Study programmes: Astronomy and Astrophysics - PhD studies

Course name: Numerical Methods of Celestial Mechanics

Lecturers: Bojan Novaković

Status: optional

ECTS: 9

Attendance prerequisites: None

Course aims: Introduction to modern numerical methods used to solve scientific problems in celestial mechanics.

Course outcome: Upon completion of the course, students should be able to work independently and apply the acquired knowledge for numerical studying and modelling of the solar system and address specific problems of the long-term dynamics of our solar system and extrasolar planetary systems.

Course content:

1. N-body problems: Differential equations of motion of celestial bodies and their characteristics. Perturbations. Equations in rectangular coordinates and variations of parametric variables.

2. Numerical integration of the equations of motion: Taylor's series methods. Runge-Kutta methods. Everhart algorithm. Explicit and implicit multistep methods. Symplectic integrators and design of algorithms of high accuracy. **OrbFit** and **SWIFT** integrators.

3. Methods for detection of chaotic motion: *Lyapunov characteristic exponent*. *Fast Lyapunov indicato*r. Method of *frequency analysis*. Diffusion coefficients.

Literature:

1. Souchay J., Dvorak R. (Eds.): **Dynamics of Small Solar System Bodies and Exoplanets**, Lect. Notes Phys. 790, Springer, Berlin Heidelberg, 2010

2. **Selected articles from scientific journals**

3. Т. В. Бордовицина, **Modern numerical methods in tasks of celestial mechanics (in russian), 1984**

Number of hours: 10	**Lectures: 4**	**Tutorials: 6**

Methods of teaching: Frontal, Group, *Individual Research* Approach

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures	10	Written exam	-
Exercises / Tutorials	-	Oral exam	40
Colloquia	-	Written-oral exam	-
Essay / Project	50		