**Study programmes:** Master academic studies - Astronomy and Astrophysics

**Course name:** Theory of Orbit Determination

**Lecturers:** Bojan Novaković

**Status:** Optional

**ECTS:** 8

**Attendance prerequisite:** No prerequisite classes

**Course aims:** Gaining general and specific knowledge needed for calculations of orbits of small planets (asteroids), comets, extrasolar planets and binary stars.

**Course outcome:** By the end of the course, student possesses the fundamental knowledge necessary for determining the trajectory of a small planet or comet starting from their observed position. Additionally, the student is qualified for determining the trajectory of binary asteroids, binary stars and extrasolar planets.

**Course content**

**1. Introduction:** Theory of gravitational interactions in cases of planetoids and comets. Units for mass, length and time. Procedures for numerical integration of differential equations of motion of celestial bodies. Kepler's motion. Types of trajectories and motion on them. Position and speed of celestial bodies. Path elements as integral constants. Basic system elements.

**2. Calculating the ephemeris:** Ephemerides of planetoids and comets; accurate and approximate; position calculations. Finding the date of the opposition and the moment of passage through the perihel. Basic calculation procedures: direct and numerical integration of differential equation of Kepler's motion. Comparison of bserved and calculated positions of the celestial body.

**3. Calculating the orbit:** Undisturbed path of planetoids and comets. The elementary principles of orbit determination based on observations from Earth.

a) Circular track calculations (Gauss – Encke's method),

b) Elliptical trajectory calculations (Gauss – Encke's, Laplace – Leuschner's and Veisel's method)

c) Parabolic trajectory calculations (Olbers method)

**4.Methods for determining orbits of dual stars:** Colvalski method, Colvaski – Olević method , Dokoba method and others.

**Literature: (Lectures and exercises)**

1. J.L.Simovljević: **Osnovne teorijske astronomije**, Građevinska knjiga, Belgrade, 1977

2. Andrea Milani and Giovanni F. Gronchi: **Theory of Orbit Determination** , Cambridge University Press, 2010

3. Selected scientific articles

| **Number of classes of active teaching: 5** | **Theoretical classes per week: 3** | **Practical teaching:** 3 |
|---|---|---|

**Teaching and learning methods**: Theoretical, group and practical work.

**Assessment (maximal 100 points)**

| Course assignments | points | Final exam | points |
|---|---|---|---|
| Lectures | 20 | Written exam | 30 |

| | | | |
|---|---|---|---|
| Exercises / Tutorials | | Oral exam | 30 |
| Colloquia | 20 | Written-oral exam | |
| Essay / Project | | | |