Study programmes: Bachelor studies – Astronomy and Astrophysics			
Course name: Stellar modelling and evolution			
Lecturers: Bojan Arbutina			
Status: Compulsory			
ECTS: 6			
Attendance prerequisites: enrolled into fourth year of studies			
Course aims: Acquiring general and specific knowledge in models and evolution of stars.			
Course outcome: At the end of the course student has knowledge in models and evolution of stars and has skill for future scientific work in this field.			
Course content: Introduction. Differential equations of stellar interiors in spherical symmetry. Conditional equations. Vogt-Russel theorem. Formal mathematical proof and physical interpretation. Homogeneous and non-homogeneous chemical composition. Analytical models. Polytropic stars and Lane-Emden equation. Standard (Eddington) model. Model with uniform distribution of energy sources. Model with point energy source. Structure of radiative and convective core envelopes. Temperature distribution in envelopes. Homologues stars. Structural functions of homologues family models. Theoretical relation mass-luminosity. Calculating models. Complete system of stellar structure equations and boundary conditions. Dimensionless variables. Transformation for integration from surface (Schwarzschild variables). Transformation for integration from centre. Numerical integration. Relative mass as independent variable. Invariants and UV planes. Haney's method. Change rate of chemical composition through interiors. Evolution time scales. Gravitational collapse. Dynamical expansion. Gravitational contraction (Kelvine time scale). Heating and cooling. Scales of nuclear evolution. Fundamental stellar evolution phases. Initial phase. Jeans instability, formation and evolution of proto stars, Hayashi tracks, zero age main sequence (ZAMS). Main-sequence phase. Global structure of stars at the ZAMS. Evolution rate dependence of stellar mass. Theoretical boundaries of main-sequence. Evolution (of massive stars) after main-sequence. Thermal instability, gravitational contraction of helium core and hydrogen reactions in envelope. Stadium of stable red giant. Contraction of carbon core, hydrogen and helium reactions in envelope, pulsation instability. Development of stellar models. Evolution with time-varying mass. Final phases. Conditions for dynamical instability. Planetary nebulae and white dwarfs. Supernova and neutron stars or black hole. Structure of stellar remnants. Evolution of chemical elements. Cosmological and modern composition of interstellar medium. Production of heavy elements in supernova explosions. Young and old stars.			
Literature: Cox J. P., Giuli R. T., 1968, *Principles of Stellar Structure, Vol. II*, Gordon and Breach, Sc. Publ. Kippenhahn P., Weigert A., 1994, *Stellar Structure and Evolution*, New York: Springer **Exercises**: Hansen C. J., Kawaler S. D., Trimble V., 2004, *Stellar Interiors - Physical Principles, Structure, and Evolution*, New York: Springer			
Number of hours: **4**	**Lectures**: **2**	**Tutorials**: **2**	
Teaching and learning methods: Group work			
Assessment (maximal 100 points)			
Course assignments	**points**	**Final exam**	**points**
Lectures	20	Written exam	30
Exercises / Tutorials	20	Oral exam	30
Colloquia			
Essay / Project			