

Study programmes: PhD STUDIES – Astronomy and Astrophysics			
Course name: Theory of Gravity 1			
Lecturers: Marija Dimitrijević and other lecturers			
Status: Optional			
ECTS: 9			
Attendance prerequisites: Relativistic quantum mechanics, Quantum field theory 1.			
Course aims: Introduction to General relativity: physical concepts and formalism; understanding of basic principles and acquiring capability to solve problems.			
Course outcome: Students have acquired the basic knowledge on General relativity; they understand the physical concepts and formalism; they are able to take an active part in research in this and related areas of physics.			
Course content:			
Lectures:			
1. Special relativity: review. 2. Manifolds: curvilinear coordinates, vectors, forms, tensors; differential calculus; diffeomorphisms, Lie derivative, Killing vectors. 3. Connection and curvature: covariant derivative, metric connection, geodesics, parallel transport; curvature, torsion. 4. Einstein equations: derivation, properties, Newtonian limit. 5. Schwarzschild solution: derivation, properties, event horizon, maximal extension, conformal diagrams. 6. Experimental tests of General relativity: perihelion of Mercury, bending of light, gravitational red shift. 7. Linearized theory, gravitational waves. 8. Basic cosmology: RW metric, Friedman equations and different cosmological models. 9. Our Universe: current experimental and theoretical status; CMB radiation spectrum, Dark matter and dark energy, inflation. 10. More general black hole solutions: charged, rotating. 11. Thermodynamics of black holes, Hawking radiation.			
Examples/ practical classes:			
Problems are solved and examples are given during the lectures; students have homework to do.			
Literature:			
1. S. M. Carroll, An Introduction to General Relativity: Spacetime and Geometry, Addison Wesley 2004.			
2. B. Schutz, A First Course in General Relativity, Cambridge University Press 2009.			
3. R. d'Inverno, Introducing Einstein's Relativity, Oxford University Press, 1992.			
4. A.P.Lightman, W.H.Press, R.H.Price and S.A. Teukolsky, Problem Book in Relativity and Gravitation, Princeton, 1975.			
5. C.W.Misner, K.S.Thorne and J.A.Wheeler, Gravitation, Freeman Press, San Francisco, 1973.			
Number of hours: 10	Lectures: 4	Tutorials: 0	Laboratory: 0
Research: 6			
Teaching and learning methods:			
Lectures, homeworks.			
Assessment (maximal 100 points)			
Course assignments	points	Final exam	points
Lectures	10	Written exam	80
Exercises / Tutorials	-	Oral exam	-
Colloquia	-	Written-oral exam	-
Essay / Project	10		