



Univerza v Mariboru



Fakulteta za
strojništvo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Eksperimentalna in računalniška karakterizacija lastnosti celičnih gradiv
Course title:	Experimental and computational characterization of cellular materials properties

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Year	Semester Semester
Strojništvo 3. stopnja	-	1./2.	zimski/poletni
Mechanical Engineering 3 rd level	-	1./2.	Winter/Summer

Vrsta predmeta / Course type:

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Avdit. vaje Tutorial	Lab. vaje Lab work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	30	-	-	-	120	6

Nosilec predmeta / Lecturer:

Jeziki / Predavanja / Lecture:
Languages: Vaje / Tutorial:

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

Prerequisites:

Vsebina:

Predavanja:
Predavanja zajemajo razvrstitev celičnih gradiv in predstavitev različnih izdelovalnih postopkov ter možnosti uporabe. Obširno so obravnavane njihove mehanske in termične lastnosti, glede na morfološke in topološke značilnosti posameznih vrst celičnih gradiv. Natančno so obravnavani načini geometrijske in mehanske karakterizacije poroznih gradiv. Pri geometrijski karakterizaciji se študentje seznanijo z zajemanjem 2D in 3D slikovnih podatkov ter njihovo obdelavo. Sledi analiza topologije in morfologije por ter rekonstrukcija celične strukture. Mehanska karakterizacija pri kvazi-statičnih in dinamičnih obremenitvah, zasnovana na sodobnih standardih določevanja mehanskih lastnosti poroznih materialov, bo temeljila na analitičnih osnovah (večinoma strukture z urejeno razporeditvijo por), eksperimentalnih testih (tlačni, natezni, upogibni) in nelinearnih računalniških simulacijah (z uporabo rekonstruiranih modelov, ki temeljijo na dejanski geometriji celičnih gradiv).

Seminar:

Content (Syllabus outline):

Lectures:
Lectures include the classification of cellular materials and presentation of different manufacturing methods with application possibilities. An extensive review of their mechanical and thermal properties is given in respect to the morphological and topological properties of different types of cellular materials. The methods for geometrical and mechanical characterization of cellular materials are discussed in detail. For geometrical characterization, students learn about capturing 2D and 3D image data and their processing, followed by the analysis of pore topology and morphology and reconstruction of cellular structure. Mechanical characterization at quasi-static and dynamic loading conditions, based on modern standards defining mechanical properties of porous materials, is based on analytical approaches (mostly structures with regular pore distribution), experimental tests (compression, tension, bending) and non-linear computer simulations (using reconstructed models, based on realistic geometry of cellular materials).

V okviru individualnih seminarskih nalog študentje uporabijo pridobljeno znanje in se podrobneje seznanijo z določitvijo lastnosti različnih vrst celičnih gradiv ob uporabi sodobnih metod. Prav tako spoznajo vpliv geometrijskih dejavnikov na mehanske lastnosti celičnih gradiv.

Seminar:

In the context of individual seminar work, students will apply acquired knowledge and get further acquainted with determination applicability of cellular materials properties while using state-of-the-art methods. They will also study the influence of the geometrical parameters on the mechanical properties of cellular materials.

Temeljni literatura in viri / Readings:

- Vesenjaj M., Konstrukcijske lastnosti in uporaba celičnih gradiv, Skripta, Univerzitetna založba Univerze v Mariboru, Maribor, 2017.
- Gibson L.J., Ashby M.F., Cellular solids: structure and properties, Cambridge University Press, Cambridge, 1997.
- Hipke T., Lange G., Poss R., Taschenbuch für Aluminiumschäume, Alu Media, Düsseldorf, 2007.
- Degischer H.P., Kriszt B., Handbook of Cellular Materials, WILEY-VCH, Weinheim, 2002.

Cilji in kompetence:

Namen predmeta je poznavanje in razumevanje geometrijske in mehanske karakterizacije, ki temelji na eksperimentalnih testih in računalniških simulacijah, celičnih gradiv ter določitev njihovih značilnih lastnosti. Cilj predmeta je seznaniti študente z uporabnostjo celičnih gradiv in kritičnim poznavanjem prilagajanja njihovih lastnosti.

Objectives and competences:

The purpose of this course is to acquire the knowledge and understanding of geometrical and mechanical characterization, based on experimental test and computational simulations, of cellular materials and determining their typical properties. The aim of this course is to get students acquainted with the applicability of cellular materials and a critical knowledge to adapt their properties.

Predvideni študijski rezultati:

Znanje in razumevanje:
poznavanje vrst, lastnosti in načinov izdelave poroznih gradiv; razumevanje določitve in ovrednotenja lastnosti celičnih gradiv

Prenesljive/ključne spretnosti in drugi atributi:
določitev karakterističnih lastnosti celičnih gradiv in njihovo kritično ovrednotenje za praktično uporabo v sodobnem inženirstvu

Intended learning outcomes:

Knowledge and understanding:
knowledge of types, properties and manufacturing of cellular materials, understanding of determination and evaluation of cellular materials properties

Transferable/Key skills and other attributes:
determination of characteristic cellular materials properties and their critical evaluation for practical use in modern engineering

Metode poučevanja in učenja:

- frontalna predavanja,
- seminarska naloga,
- diskusija in konzultacije.

Teaching and learning methods:

- frontal lectures,
- seminar work,
- discussion and consultations.

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):

- seminarska naloga,
- teoretični izpit.

Delež (v %) /
Weight (in %)

60%
40%

Assessment:

Type (examination, oral, coursework, project):

- seminar work,
- theoretical examination.

Reference nosilca / Lecturer's references:

Izvirni znanstveni članki:

Vesenjak, Matej, Sulong, Mohd Ayub, Krstulović-Opara, Lovre, Borovinšek, Matej, Mathier, Vincent, Fiedler, Thomas. Dynamic compression of aluminium foam derived from infiltration casting of salt dough. Mechanics of materials, ISSN 0167-6636, February 2016, vol. 93, str. 96-108.

Vesenjak, Matej, Hokamoto, Kazuyuki, Sakamoto, Motoki, Nishi, Takuya, Krstulović-Opara, Lovre, Ren, Zoran. Mechanical and microstructural analysis of unidirectional porous (UniPore) copper. Materials & design, ISSN 0264-1275, 15 Jan. 2016, vol. 90, str. 867-880.

Vesenjak, Matej, Ren, Zoran. Yielding and post-yield behaviour of closed-cell cellular materials under multiaxial dynamic loading. Metals and materials international, ISSN 1598-9623, 2016, vol. 22, no. 3, str. 435-442.

Predavanje na tuji univerzi:

Vesenjak, Matej. Dynamic mechanical response of cellular metals : invited lecture as a visiting professor at the Kumamoto University, Japan, on October 18th, 2017.