Faculty of Science

ASTM23, Astronomy: High Energy Astrophysics, 7.5 credits

Astronomi: Högenergiastrofysik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by The Education Board of Faculty of Science on 2025-04-22. The syllabus comes into effect 2025-04-22 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. The course can also be taken as a stand alone course or as electtive course in a bachelor or master degree in physics.

Language of instruction: 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

The overall aim of the course is that the student acquires knowledge of phenomena in high-energy astrophysics and an understanding of the physical processes that govern them. In addition, the course aims to develop the student's ability to use astrophysics research literature.

Knowledge and understanding

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

- Explain the astrophysical origins of the various types of supernova explosions
- Describe how gravitational waves can be detected and used to study compact binary sytems

- Relate the contemporary status of research in topics in high-energy astrophysics.

Competence and skills

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

- Analyse the evolution of a binary star system using the theory of mass transfer
- Compute properties of stellar remnent populations from theoretical principles
- Construct and present a lecture at appropriate level based on academic literature
- Organise their work as part of a group to solve a complex astrophysical problem

Judgement and approach

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

- Select appropriate material from the research literature to present in lecture form
- Select an approach to solving a complex astrophysical problem

Course content

The course contains the following parts:

- An overview of the evolution of massive stars.
- The origin of compact objects
- Core collapse supernovae.
- Type Ia Supernovae
- Mass transfer between binary stars
- Neutron stars and pulsars
- Gravitational waves
- Selected additional topics in contemporary high-energy astrophysics, e.g.:
  - Classical novae
  - Active galactic nuclei
  - Tidal disruption events
  - Fast radio bursts

Course design

The course consists of lectures, student-presented lectures, problem-based learning sessions and self-study. Compulsory participation is required in:

- The problem-based learning sessions

- The student lectures

Assessment

The examination is conducted in writing through a final written exam, written reports and a student-presented lecture during the course, and by participation in all mandatory components.

Students who do not pass the regular examination are offered an additional examination opportunity shortly 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

Grading scale includes the grades: Fail, Pass, Pass with distinction
The grading scale for the student lectures, reports from the problem-based learning 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 passed each of the reports on the problem-based learning exercises, the student lecture 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 problem-based learning exercises are weighted 20%, the student lecture 20% and the final written examination 60%.

Entry requirements

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.

Further information

This course cannot count for a degree together with ASTM12 High-energy astrophysics, which it replaces.

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