LES IN BIOKOMPOZITI – INDIVIDUALNO RAZISKOVALNI PREDMETI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Izbrane metode za karakterizacijo lesa in lignoceluloznih kompozitov
Course title:	Selected methods for characterisation of wood and lignocellulosic composites

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Bioznanosti, tretja stopnja, doktorski	Les in biokompoziti		Celoletni

Univerzitetna koda predmeta/University course code: 3814

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
	10	15	0	0	100	5

Nosilec predmeta/Lecturer:	Miha Humar
Izvajalci predavanj:	
Izvajalci seminarjev:	Miha Humar
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	
Vrsta predmeta/Course type:	individualno raziskovalni /individual research course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Splošni pogoji za vpis na doktorski študij	Basic preconditions for doctoral studies

Vsebina:	Content (Syllabus outline):
Les je v biološkem smislu definiran kot sekundarni ksilem, v tehničnem pa kot polimerni kompozit. Za les je tako značilna izjemna medvrstna variabilnost, prav tako pa tudi velika variabilnost znotraj vrste in celo posameznega drevesa. Četudi je les v splošnem zgrajen iz polimernih gradnikov, celuloze, lignina in hemiceluloz, je njihova vsebnost in razporeditev v steni posameznih celic dodaten dejavnik varibilnosti materiala. Les pa ni le variabilen in nehomogen temveč tudi izrazito anizotropen material. Poleg makromolekul, se v lesu nahajajo tudi nizko	Wood is defined as a secondary xylem in biological sense, and as a polymer composite in a technical sense. Wood exhibits extremely high interspecific variability, which gets highly complex due to variability within the species and even within an individual tree. Although wood is in general composed of structural polymers cellulose, lignin and hemicelluloses, their content and distribution in the wall of individual cells represent an additional factor in material variability. However, wood is not only variable and inhomogeneous material but

molekularne spojine (ekstraktivi), ki imajo kljub majhnemu deležu nesorazmerno velik vpliv na lastnosti lesa. Zaradi strukturne in kemijske variabilnosti ter nehomogenosti je les izredno zapleten raziskovalni objekt. Tako sistem vzorčenja kot priprava materiala in aplikacija sicer splošno uveljavljenih raziskovalnih metod terjajo specifične pristope. Namen predmeta je študentom doktorskega študija predstaviti najpomembnejše tehnike in metode, ki so na voljo na Oddelku za lesarstvo, oziroma metode, ki so nam na voljo na podlagi dogovorov s partnerskimi organizacijami. Študent bo pridobil pregled o njihovo primernost ter prednostih in slabostih v raziskavah lesa in lignoceluloznih materialov. Metode bodo predstavili predavatelji, ki jih redno uporabljajo pri svojem raziskovalnem delu in med drugim vključujejo različne tehnike svetlobne mikroskopije, spektroskopske metode (FTIR, XRF, NMR, AAS, TOC, CNS, UV Vis), metode za termične analize (DSC, TGA), kromatografske metode (TLC, HPLC), ekstrakcjske metode, metode mokre kemije, metode za analizo lesnih površin, mikrobiološke metode, destruktivna in nedestruktivna mehanska preizkušanja, reološke metode, metode kontrole vlažnosti lesa... V dogovoru z nosilcem predmeta in delovnim/predvidenim mentorjem bo študent izbral nekaj metod, jih teoretsko in praktično osvojil in uporabil na izbranem problemu, povezanim s temo predvidene doktorske naloge. Predmet ni namenjen le preiskavi lesa, temveč tudi analizi ostalih lignoceluloznih materialov, kot so rastlinska vlakna, papir, konoplja, miskantus…	anisotropic as well. In addition to macromolecules, wood contains relatively small amount of low molecular weight compounds, which in turn, have a high impact on wood properties. Wood is an extremely complicated research object due to its structural and chemical variability and heterogeneity. Hence, the system of sampling, preparation of material and application of commonly accepted methods demand a specific approach. The purpose of this course is to provide a short introduction regarding the selected techniques and methods to the PhD students. The methods will be selected from the pool of methods that are available at the Department of Wood Science and Technology, and methods that are available to us on the basis of agreements with partner organizations. The students will gain an overview of their suitability and their advantages and disadvantages when applied on wood and lignocellulosic materials. In the first step, the methods will be introduced by lecturers who are regularly using them in their research work. The most important methods are: various techniques of light microscopy , spectroscopic methods (FTIR, XRF, NMR, AAS, TOC, CNS, UV- Vis…) , methods of thermal analysis (DSC, TGA …) , chromatographic methods (TLC , HPLC), extraction methods, methods of wet chemistry, methods for surface analysis, microbiological methods, destructive and non-destructive mechanical testing, rheological methods, methods to control humidity of wood ... In agreement with a lecturer and the proposed supervisor and based on the planned research plan, a student will select few methods and theoretically and practically apply them to the selected problem. This course is not dedicated to wood only, but also to the analysis of other lignocellulosic materials, such as plant fibers, paper, hemp, miscanthus ...

