4. Selected topics from mechanics and strength

GENERAL INFORMATION ABOUT THE COURSE		
Course coordinator	Vlado Tropša, PhD, associate professor	
Course name	Selected topics from mechanics and strength	
Study program	**Mechanical Engineering**	
Course status	Compulsory	
Year	1	
Semester	1	
Number of credits and teaching methods	ECTS student load coefficient	6
	Number of hours (lectures + seminars + exercises)	30+0+30

1. DESCRIPTION OF THE COURSE

1.1. Course objectives

Familiarising students with the basic physical phenomena of vibration, understanding the importance of analysing vibrations with the aim of reducing harmful effects on structural elements. Familiarising students with the fundamentals of energy methods in the mechanics of deformable bodies and applying in analysing flat and frame girders, analysing thick-walled vessels and pipes, clamping joints and membrane stresses in axisymmetric shells. Familiarising students with the fundamentals of linear fracture mechanics.

1.2. Course enrolment prerequisites *(if applicable)*

Passing the course Mechanics 2 (dynamics) and Strength

1.3. Expected course learning outcomes

1. Analysing free and forced vibrations in mechanical systems with a single degree of freedom of movement with and without attenuation, explaining the concept of inherent system frequency and resonance.
2. Calculate the influence coefficients, slopes and deflections for flat and frame girders using energy methods.
3. Calculating the stresses and strains of thick pipes and applying to analysing clamping joints
4. Solving the axisymmetric shell strength problem and applying it in analysing clamping joints.

1.4. Course content

1. Dynamics of the single degree of freedom system, system elements, concept of free and forced vibrations
2. Free vibrations without attenuation, concept of inherent frequency
3. Free vibrations with attenuation
4. Forced vibrations, stationary vibrations, concept of resonation
5. Deformation energy, fundamental theory of strength
6. Deformation energy for various types of rod loads, axial loads, shear, warping, bending, deformation energy of arbitrarily loaded rods
7. Energy methods in the mechanics of deformable bodies, generalised forces and generalised displacements, influence coefficients, Maxwell-Betti reciprocal work theorem
8. Castigliano’s first and second theorem, theorem of deformation strain energy
9. Statistical indeterminate plane problems, application of Castigliano’s theorem
10. Stress and deformation for thick-walled pipes, differential equation and boundary conditions
11. Strength of assembled pipes, determining parameters of clamping joints (contact pressure and overlap), stress sand displacement distribution
12. Applying theory of strength to sizing monolithic and assembled thick pipes loaded by internal and/external pressure
13. Axisymmetric shells and domes, determining membrane stresses
14. Membrane strass of cylindrical shells, equilibrium equations, displacement and deformation
15. Introduction of linear fracture mechanics, stress concentration, stress intensity coefficient

1.5. Types of teaching	☒ Lectures ☐ Seminars and workshops ☒ Exercises ☐ Distance learning ☐ Field work	☒ Autonomous exercises ☐ Multimedia and network ☐ Laboratory ☐ Mentor assistance ☐ Other types
1.6. Comments	Classes are held in classrooms in the form of lectures and auditory exercises. Students autonomously or in teams solve particular tasks, where tasks for homework are specially assessed.	

1.7. Student obligations *(attendance at classes, lectures, tutorials, seminars)*

- Attending lectures and exercises
- Active participation in classes, participation in teamwork
- Solving homework

1.8. Tracking student work (proportion of individual activities in terms of ECTS credits based on the total number of ECTS credits)							
Class attendance	2	Class attendance		Seminar paper		Experimental work	
Written exam	1.5	Written exam	0.5	Essay		Research	0.5
Project		Project	0.5	Report		Practical work	
Online activity				Autonomous work	1		

1.9. Grading and assessment of student work during the semester and for the final exam *(quiz, written exam, oral exam)*

- First variant: class attendance 10%, quality of completed homework assignments 10%, interim exams 3 x 20% and oral exam 20%
- Second variant: written exam 50% and oral exam 50%

1.10. **Mandatory literature** (relevant at the time of submitting the proposed study program)

- Pustaić, D., Wolf. H., Tonković, Z.: Mehanika III: uvod u analitičku mehaniku s osnovama teorije vibracija, Golden marketing -Tehnička knjiga, Zagreb 2005.
- Alfirević, I., Nauka o čvrstoći II, Golden marketing, Zagreb 1999.

1.11. Supplementary literature (relevant at the time of submitting the proposed study program

- Šimić, V.: Otpornost materijala II, Školska knjiga, Zagreb 1995.
- Singiresu, S.,R., Mechanical vibrations, Prentice Hall, 2011.

1.12. Manner of tracking quality to ensure the acquisition of exit knowledge, skills and competences

Through the established quality assurance system at the university, student survey.

2. COMBINING THE LEARNING OUTCOMES, TEACHING METHODS AND ASSESSMENT OF THE LEARNING OUTCOMES

2.1. Class participation	*2.2. Student participation*	*2.3. Learning outcome*	*2.4. Assessment method*
Lectures	Actively following lectures and exercises, participating in discussions	1-4	Oral exam (20-50%) and regularly attending classes (0-10%)
Exercises	Activities in classes and attending exercises	1-4	Continual assessment of knowledge – interim exams (0-60%) or written exam (0-05%)
Autonomous assignments	Autonomous and team-like solving of	1-4	Assessment of homework assignments, evaluating

	assignments, team presentation of solutions		quality of presentation (0-10%)