ASTM28, Astronomy: Dynamical Astronomy, 7.5 credits  
Astronomi: Dynamisk astronomi, 7,5 högskolepoäng  
Second Cycle / Avancerad nivå

Details of approval

The syllabus is a draft but not yet established.

General Information

The course is a compulsory course for second-cycle studies for a Degree of Master of Science (120 credits) in astrophysics.

Language of instruction: English  
The course is normally given in English.

Main field of studies  

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<th>Physics</th>
<th>Depth of study relative to the degree requirements</th>
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Astrophysics  

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Learning outcomes

On completion of the course, the student should have acquired a good understanding of a number of basic concepts that are used to describe gravitationally dominated dynamic systems within astronomy (for example star clusters, galaxies and galaxy groups), and the ability to apply the concepts by analysing such systems by means of observational data.

Dynamical Programme

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Knowledge and understanding
On completion of the course, the student shall be able to:

1. From basic astrometric and other observational data calculate the three-dimensional positions of the objects and their velocities.
2. Calculate statistical kinematic properties such as the average velocity and the velocity dispersion for a selection of objects.
3. Describe observed correlations between the statistical properties and how these vary depending on the physical properties of the objects.
4. Explain the most important mechanisms behind these variations.
5. Explain and apply the principles of dynamic determination of the mass or the mass densities in a dynamic system.
6. Critically discuss the uncertainty in achieved results.
7. Interpret and use a Hertzsprung-Russell diagram.

Competence and skills
7. demonstrate the ability to conduct a defined computational project on a short time-scaleOn completion of the course, the student shall be able to:

1. Numerically calculate orbits for particles in a given potential.
2. Use a structured programming language.
3. Formulate and apply selection criteria for observational data so that these are suitable for statistical studies.
4. Carry out statistical calculations on different selections of objects.
5. Show proficiency in the numerical integration of ordinary differential equations.
6. Present project work in written reports.
7. Demonstrate the ability to conduct a defined computational project on a short time-scale.

Judgement and approach
On completion of the course, the student shall be able to:

1. Evaluate when and how it is appropriate to reference the work of others.

Course content
The course contains the following parts:

1. Newtonian gravitation and dynamics.
2. Reference systems and units.
4. Astrometry and the determination of the distance, the motion and distribution of stars.
5. The HR-diagram and the stellar colours, luminosities and ages of stars.
7. Circular motions

This is a translation of the course syllabus approved in Swedish
8. The motion of the sun and the local velocity standard.
9. The rotation curve, differential galactic rotation and Oort’s constants.
10. Force, potential, and Poisson’s equation.
12. The potential of the galaxy and galactic orbits.
14. The phase space, the collision free Boltzmann equation and Jeans’s equations.
15. Applications of the Jeans equations to dynamically determination of masses and mass density.

Course design

The teaching consists of lectures and group work in the form of three related projects. The projects include planning and writing a computer program to analyse observational data and carry out simulations using a model. The results of the projects are discussed in groups but are presented in individual written form. Participation in group work and project work and thereto integrated teaching is compulsory.

Assessment

The examination consists of project work including a written report for each project. A written examination is also at the end of the course. Students who do not pass the regular exam are offered a re-exam shortly after the regular exam.

Assessment is based on the performance of the students in:

- The final written examination, which assesses intended learning outcomes 1-7 in knowledge and understanding.
- The project reports also test aspects of learning outcomes 1-7 in knowledge and understanding. However, there is more focus on testing learning outcomes 1-6 in competence and skills and learning outcome 1 in judgement and approach by using proper citations.

Students who do not pass an assessment will be offered another opportunity for assessment soon thereafter.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the entire course, approved examination and passed project reports and participation in all compulsory parts are required. The final grade is determined by combining the results in the different parts of the examination.

The grading of the reports is based on answering a number of questions with the simulations. The quality of the results is reflected in the grades and the scientific results must be correct - the examiner is guided by prepared solutions which are used to assess the student solutions. The solutions can be different depending on the quality of data used and must be assessed.
The grading of the home examination is more straightforward and a series of question are posed with well defined answers.
The pass mark is 50% and the mark for pass with distinction is 75%.

**Entry requirements**

New: To be admitted to the course, as well as having English 6/B and meeting the general entry requirements, students must have 75 credits in Physics and 45 credits in Mathematics, or a Bachelor of Science in Physics, in both cases including knowledge corresponding to FYSB24 Atomic and Molecular Physics, 7.5 credits, and FYSC12 Nuclear Physics and Reactors, 7.5 credits.

Old: The prerequisites required for admission to the course are: English B and knowledge equivalent to FYSA31 (Physics 3, Modern physics), 30 credits.

**Further information**

The course may not be included in a higher education qualification together with AST217 Dynamic astronomy 5p, AST317 Dynamic astronomy 5p or ASTM13 Dynamical Astronomy 7.5hp.