UNIVERSITY OF GOTHENBURG

PHYSICS

ASM470 Space Science and Techniques, 7.5 higher education credits

Space Science and Techniques, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2008-09-16 and was last revised on 2017-05-22 to be valid from 2017-05-22, spring semester of 2017.

Field of education: Science 100%
Department: Physics

Position in the educational system

The course ASM470 is a programme course in the Physics Master Programme (N2PHY), as well as a single subject course at University of Göteborg.

The course can be part of the following programmes: 1) Complex Adaptive Systems, Master's Programme (N2CAS), 2) Physics of Materials and Biological Systems, Master's Programme (N2PMB) and 3) Physics, Master's Programme (N2PHY)

Main field of studies	*Specialization*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Entry requirements

To be eligible for the course the student needs knowledge in mathematics and physics (including basic electromagnetism) equivalent to a Bachelor degree. English B level or English proficiency equivalent to IELTS 6.5 no part under 5.5 or TOEFL 575 p, TWE score 4.5 is also required.

Learning outcomes

Students who have followed the course ASM470 Space science and techniques will be able to:

- Give examples of applications of space techniques.
- Describe which subsystems a satellite has and what they are used for.
- Analyse satellite orbits using Kepler's laws and related equations.
- Sketch the ground track for a specified orbit.
- Explain perturbations on orbits and how they are used or counteracted for practical orbits.
- Describe how a rocket works and give advantages and disadvantages with different types of rockets.
- Use the rocket equation for orbit transfer calculations.
- Perform a link budget calculation.
- Describe the motion of a charged particle in an electromagnetic field.
- Define a plasma and explain the concepts plasma oscillations and Debye shielding.
- Describe the near-Earth environment.
- Describe environmental effects on spacecraft and spacecraft design.
- Calculate the equilibrium temperature of a satellite.
- Give examples of methods to increase the reliability of a spacecraft system.
- Use computerbased tools to study ground track, attitude control and environmental effects on spacecraft.

Course content

The aim of the course is to enable students to understand the complexity of spacecraft systems, the space environment and its effect on spacecraft, and how spacecraft are used for scientific and commercial purposes. During the course basic calculations in spacecraft systems engineering (especially orbit and link budgetcalculations) will be learnt. After the course the students will be ready for deeper studies of various aspects of space science and technology.

The course covers the following topics:

- Keplers laws and related equations, orbit perturbations, GEO, LEO, sunsynchrounous orbits, spherical trigonometry, satellite tracking, ground tracks, orbits for different applications.
- Launch vehicles - Rockets (basic rocket principles, different types of rockets and propulsion systems, launch sequence)

- Satellite subsystems (platform and payload, spin and three-axis stabilisation, electrical power, attitude and orbit control, telemetry, tracking and command, temperature control, reliability)
- Satellite communication (antennas, receivers and transponders, noise, link budget)
- Applications (e.g. remote sensing, navigation, astronomy, aeronomy)
- Motion of charged particles in electromagnetic fields, basic plasma physics (definition of plasma, plasma oscillations, Debye shielding)
- The Sun, solar activity, and the Sun's influence on the space environment and on spacecraft.
- The near-Earth environment: the magnetosphere and plasmas, the radiation belts and cosmic rays, the upper atmosphere and ionosphere, auroras.
- Environmental effects on spacecraft: plasma effects, ionizing radiation, neutral particles and drag, micrometeoroids and orbital debris, electromagnetic radiation and thermal effects, weightlessness and satellite attitude disturbances, space weather.

Form of teaching

The course consists of lectures, exercises, and computer excercises.

Language of instruction: English

Assessment

Examination constitutes of hand-in problems (including computer exercises) and a written exam.

A student who has failed a test twice has the right to change examiner, unless weighty argument can be adduced. The application shall be sent to the board of the department and has to be in writing.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Course evaluation

The results of the evaluation will be communicated to the students and will function as a guide for the
development of the course.

Additional information

The course is given jointly with Chalmers University of Technology. The Chalmers code for the course is RRY016.