

Syllabus

for course at advanced level

Late Stages of Stars, Supernovae and Gamma-ray Bursts
Stjärnors slutstadier, supernovor och gammastrålningsutbrott

**7.5 Higher Education
Credits
7.5 ECTS credits**

Course code:	AS7016
Valid from:	Autumn 2019
Date of approval:	2010-05-17
Changed:	2016-01-18
Department	Department of Astronomy
Main field:	Astronomy
Specialisation:	A1F - Second cycle, has second-cycle course/s as entry requirements

Decision

This syllabus has been approved by the Board of the faculty of Science at Stockholm University 2010-05-17 and was revised 2016-01-18.

Prerequisites and special admittance requirements

To enter this course a Bachelor's degree in physics, or similar, is required. In addition, knowledge similar to the courses Stjärnornas struktur och utveckling, AN, 7,5 hp (AS7010), Astrofysikalisk gasdynamik, AN, 7,5 hp (AS7002) and Astrofysikaliska spektra, AN, 7,5 hp (AS7006) is required. Also required is knowledge equivalent to Swedish upper secondary school course English B, or equivalent to one of the following tests; Cambridge CPE and CAE: Pass, IELTS: 6.0 (with no part of the test below 5.0), TOEFL (paper based): 550 (with minimum grade 4 on the written test part), TOEFL (computer based): 213, TOEFL (internet based): 79.

Course structure

Examination code	Name	Higher Education Credits
HELA	Late Stages of Stars, Supernovae and Gamma-ray Bursts	7.5

Course content

The course deals with observations of and theoretical concepts for the late evolutionary phases of high mass stars and the processes which determine their evolution. Specifically it treats the evolution after the Main Sequence for high mass stars which ultimately explode as supernovae. The relationships to different types of gamma ray bursts are also discussed. The physical processes studied in this course are degenerate gases, nuclear burning, stellar winds / mass loss / jets, neutrino processes and thermonuclear explosions.

Learning outcomes

Upon completion of the course, students are expected to be able to

- describe the evolution of high mass stars after the Main Sequence as well as the related nuclear burning processes.
- describe mass loss processes in high mass stars together with the relevant physical and chemical processes.
- show understanding of the different explosion mechanisms in supernovae as well as of the compact objects which remain after the supernova explosion.
- explain the underlying physics and results in scientific articles in the field.

Education

Instruction consists of lectures, exercises, seminars and practical laboratory work. Participation in exercises, laboratory work and seminars and any associated integrated instruction is compulsory. In the event of special circumstances, the examiner may, after consultation with the teacher concerned, grant a student exemption from the obligation to participate in certain compulsory instruction.

Forms of examination

- a. The course is examined as follows: Knowledge assessment takes the form of written reports of hand-in exercises, presentation of literature studies through seminars and reports. If the instruction is in English, the examination may also be conducted in English.
- b. Grades will be set according to a seven-point scale related to the learning objectives of the course:
A = Excellent
B = Very good
C = Good
D = Satisfactory
E = Adequate
Fx = Fail, some additional work required
F = Fail, much additional work required
- c. The grading criteria will be distributed at the beginning of the course.
- d. In order to pass the course, a minimum grade of E is required together with:
 - participation in exercises and the other students' seminars and presentations
 - a pass on the written report for the practical laboratory work.
- e. Students who receive a failing grade on a regular examination are allowed to retake the examination as long as the course is provided. The number of examination opportunities is not limited. Other mandatory course elements are equated with examinations. As student who has received a passing grade on an examination may not retake the examination to attain a higher grade. A student who has failed the same examination twice is entitled to have another examiner appointed, unless there are special reasons to the contrary. Such requests should be made to the department board.
The course includes at least two examination opportunities per year when the course is given. At least one examination opportunity will be offered during a year when the course is not given.
- f. Students awarded the grade Fx are given the opportunity to improve their grade to E. The examiner decides the supplementary assignments to be performed and the pass mark criteria. The supplementary assignments will take place before the next examination session.

Interim

Students may request that the examination be conducted in accordance with this course syllabus even after it has ceased to be valid. However, this may not take place more than three times over a two year period after the course instruction has ended. Requests must be made to the departmental board. The provision also applies in the case of revisions to the course syllabus (and revisions of the course literature).

Limitations

The course may not be included in examinations in combination with courses Early and Late Stages of Stellar Evolution, 15 hp (AS7011) or Supernovae and Gamma Ray Bursts, 5 hp (AS7014).

Misc

The course is part of the master programme in astronomy but can also be read as a separate course.

Required reading

The course literature is decided by the department board and published on the Department of Astronomy's website at least two months before the start of the course.