Faculty of Science

ASTM26, Astronomy: Observational Techniques and Instrumentation, 7.5 credits

Astronomi: Observationsteknik och instrumentering, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by The Education Board of Faculty of Science on 2025-05-23. The syllabus comes into effect 2025-05-23 and is valid from the spring semester 2026.

General information

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

Language of instruction: Swedish and English
If needed the course is given in English.

Main field of study	*Specialisation*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements
Astrophysics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

On completion of the course, the student shall have received general knowledge of different instruments and observational techniques of significance within astrophysics and a more in-depth knowledge of telescopes, auxiliary instruments and detectors for astronomical observations within the optical and infrared wavelength region.

Knowledge and understanding

Upon completion of the course the student shall be able to:

- describe the principles of detection of astronomical signals in different parts of the electromagnetic spectrum

- describe the effect of the atmosphere on electromagnetic radiation from space
- describe advantages and disadvantages with different telescope constructions regarding their optical and mechanical properties
- explain the principles of aperture synthesis
- explain important observations in space and what these can or are expected to be able to achieve
- explain the function and properties of modern CCD detectors
- explain the standard methods for processing electronic images
- analyse advantages and disadvantages with various types of spectrometers
- describe principles, problems and solutions for adaptive optics.

Competence and skills

Upon completion of the course the student shall be able to:

- estimate expected resolution, signal-to-noise ratios and precision in a given observational situation
- plan an observing run at a modern observatory
- use standard software for reduction of photometric and spectrometric data.

Judgement and approach

Upon completion of the course the student shall be able to:

- analyze complex astronomical oberrvsation problems by decomposing them into their main components, find a solution and reflect on the approach chosen.

Course content

The course contains the following aspects:

- Electromagnetic radiation and non-photonic astronomy.
- The effect of the atmosphere on observations.
- Detectors for optical and infrared radiation.
- Detectors for radio waves.
- The noise characteristics of detectors.
- Signal-to-noise ratio, quantum efficiency and detective quantum efficiency.
- Light collecting and imaging instruments.
- Adaptive optics and extremely large telescopes.
- Space observatories.
- Spatial resolution and modulation transfer function.
- Interferometry, visibility, (u,v)-plane and interferometric imaging.
- Photometry, photometric systems and photometric reduction methods.
- Spectroscopy, grating, echelle and Fourier transform spectrometers.

- Astrometry through the atmosphere and from space.
- Polarimetry and determination of the Stokes vector.

Course design

The teaching consists of lectures, laboratory sessions, group work and project work.

Assessment

The examination is conducted in through a final written exam at the end of the course, as well as through written laboratory reports, written project work, and participation in all mandatory components during the course.

For students who do not pass the regular examination, an additional examination is offered in close proximity.

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

Grading scale includes the grades: Fail, Pass, Pass with distinction
The grading scale for the course project, reports from lab exercises, and the final written examination are Fail, Pass and Pass with distinction.

For a grade of pass on the whole course the student must have participated in all mandatory components, passed each of the reports on the lab exercises, the course project and the final written examination.

The final grade is specified by the aggregated results of the different assessed components. The pass mark is 50% and the mark for a pass with distinction is 80%.

When calculating the aggregated result, the lab exercises are weighted 20%, the student lecture 20% and the final written examination 60%.

Entry requirements

Admission to the course requires 75 credits in physics and 45 credits in mathematics, or a bachelor's degree in physics or equivalent. General entry requirements and English 6/B.

Further information

The course may not be credited towards a degree together with ASTM18 which it replaces.

The course is offered at the Department of Physics, Lund University.