



Univerza v Mariboru

Fakulteta za strojništvo



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strojništvo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Nelinearna mehanika loma
Course title:	Nonlinear Fracture Mechanics

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 / Languages:	Predavanja / Lecture:	Slovenski jezik / Slovene language
	Vaje / Tutorial:	Slovenski jezik / Slovene language

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

Prerequisites:

Vsebina:

Predavanja:
Namen predmeta je predstaviti, opisati in demonstrirati uporabo nelinearne 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 CEGB R6 postopku, Porušitev pri mejni obremenitvi, Dinamična rast in ustavitev razpoke, mehanizmi loma v kovinskih materialih, Vpliv mehanskega obnašanja materiala na lomnomehanske značilnosti.

Seminar:

Seminar, v obliki projektnega dela, dopolnjujejo analizo nelinearnega mehanskega obnašanja mehanskih sistemov in lomnega obnašanja

Content (Syllabus outline):

Lectures:

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 CEGB R6 Procedure, Sustained Load Fracture, Dynamic Crack Growth and Arrest, Mechanisms of Fracture in Metallic Materials, The Influence of Material Behaviour on Fracture Mechanics Properties.

Seminar:

Seminar in form of project work supplement analysis of mechanical behaviour of mechanical system and fracture behaviour of materials.

materialov.

Temeljni literatura in viri / Readings:

- Janssen M., Zuidema J., Wanhill R.J.H., Fracture Mechanics, DUP Blue Print, Delft NL, 2002
- Beson J, Local Approach to Fracture, Les Press de l'Ecole des Mines, Paris, 2004
- Ferahmand B., Fatigue and Fracture Mechanics of High Risk Parts, International Thomson Publishing, New York, 1997
- Sih G.C., Mechanics of Fracture Initiation and Propagation, Kluwer Academic Publishers, Dordrecht, 1991
- Stavroulakis G. E., Inverse and Crack Identification Problems in Engineering Mechanics, Kluwer Academic Publishers, Dordrecht, 2001
- N. Gubelj, Mehanika loma, Univerza v Mariboru, 2008

Cilji in kompetence:

- Podati ter opisati in predstaviti uporabo mehanike loma pri reševanju nelinearnih mehanskih problemov.
- razviti sposobnosti študentov za samostojno in kreativno reševanje inženjerskih problemov v nelinearni mehaniki loma z uporabo strokovne literature ter standardnih in nestandardnih postopkov.

Objectives and competences:

- to present and describe and demonstrate the use fracture mechanics in solving nonlinear fracture problems.
- to further develop student's capabilities of independent thinking and creative solutions of nonlinear fracture mechanics problems by using references, standards and non-standard procedures.

Predvideni študijski rezultati:

Znanje in razumevanje:

- poznavanje osnovnih metod za reševanje kompleksnih problemov v mehaniki loma;
- razumevanje sovisnosti različnih znanj in postopkov ter pomena uporabe strokovne literature za učinkovito reševanje inženjerskih problemov v mehaniki loma.

Prenesljive/ključne spretnosti in drugi atributi:

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

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 and importance of professional literature for efficient solutions of engineering problems in fracture mechanics.

Transferable/Key skills and other attributes:

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

Metode poučevanja in učenja:

- frontalna predavanja,
- reševanje domačih nalog,
- praktično delo pri laboratorijskih vajah,
- izdelava seminarske naloge.

Teaching and learning methods:

- frontal lectures,
- coursework,
- practical work at laboratory work,
- seminar (project) work.

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

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

- opravljene domače naloge,
- opravljena seminarska naloga,
- teoretični del izpita v obliki reševanja vprašalnikov,
- praktični del izpita v obliki predstavitve opravljenih izračunov in reševanja zastavljenega problema.

30%
20%
25%
25%

Type (examination, oral, coursework, project):

- completed coursework,
- completed seminar (project) work,
- theoretical examination in the form of multiple-choice questioners,
- examination in the form of practical presentation of calculation and solution of given task.

Reference nosilca / Lecturer's references:

Nenad Gubelj

1. MOČILNIK, Vinko, GUBELJAK, Nenad, PREDAN, Jožef. Surface residual stresses induced by Torsional Plastic Pre-setting of Solid Spring Bar. *International journal of mechanical sciences*, ISSN 0020-7403. [Print ed.], March 2015, vol. 92, str. 269-278, A'
2. 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, A'
3. CVIJOVIČ-ALAGIČ, Ivana, GUBELJAK, Nenad, RAKIN, Marko, CVIJOVIČ, Zorica, GERIČ, Katarina. Microstructural morphology effects on fracture resistance and crack tip strain distribution in Ti-6Al-4V alloy for orthopedic implants. *Materials & design*, ISSN 0264-1275, Jan. 2014, vol. 53, str. 870-880, A'

Izbrani znanstveno raziskovalni projekti:

1. [Projekt ARRS N2-0030\(B\), Vpliv različnih heterogenih lastnosti na konstrukcijsko celovitost zvara z napako](#), jan. 2015- dec. 2018, nosilec ARRS-FWO projekta
2. [Program P2-0137\(B\), Numerična in eksperimentalna analiza nelinearnih mehanskih sistemov](#) jan. 2017- dec. 2021

3. Projekt KOMET 2 New computer-assisted fracture & fatigue testing concepts and assessment procedures for multi-material and multi-scale systems, jan. 2017- dec. 2021, vodja projekta v Sloveniji, koordinator MCL-Leoben