Study programmes: Bachelor studies – Mathematics

Course name: Rational mechanics 2

Lecturers: Anđelka Kovačević

Status: Optional

ECTS: 5

Attendance prerequisites: None

Course aims: Hamilton's and Lagrange's conception of mechanics give deeper view in the structure of mechanics

Course outcome: The student has basic knowledge of energy and momentum conservation and ability of using generalised coordinates for solving problems.

Course content: Kinematics of a rigid body. The notion of a rigid body. Determination the position of a rigid body. The final equations of motion of a rigid body. Rotation around fixed axes; The Euler and Rodrigo formula. The velocity of the point of a rigid body (velocity field). Motion in a flat space, pol of speed. General case of movement (corrugated axis). Acceleration of the point of the solid body. The current acceleration center. Speed and acceleration of the point rigid body due to the relative motion of a rigid body system. The kinetics of the material system. Differential equations of motion of a free material system.
Two bodies problem. Connections: holonomic and non-holonomic. Possible speeds, possible and virtual shifts. Connection reactions, smooth connections. Differential equations of the movement of the system of material points on connections (Lagrange equations of type I). General theorems on the motion of the system of material points: the theorem on the amount of motion, on the moment of the amount of motion and the increase in kinetic energy. The first integral equation of motion. Independent coordinates. Configuration multiplicity. General dynamic equation. Equations of motion of the system of material points in independent coordinates (Lagrange equations of type II). Analysis of Lagrange equation (potential, gyroscopic and dissipative forces). The first integral Lagrange equations. Simplect coordinates. Hamilton equations movement. Raut's equation. Principles of mechanics. Differential principles: Dalaman's principle and principle of virtual shifts. Integral principles: Hamilton's principle of least effect and Mopertui-Lagrange principle (shortened). Mass geometry: center of mass, moments and products of inertia, inertia tensor. Ellipsoid inertia. Main moments and main axes. Kinetics of rigid body. Kinetic energy of a rigid body. Quantity of motion and kinetic the moment of a rigid body. Differential equations of motion of a rigid body (free). Differential equations of the motion of a bound rigid body. Movement of a rigid bod in a flat space. Rotation of a rigid body around a fixed axis. Permanent and free axis of rotation. Physical pendulum. Moving the rigid body around a fixed point: Euler, Lagrange and the Kovaljev case.

Literature:

1. T. Anđelić, R. Stojanović, Racionalna mehanika, Beograd, 1965.
2. Daniel Arovas, Lecture Notes on Classical Mechanics (A Work in Progress), ebook, University of California, USA, 2013
3. David Tong, Lecture Notes: Classical Dynamics, University of Cambridge
4. Kevin Berwick, Computational physics using MATLAB, ebook, 2012
5. A. Kovačević, skripte.

Number of hours: **8**	**Lectures**: **4**	**Tutorial**: **2**	**Laboratory**: **2**
Teaching and learning methods: Method of University in Texas, student oriented teaching			
Assessment (maximal 100 points)			
Course assignments	**points**	**Final exam**	**points**
Lectures	15	Written exam	25
Exercises / Tutorials	15	Oral exam	25
Colloquia	20		
Essay / Project			