Study programmes: Mathematics - Master Academic Studies, Astronomy - Master Academic Studies

Course name: Theory of Relativity and Cosmological Models

Lecturers: Darko Milinković, Jelena Katić, Bojan Novaković

Status: Optional

ECTS: 8

Attendance prerequisite: None

Course aims: Acquiring general knowledge in the theory of relativity and cosmology

Course outcome: By the end of the course, student has advanced knowledge in theory of relativity and cosmological models, as well as the understanding of the origin and evolution of the cosmos.

Course content:

Introduction: Inertial systems in classical mechanics. Galilean transformation. Spherical motion. The equations of motion of Foucault’s pendulum. Mach's principle. Lagrange and canonical equations of motion.

Special Relativity Theory (STR): Postulates of STR. Relativistic time dilation, relativistic length contraction, agreement of relativistic velocities. Lorenz transformations. Minkowski space. Lorenz-Poincare group. Invariability of the scalar product in relation to the Lorenz group. Relativistic dynamics and invariants. Thomas precession. Relativistic wave motion. Doppler effect. Wave-like nature of matter. De Broglie invariant. Maxwell equations, relativistic electrodynamics.

General theory of relativity: Gravitation. Equivalence principle (heavy and inertial masses). Metric of space-time. Einstein's field equations. Metric of space-time continuum.

Cosmology: Cosmological principle of homogeneity and isotropic, structure of cosmos on a bigger scale. Floating coordinates. Big Bang Theory. Friedmann equations – derivation of Einstein's field equations, geometry of cosmos. Hubble's law and cosmological parameters (expansion, density, deceleration). Universe expansion and red shift. Age of the universe. Analysis of cosmological parameters according to Friedmann equations. Evolution of the cosmos - Einstein's cosmological constant. Dark matter. String theory.

Literature:

1. I. Supek, *Theoretical Physics I*, Školska knjiga, Zagreb, 1960.
2. I. Lukačević: *The Basics of Theory of Relativity*, Belgrade, 1982.
3. M. Spivak, *Physics for Mathematicians*, Publish or Perish, 2010.
4. A. Liddle, *An Introduction to Modern Cosmology*, WILEY, 2nd edition, 2003.
5. A.Kostrikin, Yu. Manin, *Linear algebra and Geometry,*
6. Sachs, Wu: General Relativity for Mathematicians, Springer 1977
7. Hawking, Ellis: *The Large Scale Structure of Space-Time, Cambridge University Press 1975.*
8. A. Lightman, *W. Press, R. Price, Problem book and relativity and gravitation*, 1975, Princeton

Number of classes of active teaching: 4	**Theoretical:** 3+2	**Lab and practical:** 2

Teaching and learning methods: lectures and exercises

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures	-	Written exam	30
Exercises / Tutorials	-	Oral exam	40
Colloquia	30	Written-oral exam	-

Essay / Project	-		