Study programs: Bachelor studies – Astronomy and astrophysics, Mathematics

Course name: Introduction to celestial mechanics

Lecturers: Bojan Novaković

Status: Compulsory

ECTS: 5

Attendance prerequisites: No prerequisites

Course aims: Obtaining general and specific knowledge about motion of the celestial bodies.

Course outcome: Upon course completion, student has basic knowledge about motions of the celestial bodies and he is able to solve different problems in celestial mechanics.

Course content:

1. Motion of the celestial bodies: Kepler's laws. Newtonian law of gravitation.
2. Two body problem: Integrals of two body problem. Shape of the object trajectory. Elliptical motion of the celestial bodies. Orbital elements.
3. N- body problem: General integrals of the N-body problem. Translatory movement of the Solar System. Laplace's invariable plane.
4. Special cases of the 3-body problem. Center of attraction of three bodies. Asteroidal problem. Equations of the motion. Jacobi's integral. Lagrange equilibrium points. Trojan asteroids and their movement.
5. Disturbing function. General theory of the planetary perturbations. Disturbing function and its derivatives. Lagrange's brackets and their characteristics. Calculation of the Lagrange's brackets. Differential equation of heliocentric motion of the planets. Developing disturbing function in the series expansion. Resonances. Classification of the perturbations. Secular perturbations.
6. Gravitational field of the Earth: Gravitational potential. Laplace's equation. Spherical functions. Legendre's polynomials. Development of the gravitational potential. Potential of the Earth attraction. Normal gravitational potential of the Earth. Perturbations due to Earth flattening. Differential equations of perturbed motion. Differential equations of perturbed movement of the artificial Earth satellite. Differential equation of elliptical elements of the Earth artificial satellite.

Literature:

1. Milutin Milanković: *Nebeska mehanika,* Zadužbina Luke Ćelovića-Trebinjca, Beograd, 1935
2. Gerhard Beutler: *Methods of Celestial Mechanics*, Volume I, Springer-Verlag Berlin Heidelberg 2005
3. Carl D. Murray, Stanley F. Dermott: *Solar System Dynamics***,** Cambridge University Press, 2000
4. Jean Souchay: *Dynamics of Extended Celestial Bodies and Rings*, Lect. Notes Phys. 682, Springer, Berlin Heidelberg, 2006

Number of hours: 4	**Lecures: 2**	**Tutorials: 2**	**Laboratory: -**	**Research: -**

Teaching and learning methods: Frontal, Group, Exercises

Assessment (maximal 100 points)

Course assignments	**points**	**Final exam**	**points**
Lectures	10	Written exam	20
Exercises / Tutorials	-	Oral exam	40
Colloquia	10	Written-oral exam	
Essay / Project	20		