



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Mehanika loma
Subject Title:	Fracture Mechanics

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Tehnika – področje izobraževanja, 3. stopnja		2	zimski/poletni ali
		3	poletni
Education in Engineering, 3 rd cycle		2	winter/summer or
		3	summer

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	5				75	3

Nosilec predmeta / Lecturer:

red. prof. dr. Nenad GUBELJAK

Jeziki /
Languages:

Predavanja / Lecture: Slovenščina in angleščina

Vaje / Tutorial: Slovenščina in angleščina

Pogoji za opravljanje študijskih obveznosti:

Osnovno znanje računalništva, fizike, matematike, gradiv

Prerequisites:

Basic knowledge of computer science, physics, mathematics, materials

Vsebina:

Namen predmeta je predstaviti, opisati in demonstrirati uporabo mehanike loma pri reševanju problema razpok v mehanskih sistemih. Predmet je osredotočen na teoretične in praktične lomne analize mehanskih komponent po naslednjih poglavjih:

Pristop ocene polja elastičnih napetosti, Plastifikacija na konici razpoke, Pristop ravnovesja energije, Osnovni aspekti elasto-plastične mehanike loma, Ocenitev porušitve po SINTAP postopku, Porušitev pri mejni obremenitvi, Dinamična rast in ustavitev razpoke, mehanizmi loma v kovinskih materialih, Vpliv mehanskega obnašanja materiala na lomno-mehanske značilnosti.

Content (Syllabus outline):

The purpose of course is present, describe and demonstrate the application of nonlinear fracture mechanics in solving crack problems of mechanical systems. The course concentrates, to a theoretical and practical fracture analysis of mechanical components, with follows topics:

The Elastic Stress Field Approach, Crack Tip Plasticity, The Energy Balance Approach, Basic Aspects of Elastic-Plastic Fracture Mechanics, Failure Assessment SINTAP Procedure, Sustained Load Fracture, Dynamic Crack Growth and Arrest, Mechanisms of Fracture in Metallic Materials, The Influence of Material Behaviour on Fracture Mechanics Properties.

Temeljni literatura in viri / Textbooks:

- Janssen M., Zuidema J., Wanhill R.J.H., Fracture Mechanics, DUP Blue Print, Delft NL, 2002
- Gubelj N., Mehanika loma, Univerza v Mariboru, Fakulteta za strojništvo, 2009
- Ferahmand B., Fatigue and Fracture Mechanics of High Risk Parts, International Thomson Publishing, NY, 1997
- N. Gubelj: *Celovitost konstrukcij*, Fakulteta za strojništvo, 2005.

Cilji:

- Podati ter opisati in predstaviti uporabo mehanike loma pri reševanju problemov porušitve konstrukcij, komponent in havarij,
- razviti sposobnosti študentov za definiranje robnih pogojev za varno uporabo konstrukcij in sklopov s stališča mehanike loma.

Objectives:

- to present and describe and demonstrate the use fracture mechanics in solving fracture problems, failure of structures, components and disasters,
- to develop student's capabilities of independent thinking and determination of boundary conditions for safe use of structures regarding to fracture mechanics.

Predvideni študijski rezultati:Znanje in razumevanje:

- poznavanje osnovnih metod za reševanje problemov v mehaniki loma;
- razumevanje sovisnosti različnih znanj in postopkov za učinkovito reševanje inženirskih problemov v mehaniki loma

Intended learning outcomes:Knowledge and understanding:

- knowledge of basic numerical methods for solving complex problems in fracture mechanics;
- understanding of relationships between different skills and procedures for efficient solutions of engineering problems in fracture mechanics.

Prenesljive/ključne spretnosti in drugi atributi:

- kombinirana uporaba različnih osnovnih znanj za reševanje problemov v mehaniki loma;
- osnovni principi za določitev koncentracije napetosti na statično in dinamično obremenjenih elementih.

Transferable/Key Skills and other attributes:

- combined use of different fundamental skills for solution of problems in fracture mechanics,
- general principles of stress concentrations determination for static and dynamic loaded elements.

Metode poučevanja in učenja:

frontalna predavanja,
izdelava seminarske naloge,
diskusije v elektronskem forumu,
e-učenje.

Teaching and learning methods:

frontal lectures,
seminar work,
discussion in electronic forums,
e-learning.

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):
diskusije v elektronskem forumu,
seminarska naloga,
pisni izpit in teoretični izpit

Delež (v %) /
Weight (in %)

Assessment methods:

Type (examination, oral, coursework, project):
discussion in electronic forums,
seminar work,
written and oral examination

Reference nosilca / Lecturer's references:

1. DAMJANOVIĆ, Darko, KOZAK, Dražan, GUBELJAK, Nenad. The influence of residual stresses on fracture behavior of Pipe Ring Notched Bend specimen (PRNB). *Engineering fracture mechanics*, ISSN 0013-7944. [Print ed.], First Online: 19 October 2018, str. 1-12, doi: [10.1016/j.engfracmech.2018.10.016](https://doi.org/10.1016/j.engfracmech.2018.10.016). [COBISS.SI-ID [21827862](https://www.cobiss.si/id/21827862)],

2. FOKTER, Samo K., MOLIČNIK, Andrej, KAVALAR, Rajko, PELICON, Primož, RUDOLF, Rebeka, GUBELJAK, Nenad. Why do some titanium-alloy total hip arthroplasty modular necks fail?. *Journal of the mechanical behavior of biomedical materials*, ISSN 1751-6161, May 2017, vol. 69, str. 107-114, doi: [10.1016/j.jmbbm.2016.12.012](https://doi.org/10.1016/j.jmbbm.2016.12.012). [COBISS.SI-ID [20099094](#)]
3. GUBELJAK, Nenad, CVETIČ, Miljenko, BOŽIČ, Željko, PREDAN, Jožef. Application of structural integrity assessment procedure on an axle pin of a wind turbine. *Fatigue & fracture of engineering materials & structures*, ISSN 8756-758X, 16th International Conference on New Trends in Fatigue and Fracture (NT2F16), May 24-27, 2016, Avg. 2017, vol. 40, iss. 8, str. 1284-1294, doi: [10.1111/ffe.12654](https://doi.org/10.1111/ffe.12654). [COBISS.SI-ID [20674070](#)],
4. GUBELJAK, Nenad, PREDAN, Jožef, JAKL, Franc, VEG, Aleksandar, VEG, Emil, BAKIČ, Krešimir. Possible approach of tensile strength calculation in conductors considering strain measurement of tower legs of ohls. *Electra*, ISSN 1286-1146, Jun. 2016, no 5, str. 79-86. [COBISS.SI-ID [19696150](#)]
5. DAMJANOVIĆ, Darko, KOZAK, Dražan, MARSONER, Stefan, GUBELJAK, Nenad. Residual stress state in pipe cut ring specimens for fracture toughness testing. *Materials testing*, ISSN 0025-5300. [Print ed.], Jun. 2017, vol. 59, iss. 6, str. 530-535, doi: [10.3139/120.111038](https://doi.org/10.3139/120.111038). [COBISS.SI-ID [20611350](#)],
6. JAGARINEC, Darko, KIRBIŠ, Peter, PREDAN, Jožef, VUHERER, Tomaž, GUBELJAK, Nenad. Analysis of deformation induced martensite in AISI 316L stainless steel. *Materials testing*, ISSN 0025-5300. [Print ed.], June 2016, vol. 58, no. 6, str. 547-552. <http://www.hanser-elibrary.com/toc/mp/58/6>. [COBISS.SI-ID [19594006](#)]