Faculty of Health, Science and Technology
Physics

Syllabus

General Relativity

Course Code:	FYAE18
Course Title:	General Relativity *Allmän relativitetsteori*
Credits:	7.5
Degree Level:	Master's level
Progressive Specialisation:	Second cycle, has only first-cycle course/s as entry requirements (A1N)

Major Field of Study:
FYA (Physics)
TKA (Engineering Physics)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2014-12-01, and is valid from the Spring semester 2015 at Karlstad University.

Prerequisites
Mathematics 37.5 ECTS cr. and Physics 46.5 ECTS cr., or equivalent. Upper secondary school level Swedish 3 or B/Swedish as a second language 3 or B, and English 6 or A, or equivalent.

Learning Outcomes
Upon completion of the course students should be able to:
- give an account of and apply tensor calculus and Riemann geometry in general relativity theory
- describe the physical content of Einstein's field equations
- give an account of tests of Einstein's general relativity theory
- apply Einstein's equations to astrophysical and cosmological contexts
- use relativistic models for the final stages of stars, neutron stars as well as black holes
- describe cosmological solutions to Einstein's field equations and demonstrate knowledge of their physical interpretation and implications
- describe gravity waves.

Content
Instruction is in the form of lectures and discussion.

The course deals with:
- tensor calculus and Riemann geometry: vector and tensor, affine connection, covariant derivatives, the geodetic equation, Riemann's curvature tensor, the Einstein tensor
- Einstein's equations and the limit of weak gravitational fields, especially gravitational waves
- spherical symmetrical solutions to Einstein's equations, especially the Schwarzschild solution
- physics in spherically symmetrical space-times

- the cosmological spatially homogeneous and isotropic Friedmann-Robertson-Walker (FRW) solution
- physics in a FRW-universe.

Reading List
See separate document.

Examination
Assessment is based on a written and oral examination.

Grades
One of the grades U (Fail), 3 (Pass), 4 (Some Distinction), or 5 (Distinction) is awarded to engineering program students. To other students one of the grades U (Fail), G (Pass) or VG (Distinction) is awarded.

Quality Assurance
Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate
A course certificate will be provided upon request.

Additional information
The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.