toplote;
- pridobi sposobnosti, ki jih potrebuje za pravilno vzdrževanje sistemov z vgrajenimi prenosniki toplote;
- pridobi temeljna znanja glede načrtovanja eksperimentalnih preskušanj prenosnikov toplote;
- pridobi sposobnosti za načrtovanje merilnih sistemov za tlačne preskuse, preskuse tesnosti, določanje tlačnih izgub, določanje učinkovitosti prenosnika toplote.

Kompetence:

1. S1-MAG, P2-MAG, Razumevanje umestitve, delovanja in obratovalnih karakteristih prenosnikov toplote v procesni in energetski industriji. Sposobnost vključitve v širše delovne skupine za reševanje kompleksnih problemov na

Objectives and competences:

Objectives:

The main objective of the subject is to provide student with knowledge in a domain of heat exchangers and their applications. With the knowledge obtained from the field of heat exchangers student will gain:

- basic knowledge for dimensioning and calculation analysis of heat exchangers;
- attain knowdlege for appriate selection and integration of heat exchanger in process and energy systems;
- attain abilities, which are needed for reduction of energy consumption in process and energy technologies, with the appropriate selection of heat exchangers;
- attain abilities, required for appropriate maintenance of systems with heat exchangers;
- attain basic knowledge on planning and design of experimental testing of heat exchangers;
- attain abilities for design of measurement systems for pressure testing, leak tightness testing, determination of pressure losses, and determination of heat exchanger efficiency.

Competences:

1. S1-MAG, P2-MAG, Knowledge and understanding problems for implementation, process and operation characteristics of heat exchangers in process and energy related industry. The ability to integration of a working group for solving complex problems in the field of heat exchangers

področju prenosnikov toplote v energetiki in procesni tehniki. 2. S2-MAG, S10-MAG, P5-MAG, Sposobnost samostojnega pridobivanja novih znanj in veščin.sposobnosti kritičnega, analitičnega in sintetičnega mišljenja pri zasnovi, analizi in dimenzioniranju prenosnikov toplote z razvojem novega znanja in razumevanja ter s sposobnostjo prenašanja rezultatov raziskav v prakso. 3. S2-MAG, S7-MAG, P6-MAG, Razvijanje novih znanj glede metodologije eksperimentalnega preskušanja prenosnikov toplote, usposobljenost za uporabo pridobljenih znanj pri načrtovanju s tem povezanih preskusnih sistemov in merilnih metod.	in energy and process technologies. 2. S2-MAG, S10-MAG, P5-MAG, The ability of individual learning and gaining skills for critical, analytical, and synthetic thinking for analysis, dimensioning of heat exhcangers, with the ability for transfer of research results into practice.. 3. S2-MAG, S7-MAG, P6-MAG, The ability to develop new knowledge with regard to the methodology of experimental testing of heat echangers, ability for knowledge transfer in design of experimental systems and measurement methods.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanja: Z2: Poglobljeno teoretično, metodološko in analitično znanje s področja prenosnikov toplote in njihovega preskušanja, ki je kot tako prenosljivo in dopolnjujoče z ostalimi disciplinami energetike in procesne industrije za kvalitetno delo na razvojno raziskovalnem in aplikativnem področju. Spretnosti: S2.1: Pridobitev prenosljivih spretnosti – niso vezane le na en predmet, in ki omogočajo sistematični pristop k obravnavi predmetne vsebine prenosnikov toplote. S2.3: Sposobnost izvirnih dognanj in kritične refleksije na področju procesnega in okoljskega inženirstva.	Knowledge: Z2: Deep theoretical, methodological, and analytical knowledge from the field of heat exchangers and their testing, which can be transferred and supplement to other domains of process industry for high quality basic and applied research. Skills: S2.1 : Attaining of transferrable skills – which are not related only to one subject – and which enable systematic approach in analysis of the subject from the field of heat exchangers. S2.3: Ability of unique inovations and critical reflections in the field of process and environmental engineering.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Klasične oblike poučevanja: • P1 Avditorna predavanja z reševanjem izbranih - za področje značilnih - teoretičnih in praktično uporabnih primerov. • P3 Avditorne vaje, kjer se teoretično znanje s predavanj podkrepi z računskimi primeri. • P4 Laboratorijske vaje z namenskimi didaktičnimi pripomočki (ploščni prenosnik toplote, prenosnik toplote cev v cevi, regenerator, križni prenosnik toplote, eksperimentalni sistemi za določanje tlačnih izgub, pretoka puščanja, toplotne učinkovitosti). • P5 Uporaba študijskega gradiva v obliki (zapiskov,	Classical types of teaching: • P1 Auditorial lectures with solving of selected-for the domain specific – theroretical and practically applicable examples. • P3 Auditorial excercized, in which the theoretical knowledge is supported with numerical/analytical problems . • P4 Laboratory work with didactical means (plate heat exchanger, tube in tube heat exchanger, regenerators, cross-flow heat exchanger, experimental systems for determination of pressure losses, leakage flow rate and thermal effiiciency).

