**Study programmes**: Bachelor studies – Astronomy and Astrophysics

**Course name**: Astronomical data processing 1

**Lecturers**: Dušan Marčeta

**Status**: Compulsory

**ECTS**: 6

**Attendance prerequisites**: None

**Course aims**: Acquisition of general and specific knowledge of the processing of large and individual observation results and the development of methods of theory and practice based on numerical, probabilistic and statistical characteristics of the astronomical experimental material. Development of analytical and synthetic skills of a student for effective treatment of observation results

**Course outcome**: Upon completion of the course, the student has the necessary theoretical and practical knowledge of processing all recognizable types of observational results (endogenous, exogenous, qualitative, quantitative) and the ability to perform independently the final part of an astronomical experiment using mathematics tools and computing.

**Course content**:

Introduction to the numerical analysis. Theory of the numerical errors. Number rounding. Interpolation. Approximations. Central differences. A fast planetary ephemeris. Theoretical and true errors of interpolation with Lagrange polynomials, cubic splines and trigonometric polynomials. Inverse interpolation of the ephemeris.

Formulas of numerical integration. Applying of the known numerical integration methods for calculation of the Fourier's polynomials which are used to smooth astronomical observations of Solar activity, periodical flux changes of celestial bodies etc. Methods of the smoothing, inflexible, flexible and combined. Chaining method. Efficiency of the calculation of the different astronomical observations with known methods: least-square method, cubic spline method and Whittaker-Robinson-Vondrak method. Whittaker-Robinson-Vondrak method and obtaining oscillatory changes of the observed functions.

Stability of the matrices and determinants. Solving equations with multiple variables. Numerical precision of the unknown variables and iterative method for improving the accuracy of the solution. Non linear systems and specific methods for their calculation. Robust methods. Collocation methods. Approximations of the secular changes with orthogonal polynomials and Ficher criteria for obtaining the highest degree of the polynomials.

**Literature:**

1. D. Đurović: Matematička obrada astronomskih posmatranja (1974)
2. S. Šegan: Set od 15 lekcija iz obrade posmatranja "Lekcije po redu i bez reda"
3. Astronomical Almanac
4. J. V. Wall, C. R. Jenkins, Practical Statistics for Astronomers, Cambridge, 2003
Astronomical Almanac

| **Number of hours: 5** | **Lectures: 3** | **Tutorials: 2** | **Laboratory: -** | **Research: -** |
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**Teaching and learning methods**: Frontal, Interactive, Tutorial, Lectures, Exercises

**Assessment (maximal 100 points)**

| Course assignments | points | Final exam | points |
|---|---|---|---|
| Lectures | 20 | Written exam | - |
| Exercises / Tutorials | 30 | Oral exam | 20 |
| Colloquia | 20 | Written-oral exam | |
| Essay / Project | 10 | | |