Luleå University of Technology
Division of Physics

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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, there is only time to present a basic, core material.

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
34 "lecture hours" (45 min) divided into 17 occasions.

Preliminary schedule

Lecture	Chapter	Content
1	Overview	**Overview and introduction**
2 - 3	2, 18	Overview (continued) The solar system Kepler's laws Newton's gravitational law The virial theorem
4	3, 5	**Radiation** Electromagnetic radiation Spectral lines Black body radiation
5	11	**The Sun** "Prototype star" Structure Interior Energy production Stellar models
6	Lecture notes	**Distance measurements** Radar ranging Parallax Cepheids Galaxy brightness Redshift
7	8, 13	**Stars** The Hertzsprung-Russel diagram Star populations The life of a star Supernovae
8	22, 23	**Galaxies** Introduction Milky way Galaxy classification
9	22	**Galaxy rotations** Observations Dark matter

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