

# TEORIJA ZGOREVANJA

## UČNI NAČRT PREDMETA/COURSE SYLLABUS

<b>Predmet:</b>	TEORIJA ZGOREVANJA
<b>Course title:</b>	COMBUSTION THEORY
<b>Članica nosilka/UL Member:</b>	UL FS

<b>Študijski programi in stopnja</b>	<b>Študijska smer</b>	<b>Letnik</b>	<b>Semestri</b>	<b>Izbirnost</b>
Strojništvo, tretja stopnja, doktorski	Energetske, procesne in okoljske inženirske znanosti (smer)	1. letnik, 2. letnik	Celoletni	izbirni

<b>Univerzitetna koda predmeta/University course code:</b>	0033452
<b>Koda učne enote na članici/UL Member course code:</b>	7207

<b>Predavanja /Lectures</b>	<b>Seminar /Seminar</b>	<b>Vaje /Tutorials</b>	<b>Klinične vaje /Clinical tutorials</b>	<b>Druge oblike študija /Other forms of study</b>	<b>Samostojno delo /Individual student work</b>	<b>ECTS</b>
90					160	10

<b>Nosilec predmeta/Lecturer:</b>	Andrej Senegačnik, Tomaž Katrašnik
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<b>Izvajalci predavanj:</b>	Tomaž Katrašnik, Andrej Senegačnik
<b>Izvajalci seminarjev:</b>	
<b>Izvajalci vaj:</b>	
<b>Izvajalci kliničnih vaj:</b>	
<b>Izvajalci drugih oblik:</b>	
<b>Izvajalci praktičnega usposabljanja:</b>	

**Vrsta predmeta/Course type:**

Izbirni predmet /Elective course

**Jeziki/Languages:**

Predavanja/Lectures:

Angleščina, Slovenščina

Vaje/Tutorial:

Angleščina, Slovenščina

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

Veljajo splošni pogoji za doktorski študij.

General prerequisites for the third level studies.

**Vsebina:****Content (Syllabus outline):**

Fizikalni procesi v plamenu, termodinamična izhodišča, kemijski procesi in reakcijska kinetika. Transportni pojavi in dinamika zgorevanja v stacionarnih kuriščih, pečeh, kotlih. Fizikalne interpretacije zgorevanja različnih goriv in različnih sistemov kurjenja. Zagotavljanje kakovosti zgorevalnih procesov. Potencial kemične energije goriv in njena transformacija. Uplinjanje, ukapljevanje in transformiranje goriv, biomase. Pridobivanje vodika. Napredne premogove tehnologije, alternativna sintetična goriva. Tehnologije zajemanja in shranjevanja ogljikovega dioksida. Nastanek okolju škodljivih snovi pri zgorevalnih procesih in ukrepi za njihovo zmanjševanje, čiščenje produktov zgorevanja.

Physical processes in flame, thermodynamical rudiments, chemical processes and the kinetics of reactions. Transport phenomena and dynamics of combustion in stationary combustion chambers and in internal combustion engines (ICE). Physical interpretation of combustion of various fuels and various combustion systems. Combustion processes in fixed and variable geometry combustion chambers. Providing quality of combustion processes. Chemical energy potential of fuels and transformation. Gasification and liquefaction of fuels and biomass. Hydrogen production. Advanced technologies of coal usage, alternative synthetic fuels. Process of fuel-air mixture preparation in internal combustion engines. Technologies of carbon dioxide capturing and storing. Formation of pollutants at combustion processes and measures for its reduction, cleaning of combustion products.

**Temeljna literatura in viri/Readings:**

- [1] Strehlow, Roger A. Combustion fundamentals. New York: McGraw-Hill, 1985, ISBN: 0-07-466599-0. COBISS.SI-ID - 16265473
- [2] Williams, Forman Arthur. Combustion theory : the fundamental theory of chemically reacting flow systems. Menlo Park; Californija : The Benjamin /Cummings, 1985, ISBN: 0-8053-9801-5. COBISS.SI-ID - 225051
- [3] Cant, R. S. Mastorakos, E. An introduction to turbulent reacting flows. London : Imperial College Press, cop. 2008. ISBN: 1-86094-778-6. COBISS.SI-ID -

**Cilji in kompetence:****Cilji:**

Študentu približati in na njegovem konkretnem primeru pokazati principe raziskovalnega dela na področju zgorevanja. Študent izvede pregled literature širšega področja in nato najnovejših dognanj ožjega področja. Študent je poleg razumevanja obravnavanega procesa usposobljen da proces opiše tudi z numeričnim modelom, ki ga potem lahko ovrednoti s pomočjo eksperimenta. Dobljene rezultate samostojno analizira in o ugotovljenih dognanjih sestavi poročilo v obliki članka.

