UNIVERSITY OF NIŠ

Course Unit Descriptor	Faculty	Faculty of Mechanical Engineering

GENERAL INFORMATION			
Study Program	**Mechanical Engineering**		
Study Module (if applicable)	-		
Course Title	Theory of Nonlinear Vibration		
Level of Study	☐Bachelor	☐ Master's	☒ Doctoral
Type of Course	☐ Obligatory	☒ Elective	
Semester	☒ Autumn	☐ Spring	
Year of Study	II		
Number of ECTS Allocated	10		
Name of Lecturer/Lecturers	Predrag Kozić, Goran Janevski		
Teaching Mode	☒ Lectures ☐ Laboratory work ☐ Distance learning	☐ Group tutorials ☒ Project work ☐ Blended learning	☒ Individual tutorials ☒ Seminar ☐ Other

Purpose and Overview (max. 5 sentences)

Introduce students to the theoretical foundations of nonlinear dynamics of mechanical systems. The aim of the course is to enable students to use all of the essential elements of nonlinear vibration-problem formulation, clarity and logic reasoning. The acquisition of knowledge and skills in theoretical and analytical thinking about scientific knowledge, insights and empirical research in more complex models of nonlinear dynamics of mechanical-engineering systems and structures.

Syllabus (brief outline and summary of topics, max. 10 sentences)

Differential equations and dynamical systems. Linear and nonlinear systems. Van der Pol's equation. Duffing's equation. Local bifurcation. Averaging method and perturbation method. The approximate methods of nonlinear mechanics. Phase plane method, phase trajectories, singular points, homoclinic orbits. Equilibrium stability and vibration. Lyapunov's theorem on stability and first and second order Lyapunov's function. The stability limit of orbit. Stability testing using the differential equations of the first approximation. Lyapunov's systems, conservative systems and geometric discussion of energy curves in the phase plane. Forced nonlinear vibration. Application of asymptotic methods. Amplitude-frequency and phase-frequency curve. Nonlinear phenomena and nonlinear modes of dynamics of mechanical systems. Resonant leaps and bifurcations. Hill's differential equations and solutions. Mathieu's differential equation and application examples. Parametric resonance condition. Nonlinear vibration with more degrees of freedom vibration. Single-frequency and multi-frequency modes of vibration systems with more degrees of freedom.

Language of Instruction

☒Serbian (complete course) ☒ English (complete course) ☐ Other _____ (complete course)

☐Serbian with English mentoring ☐Serbian with other mentoring _____

Assessment Methods and Criteria

Pre exam Duties	Points	Final Exam	Points
Activity During Lectures	0	Written Examination	80
Practical Teaching	80	Oral Examination	Max. 20
Teaching Colloquia	40	Overall Sum	100
*Final examination mark is formed in accordance with the Institutional documents			