e-verzija predstavitve predavanj). Moderne in prožne oblike poučevanja: • P6 Interaktivna predavanja • P8 Izdelava in predstavitev aplikativnih seminarskih nalog • P9 Skupinsko delo (razprave za – proti, razprave o prebranem, snežena kepa, strukturirana diskusija, viharjenje možganov, projektno delo,...) • P14 Virtualni eksperimenti • P15 Uporaba video vsebin kot priprava na predavanja in vaje	• P5 The use of study material in the form of (lecture notes, e-version of lectures). Modern and flexible methods of teaching: • P6 Interactive lectures • P8 Applicative seminary work and its presentation • P9 Team work (discussion for– against, discussions about read materials, snow-ball, structured discussion, brain-storming, project work,...) • P14 Virtual experiments • P15 The use of video materials in lectures and excercizes

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Teoretične vsebine (predavanja, računske naloge).	50,00 %	Theory (from lectures and excercize problems).
Samostojno/skupinsko delo na vajah.	25,00 %	Individual/group work at excercizes.
Praktični seminar.	25,00 %	Practical seminary work.

Reference nosilca/Lecturer's references:

Andrej Kitanovski

1. EGOLF, Peter W., KITANOVSKI, Andrej, DIEBOLD, Marc, GONIN, Cyrill, VUARNOZ, Didier. Magnetic power conversion with machines containing full or porous wheel heat exchangers. *Journal of Magnetism and Magnetic Materials*, ISSN 0304-8853. [Print ed.], 2009, vol. 321, iss. 7, str. 758-762, [COBISS.SI-ID 11242267], [JCR, SNIP, WoS]
2. VUARNOZ, Didier, KITANOVSKI, Andrej, GONIN, Cyrill, SARI, Osmann, EGOLF, Peter W. Modeling of a two-stage magnetic refrigerator with wavy-structure gadolinium heat exchangers = Modélisationon d'un réfrigérateur magnétique biétagé muni d'échangeurs de chaleur ondulés en gadolinium. *International journal of refrigeration*, ISSN 0140-7007. [Print ed.], 2010, vol. 33, iss. 4, str. 745-752, [COBISS.SI-ID 11256603], [JCR, SNIP, WoS]
3. ENGELBRECHT, Kurt, TUŠEK, Jaka, NIELSEN, Kaspar K., KITANOVSKI, Andrej, BAHL, Christian Robert Haffenden, POREDOŠ, Alojz. Improved modelling of a parallel plate active magnetic regenerator. *Journal of physics. D, Applied physics*, ISSN 0022-3727, 2013, vol. 46, iss. 25, str. 1-12, [COBISS.SI-ID 12927515], [JCR, SNIP, WoS]
4. PETELIN, Nada, GATARIĆ, Pero, KITANOVSKI, Andrej, POREDOŠ, Alojz. Modelling and experimental evaluation of a condenser for a heat-pump tumble dryer. V: MINEA, Vasile (ur.). ICR 2019 : refrigeration science and technology proceedings, 25th IIR International Congress of Refrigeration, August 24-30, 2019, Montreal, Canada. Paris: International Institute of Refrigeration = Institut International du Froid. 2019, f. 4455-4462, ilustr. [COBISS.SI-ID 16782363]
5. POREDOŠ, Alojz, LORBEK, Luka, GRUM, Stane, KITANOVSKI, Andrej, POREDOŠ, Primož, PLAZNIK, Uroš. Meritve RB prenosnikov toplote s povečano površino in cevno-lamelnega prenosnika toplote : poročilo o delu na projektu. Ljubljana: Fakulteta za strojništvo, 2016. 26 f., graf. prikazi. [COBISS.SI-ID 15008539]

Iztok Golobič

1. GOLOBIČ, Iztok, PETKOVŠEK, Jure, BAŠELJ, Matej, PAPEŽ, Andrej, KENNING, D.B.R. Experimental determination of transient wall temperature distributions close to growing vapor bubbles.Heat and Mass Transfer, 2009, vol. 45, str. 857-866.[COBISS.SI-ID 10062363], [JCR]
2. SANNA, A., KARAYIANNIS, T.G., KENNING, D.B.R., HUTTER, C., SEFIANE, K., WALTON, A.J., GOLOBIČ, Iztok,

PAVLOVIČ, Erik, NELSON, R.A. Steps towards the development of an experimentally verified simulation of pool nucleate boiling on a silicon wafer with artificial sites.. Applied thermal engineering, 2009, vol. 29, str. 1327-1337. [COBISS.SI-ID 10694427], [JCR]