**Kompetence:**

Študent po končanem doktorskem študiju superiorno obvladuje neko ozko tehnično področje. V obravnavanem primeru je to določena podrobnost iz širokega področja zgorevanja. Kandidat z uspešnim raziskovalnim in eksperimentalnim delom pokaže, da je sposoben ustvariti nek nov izviren izdelek, metodo, oziroma odkriti novo tehnično spoznanje in ga predstaviti svetovni javnosti v obliki članka v mednarodni reviji. Obenem je kandidat sposoben svoje trditve in dognanja tudi kompetentno zagovarjati.

**Objectives and competences:****Goals:**

Student is introduced to the principles of research work in the field of combustion processes through case studies. Overview of the references from the wider field of interest as well as the studies of the most recent discoveries is made by the student. Besides understanding the discussed process the student is also capable of describing the process with numerical model as well as experimental evaluation of the model. Students perform autonomous analyses of the results and present them in the form of an article.

**Competences:**

After completing the doctoral studies the student possesses superior expertise in a certain narrow technical field of interest, namely a particular detail from the wide field of combustion processes. Through successful research and experimental work the candidate shows ability to develop a new, original product, method, to make new technical discoveries and to present the results to the publics in the form of an article in an international technical or scientific journal. The candidate is also capable of competent verbal presentation of his or her findings and statements.

**Predvideni študijski rezultati:**

Študent po končanem doktorskem študiju superiorno obvladuje neko ozko tehnično področje. V obravnavanem primeru je to določena podrobnost iz širokega področja zgorevanja. Kandidat z uspešnim raziskovalnim in eksperimentalnim delom pokaže, da je sposoben ustvariti nek nov izviren izdelek, metodo, oziroma odkriti novo tehnično spoznanje in ga predstaviti svetovni javnosti v obliki članka v

**Intended learning outcomes:**

After completing the doctoral studies the student possesses superior expertise in a certain narrow technical field of interest, namely a particular detail from the wide field of combustion processes. Through successful research and experimental work the candidate shows ability to develop a new, original product, method, to make new technical discoveries and to present the results to the publics in the form of an article in an

mednarodni reviji. Obenem je kandidat sposoben svoje trditve in dognanja tudi kompetentno zagovarjati.	international technical or scientific journal. The candidate is also capable of competent verbal presentation of his or her findings and statements.
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#### **Metode poučevanja in učenja:**

#### **Learning and teaching methods:**

Predavanja, laboratorijske vaje, seminarsko delo, e-izobraževanje, konzultacije. Seminarsko delo v čim večji meri navezuje se na področje doktorskega raziskovanja. Študij z uporabo priporočene literature.	Lectures, laboratory practice & seminar work, e-education, consulting. The seminar work is related, as much as possible, to the student's doctoral research field. Study on a recommended literature basis.
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#### **Načini ocenjevanja:**

#### **Delež/Weight**

#### **Assessment:**

Ustni izpit, poročilo o seminarskem delu. Pogoji za opravljanje ustnega izpita je uspešno izdelano in pozitivno ocenjeno seminarsko delo. Način (ustno izpraševanje, naloge, projekt) • naloge (20%) • projektni seminar (50%) • ustno izpraševanje (30%)		Oral exam, report on seminar work. The condition for admission to oral exam is successful completion of seminar work, rewarded with a passing grade. Method (oral examination, assignments, project) • assignments (20%) • project seminar (50%) • oral examination (30%)
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#### **Ocenjevalna lestvica:**

#### **Grading system:**

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#### **Reference nosilca/Lecturer's references:**

##### **prof. dr. Tomaž KATRAŠNIK**

FAUSSONE, Gian Claudio, SELJAK, Tine, JASIUKAITYTE, Edita, ŽVAR BAŠKOVIČ, Urban, KATRAŠNIK, Tomaž, GRILC, Miha, FAUSSONE, Gian Claudio. Pyrolysis oil from post-consumer packaging and its ageing : physical and chemical properties and drop-in performance in a power generating unit. Energy reports. Nov. 2023, vol. 10, str. 613-627, ilustr. ISSN 2352-4847. [COBISS.SI-ID 161718531]

