

Course information

ASTROPHYSICS AND COSMOLOGY (MTF109)

Lecturer and examiner

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Course homepage

<http://sirius.mt.luth.se/lassew/AO1/mtf109/mtfxxx.htm>

General

This course gives an introduction to modern astrophysics and cosmology. Astrophysics deals with phenomena in the universe that can be described and explained using physical laws while cosmology addresses questions regarding the origin, evolution and final fate of the universe.

Course content

The main theme in the course is the structure and the evolution of the universe, galaxies, stars and the solar system. Astrophysics is a branch of physics driven by observations, and thus is in constant and rapid development. Many fairly new and poorly understood phenomena will be discussed, such as dark matter, quasars, gamma-ray bursts, compact stars, microwave background radiation and recent supernova data indicating that the expansion of the universe is actually accelerating, perhaps due to some mysterious form of “dark energy”.

Lectures

The course lectures are mainly devoted to material covered in various chapters of the textbook. During the lectures, only a basic overview is presented. The details will be addressed in hand-in problems.

Examination and grading

The purpose of the examination is to train the student in quantitative problem-solving skills in astrophysics and cosmology, complementing the broad topical overview presented in the lectures. The examination consists of five different ‘problem sets’. They are to be done by each student separately or in groups of at most four students. The first three are ordinary calculational problems. They are due two weeks after their distribution.

Only ONE of the problems from each problem set will be handed in for grading. It will be randomly selected on the deadline date. The fourth set consists of writing an essay on some subject in astrophysics/cosmology. **The deadline for the essay is one week after the last lecture.** The essay should be 2000-3000 words and its character should be advanced, i.e. it should be *a deepened study beyond the level of the course book*. It should be aimed towards the typical class-mate (and not some student with less knowledge in astrophysics/cosmology). The fifth problem set is a small research project. This project is not limited in time, but the main part should be carried out during the course. Your grade on this course corresponds to the total amount of achieved points on the five problem sets. Each problem set gives 0-3 points. You may receive 1 bonus point by presenting either your essay or project in front of the class.

Grade scale

3 (pass): 6.5-10 points, **4:** 10.5-13.5 points, **5:** 14-16 points

Course literature

B.W. Carroll, D.A. Ostlie, “An Introduction to Modern Astrophysics”,
Addison-Wesley (1996).

Time distribution

30 “lecture hours” (45 min) divided into 15 occasions.

Preliminary schedule

Lecture	Chapter	Content
1	Overview	Overview and introduction
2	2, 18	Overview (continued) The solar system Kepler's laws Newton's gravitational law The virial theorem
3	3, 5	Radiation Electromagnetic radiation Spectral lines Black body radiation
4	11	The Sun "Prototype star" Structure Interior Energy production Stellar models
5	Lecture notes	Distance measurements Radar ranging Parallax Cepheids Galaxy brightness Redshift
6	8, 13	Stars The Hertzsprung-Russel diagram Star populations The life of a star Supernovae
7	22, 23	Galaxies Introduction Milky way Galaxy classification
8	22	Galaxy rotations Observations Dark matter

Lecture	Chapter	Content
9	15, 16	Compact objects White/brown dwarfs Neutron stars Black holes MACHOs
10	25	Large scale structure Galaxies Galaxy clusters Superclusters Voids and filaments
11	26	Violent processes Active galaxies Quasars Active galactic nuclei (AGN)
12	27	Cosmology General relativity The expansion of the universe The "hot big bang" model
13	27	Cosmology Cosmological models Nucleosynthesis Cosmic microwave background radiation (CMBR)
14	28 + recent results	Cosmology The history of the universe Inflation The beginning?
15	-	Summary and conclusions Essay presentations