3. SITAR, Anže, LEBAR, Andrej, CRIVELLARI, Michele, BAGOLINI, Alvise, GOLOBIČ, Iztok. Oscillations during flow boiling in single microchannels. Acta chimica slovenica. 2018, vol. 65, str. 980-988. [COBISS.SI-ID 16407579], [JCR]
4. ZUPANČIČ, Matevž, MOŽE, Matic, GREGORČIČ, Peter, GOLOBIČ, Iztok. Nanosecond laser texturing of uniformly and non-uniformly wettable micro structured metal surfaces for enhanced boiling heat transfer. Applied Surface Science. 2017, vol. 399, str. 480-490. [COBISS.SI-ID 15158043], [JCR]
5. SITAR, Anže, GOLOBIČ, Iztok. Effect of nucleation cavities on enhanced boiling heat transfer in microchannels. Nanoscale and microscale thermophysical engineering. 2016, vol. 20, str. 33-50, [COBISS.SI-ID 14609435], [JCR]

Jože Kutin

1. RUPNIK, Klemen, BAJSIČ, Ivan, KUTIN, Jože. Modelling of a thermal dispersion mass flow meter. Flow measurement and instrumentation, 2018, vol. 59, str. 37-44 [tipologija 1.01, SCI]
2. KUTIN, Jože, BOBOVNIK, Gregor, BAJSIČ, Ivan. Heat exchange effects on the performance of a clearance-sealed piston prover for gas flow measurements. Metrologia, 2015, vol. 52, nr. 6, str. 857-863 [tipologija 1.01, SCI]
3. SVETE, Andrej, KUTIN, Jože, BAJSIČ, Ivan. Static and dynamic characteristics of a hydraulic Wheatstone bridge mass flowmeter. Flow measurement and instrumentation, Dec. 2009, vol. 20, iss. 6, str. 264-270. [tipologija 1.01, SCI]
4. RUPNIK, Klemen, KUTIN, Jože, BAJSIČ, Ivan. Axial heat transfer effects on the performance of a thermal dispersion mass flow meter. V: IMEKO 2015, XXI IMEKO World Congress, Prague [tipologija 1.08]
5. KUTIN, Jože, BOBOVNIK, Gregor, BAJSIČ, Ivan. Analiza merilnih sistemov za merjenje puščanja izdelkov za avtomobilsko industrijo : končno poročilo. Ljubljana: Fakulteta za strojništvo, 2012. [tipologija 2.12]

Jaka Tušek

1. **TUŠEK, Jaka**, POREDOŠ Alojz. Metode za preračun in dimenzioniranje prenosnikov toplote: učni pripomoček pri predmetu Prenosniki toplote. Fakulteta za strojništvo, Univerza v Ljubljani, 2017 [COBISS.SI-ID: 15299611]
2. **TUŠEK, Jaka**, ENGELBRECHT, Kurt, ERIKSEN, Dan, DALL'OLIO, Stefano, TUŠEK, Janez, PRYDS, Nini. A regenerative elastocaloric heat pump. *Nature Energy*, ISSN 2058-7546, 2016, vol. 1, iss. 10, str. 1-6, doi: 10.1038/nenergy.2016.134. [COBISS.SI-ID: 14935067]
3. AHČIN, Žiga, LIANG, Jierong, ENGELBRECHT, Kurt, **TUŠEK, Jaka**. Thermo-hydraulic evaluation of oscillating-flow shell-and-tube-like regenerators for (elasto)caloric cooling. *Applied thermal engineering*, ISSN 1359-4311, 2021, vol. 190, str. 1-15, doi: 10.1016/j.applthermaleng.2021.116842. [COBISS.SI-ID: 57027843]
4. NAVICKAITE, Kristina, PENZEL, Michael, BAHL, Christian Robert Haffenden, ENGELBERCHT, Kurt, **TUŠEK, Jaka**, MARTIN, André, ZINECKER, Mike, SCHUBERT, Andreas. CFD-simulation assisted design of elastocaloric regenerator geometry. *Sustainability*, ISSN 2071-1050, 2020, vol. 12, iss. 21, str. 1-16, doi: 10.3390/su12219013. [COBISS.SI-ID: 39799299]
5. **TUŠEK, Jaka**, KITANOVSKI, Andrej, ZUPAN, Samo, PREBIL, Ivan; POREDOŠ, Alojz. A comprehensive experimental analysis of gadolinium active magnetic regenerators. *Applied thermal engineering*, ISSN 1359-4311, 2013, vol. 53, iss. 1, str. 57-66, doi: 10.1016/j.applthermaleng.2013.01.015. [COBISS.SI-ID: 12647707]