GOH, Brandon Han Hoe, CHONG, Cheng Tung, ONG, Hwai Chyuan, SELJAK, Tine, KATRAŠNIK, Tomaž, JÓZSA, Viktor, NG, Jo-Han, TIAN, Bo, KARMARKAR, Srinibas, ASHOKKUMAR, Veeramuthu. Recent advancements in catalytic conversion pathways for synthetic jet fuel produced from bioresources. Energy conversion and management. [Print ed.]. Jan. 2022, vol. 251, str. 1-24, ilustr. ISSN 0196-8904. [COBISS.SI-ID 98610435]

SELJAK, Tine, BUFFI, Marco, VALERA-MEDINA, Augustin, CHONG, Cheng Tung,

CHIARAMONTI, David, KATRAŠNIK, Tomaž. Bioliquids and their use in power generation : a technology review. Renewable & sustainable energy reviews : an international journal. [Print ed.]. Sep. 2020, vol. 129, str. 1-20, ilustr. ISSN 1364-0321. [COBISS.SI-ID 17774595]

SELJAK, Tine, RODMAN OPREŠNIK, Samuel, KUNAVER, Matjaž, KATRAŠNIK, Tomaž. Effects of primary air temperature on emissions of a gas turbine fired by liquefied spruce wood. Biomass & bioenergy. [Print ed.]. 2014, vol. 71, str. 394-407, ilustr. ISSN 0961-9534. DOI: 10.1016/j.biombioe.2014.09.016. [COBISS.SI-ID 13804059]

VIHAR, Rok, SELJAK, Tine, RODMAN OPREŠNIK, Samuel, KATRAŠNIK, Tomaž. Combustion characteristics of tire pyrolysis oil in turbo charged compression ignition engine. Fuel, ISSN 0016-2361. [Print ed.], Jun. 2015, vol. 150, str. 226-235. [COBISS.SI-ID 13902363]

**izr. prof. dr. Andrej SENEGAČNIK**

JURJEVČIČ, Boštjan, SENEGAČNIK, Andrej, KUŠTRIN, Igor. A surveillance of direct-firing system for pulverized-coal using statistically treated signals from intrusive electrostatic sensors. Strojniški vestnik. Apr. 2017, vol. 63, no. 4, str. 265-274, si 38, ilustr. ISSN 0039-2480. <http://www.dlib.si/details/URN:NBN:SI:doc-351MX8K1>, DOI: 10.5545/sv-jme.2016.4264. [COBISS.SI-ID 15478043]

JURJEVČIČ, Boštjan, SENEGAČNIK, Andrej, DROBNIČ, Boštjan, KUŠTRIN, Igor. The Characterization of pulverized-coal pneumatic transport using an array of intrusive electrostatic sensors. IEEE transactions on instrumentation and measurement. [Print ed.]. Dec. 2015, vol. 64, no. 12, str. 3434-3443, ilustr. ISSN 0018-9456. DOI: 10.1109/TIM.2015.2465731. [COBISS.SI-ID 14196507]

SENEGAČNIK, Andrej, KUŠTRIN, Igor. Technology-related limitations during wood gas co-firing in industrial. V: EKINOVIĆ, Sabahudin (ur.), YALÇIN, Senay (ur.), VIVANCOS CALVET, Joan (ur.). TMT 2015 : proceedings. 19th International Research/Expert Conference "Trends in the Development of Machinery and Associated Technology", 22-23 July 2015, Barcelona, Spain. Zenica [etc.]: Faculty of Mechanical Engineering [etc.], 2015. Str. 197-200, ilustr. TMT Proceedings, Year 19, no. 1. ISSN 1840-4944. [COBISS.SI-ID 14108955]

SENEGAČNIK, Andrej, KUŠTRIN, Igor, SEKAVČNIK, Mihael. Wood syngas as co-fuel in industrial furnaces. Journal of trends in the development of machinery and associated technology. Jan. 2014, vol. 18, no. 1, f. 171-174, ilustr. ISSN 2303-4009. [http://www.tmt.unze.ba/zbornik/TMT2014/TMT2014\\_063.pdf](http://www.tmt.unze.ba/zbornik/TMT2014/TMT2014_063.pdf), <http://connection.ebscohost.com/c/articles/98919079/wood-syngas-as-co-fuel-industrial-furnaces>. [COBISS.SI-ID 13946395]

SENEGAČNIK, Andrej, KUŠTRIN, Igor, LENART, Jože, LEBAN, Miran, SEKAVČNIK, Mihael. Možnosti energijske izrabe prezračevalnega zraka iz premogovnika. V: VORŠIČ, Jože (ur.). Komunalna energetika : oskrba z energijo. Maribor: Fakulteta za elektrotehniko, računalništvo in informatiko, 2013. Str. 1-9, ilustr. ISBN 978-961-248-388-3. [COBISS.SI-ID 13151003]