Temeljna literatura in viri/Readings:

Skoog D. A., Holler F. J., Crouch S. R. 2006. Principles of instrumental analysis. Thomson Higher education, Belmont, 529 p. ISBN-13: 978-0495012016

Merritt W., Settle D. 2013. Instrumental Methods of Analysis Wadsworth Publishing Company, Wadsworth. 895 p. ISBN: 0534081428

Bucur V. 2003. Nondestructive Characterization and Imaging of Wood. Springer. Berlin. 354 p. ISBN: 978-3-662-08986-6

Študentom bo na razpolago tudi gradivo s predavanj in vaj v elektronski obliki. Gradivo bo objavljeno pred začetkom predavanj na spletni strani. Za izdelavo seminarskih nalog in dodatno razumevanje vsebin bodo študentje uporabili tudi svetovni splet (internet).

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je seznaniti slušatelje z izbranimi metodami za analizo lesa,lesnih kompozitov in različnih drugih lignoceluloznih materialov. Študentom bomo predstavili tako teoretske osnove, kot tudi možne aplikacije izbranih metod. V okviru predmeta se bodo seznanili tako s prednostmi, kot tudi omejitvami posameznih metod. Kompetence: Posamezne metode bodo preizkušene na realnem primeru. Te metode bodo študentje sposobni samostojno uporabiti pri nadaljnjem raziskovalnem delu.	The aim of this course is to inform students with selected methods for the analysis of wood, wood based composites, and various other lignocellulosic materials. Students will be informed both on theoretical foundations as well as on possible applications of the selected methods on wood or wood based materials. The topic of the course will be about both the advantages and limitations of the selected methods. Competencies: Each method will be applied on a real case. These methods will enable students to perform independent research in the frame of their future research work.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Spoznati najpomembnejše raziskovalne metode, ki so na voljo za analizo lesa in lignoceluloznih kompozitov. *Refleksija:* Kritično ovrednotiti primernost posamezne raziskovalne metode za dosego raziskovalnega cilja. *Uporaba:* Uporabiti izbrane metode na lastnem problemu in jih preizkusiti na praktičnem primeru v laboratoriju. Naučiti se izbrati ustrezne metode za potrditev postavljene hipoteze.	Knowledge and Understanding: To learn about the most important research methods that are available for the analysis of wood and lignocellulosic composites. Reflection: To evaluate Critically the suitability of particular research methods in order to achieve the research objective. Application: To use the chosen methods on the problem of their own and apply them on a case study in the laboratory. To learn how to choose the appropriate method to confirm selected hypotheses.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Seminarji (10 ur), Laboratorijske vaje (15 ur)	Seminar (10 h) Laboratory work (15 h)

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni in ustni izpit	60,00 %	Oral and written exam
Seminar	40,00 %	Seminar

Reference nosilca/Lecturer's references:

Miha Humar

1. THALER, Nejc, HUMAR, Miha. Copper Leaching from Copper-ethanolamine Treated Wood: Comparison of Field Test Studies and Laboratory Standard Procedures. Bioresources, ISSN 1930-2126, 2014, vol. 9 in press

2. HUMAR, Miha, LESAR, Boštjan. Performance of native and copper-ethanolamine-treated wood exposed in sea water at Port Koper, Slovenia. Drvna industrija, ISSN 0012-6772, 2013, vol. 64, no. 4, str. 273-281.
3. HUMAR, Miha, THALER, Nejc, LESAR, Boštjan. Performance of selected copper amine based wood preservative supplemented with wood swelling agents. Wood research, ISSN 1336-4561, 2012, vol. 57, no. 3, str. 453-462.
4. LESAR, Boštjan, SEVER ŠKAPIN, Andrijana, HUMAR, Miha. The influence of drying on the sorption properties of polyethylene wax treated wood. Drewno, ISSN 1644-3985, 2011, vol. 54, nr. 185, str. 5-18.
5. KUTNAR, Andreja, HUMAR, Miha, KAMKE, Frederick A., ŠERNEK, Milan. Fungal decay of viscoelastic thermal compressed (VTC) wood. Holz als Roh- und Werkstoff, ISSN 0018-3768. [Print ed.], 2011, vol. 69, no. 2, str. 325-328
6. LESAR, Boštjan, KRALJ, Polonca, HUMAR, Miha. Influence of polyethylene and oxidized polyethylene wax emulsions on leaching dynamics of boric acid from impregnated spruce wood. Drvna industrija, ISSN 0012-6772, 2010, vol. 61, br. 4, str. 213-221.