|  |
| --- |
| **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 | ☐ Group tutorials | ☒ Individual tutorials |
| ☐ Laboratory work | ☒ Project work | ☒ Seminar |
| ☐ Distance learning | ☐ Blended learning | ☐ 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. Еquilibrium 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** |