Univerza v Mariboru

Fakulteta za strojništvo

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Stabilnost in dinamika konstrukcij
Course title:	Stability and Dynamics of Structures

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Strojništvo	Nelinearna mehanika	1	Poletni
Mechanical Engineering	Nonlinear mechanics	1	Spring

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	Rač. vaje Comp. work	Samost. delo Individ. work	ECTS
30	30	-	-	-	-	120	6

Nosilec predmeta / Lecturer: Boštjan Harl

Jeziki / Languages:

Predavanja / Lectures:	Slovenski jezik / Slovene language
Vaje / Tutorial:	Slovenski jezik / Slovene language

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

Osnovno znanje iz matematike, statike, dinamike in elasto-plasto mehanike

Prerequisits:

Basic knowledge of mathematics, statics, dynamics and elasto-plasticity

Vsebina:

- Uvod v stabilnost konstrukcij: mehanski modeli stabilnosti, energijski kriterij, ravnovesna pot, stabilnostna točka, imperfekcije.
- Klasični pristop: Eulerjeva diferencialna enačba, uklon elastičnih nosilcev, uklon elastičnih okvirjev, upoštevanje plastifikacije materiala.
- Numerični pristop: diskretna enačba konstrukcije, tangentna togostna matrika, klasifikacija stabilnostnih točk, vpliv imperfekcij na tip stabilnostnih točk in ravnovesno pot, računanje stabilnostnih točk in uklonskih oblik.
- Uvod v dinamiko konstrukcij: nedušeni in dušeni elastični sistemi, dinamično vzbujanje, resonanca.
- Temelji: deformacijska in kinetična energija elastičnega telesa, izpeljava enačb dinamike,

Content (Syllabus outline):

- Introduction to structural stability: mechanical stability models, energy criterion, equilibrium path, stability point, imperfections.
- Classical approach: Euler differential equation, buckling of elastic beams, buckling of elastic frames, consideration of material plasticity.
- Numerical approach: discrete structural equation, tangent stiffness matrix, classification of stability points, imperfection influence on stability point type and equilibrium path, computation of stability points and buckling modes.
- Introduction to structural dynamics: undamped and damped elastic systems, dynamic excitation, resonance.
- Foundations: strain and kinetic energy of elastic

implementacija enačb na končnem elementu. • Računanje dinamičnega odziva konstrukcije: integracijske sheme, ohranjanje energije, načini disipacije energije, lastne frekvence in nihajne oblike.	body, derivation of dynamic equations, implementation of equations on a finite element. • Computation of structural dynamic response: integration schemes, energy conservation, means of energy dissipation, eigenfrequencies and vibration modes.

Temeljni literatura in viri / Readings:

- G. Simitses, D. Hodges: Fundamentals of structural stability, Elsevier, 2005.
- M. Paz: Structural Dynamics: Theory and Computation, Chapman & Hall, 1997.
- T. J. R. Hughes: The Finite Element Method : Linear Static and Dynamic Finite Element Analysis, Mineola, NY:Dover, 2000.

Cilji in kompetence:	Objectives and competences:
Cilj predmeta je seznaniti študente s temeljnimi problemi pri stabilnosti in dinamiki konstrukcij ter z metodami in pristopi za njihovo reševanje.	The objective of this course is to acquaint students with fundamental problems in structural stability and dynamics as well as with the methods and approaches for their solution.

Predvideni študijski rezultati:	Intended learning outcomes:
<u>Znanje in razumevanje:</u> Po zaključku tega predmeta bo študent sposoben • izkazati znanje iz področja stabilnosti in dinamike konstrukcij • analizirati in načrtovati stabilnostne in dinamične probleme v komercialnih programskih okoljih – poznal bo omejitve in možnosti analize, ter teoretično ozadje • ovrednotiti dobljene rezultate <u>Prenesljive/ključne spretnosti in drugi atributi:</u> • Spretnosti komuniciranja: ustni zagovor laboratorijskih vaj, ustni izpit • Uporaba informacijske tehnologije: razvoj računalniške kode ter uporaba programskih orodij za analizo konstrukcij • Reševanje problemov: analiziranje problema in priprava za njegovo reševanje	<u>Knowledge and understanding:</u> On completion of this course the student will be able to • demonstrate knowledge from the field of structural stability and dynamics • analyze and design stability and dynamic problems by using commercial software – he will know the limitations and possibilities of analysis and theoretical background • evaluate the results <u>Transferable/Key skills and other attributes:</u> • Communication skills: oral lab work defence, manner of expression at oral examination. • Use of information technology: development of software code and use of software tools for analysis of structures • Problem solving: analysis of the problem and preparation of its solution

Metode poučevanja in učenja:	Learning and teaching methods:
• predavanja • seminarska naloga	• lectures • seminar work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
<u>Način (pisni izpit, ustno izpraševanje, naloge, projekt):</u> • opravljena seminarska naloga	**50%**	<u>Type (examination, oral, coursework, project):</u> • completed seminar work

• ustni izpit	**50%**	• oral examination

Reference nosilca / Lecturer's references:

1. HARL, Boštjan, PREDAN, Jožef, GUBELJAK, Nenad, KEGL, Marko. On configuration-based optimal design of load-carrying lightweight parts. *International journal of simulation modelling*, ISSN 1726-4529, June 2017, vol. 16, no. 2, str. 219-228, doi: 10.2507/IJSIMM16(2)3.369. [COBISS.SI-ID 20622614]

2. HARL, Boštjan, GUBELJAK, Nenad, KEGL, Marko. Probabilistic behaviour of joints on joint forces in mechanisms = Probabilističko ponašanje spojeva na spojnim silama mehanizama. *Tehnički vjesnik*, ISSN 1330-3651, Jan./Feb. 2015, vol. 22, no. 1, str. 113-117, doi: 10.17559/TV-20131023220214. [COBISS.SI-ID 18547734]

3. KEGL, Marko, HARL, Boštjan. Topology optimization using nonlinear finite elements and control-point-based parametrization. *International journal of nonlinear sciences and numerical simulation*, ISSN 1565-1339. [Print ed.], Jul. 2013, vol. 14, iss. 5, str. 275-283, graf. prikazi, doi: 10.1515/ijnsns-2012-0041. [COBISS.SI-ID 17160982]