SYLLABUS

ASTROPHYSICS

Academic year: 2019-2020
(Last Update: 05/07/2019)
(Approval in department concial: 23/05/2019)

MODULE	SUBJECT	YEAR	TERM	CREDITS	TYPE
Astrophysics	Astrophysics	4th	2nd	6	Optional

LECTURER(S)	CONTACT INFORMATION
Ute Lisenfeld Mónica Relaño	Dpto. Física Teórica y del Cosmos, planta baja, Edificio Mecenas. Office: 8 and 11 Telephone: 958242745, 958241723
	OFFICE HOURS
	Check: http://www.ugr.es/~fteorica/Docencia/Tutorias.php

DEGREE	OTHER SUITABLE DEGREES
Grado en Física (Physics Degree)	

PREREQUISITES and/or RECOMENDATIONS

It is recommended to have taken the course Fundamentals of Astrophysics and to have adequate knowledge on:

- Atomic and molecular physics
- Electromagnetism
- Optics
- Statistical physics
- Relativity

CONTENTS SUMMARY (AS IN MEMORIA DE VERIFICACIÓN DEL GRADO)

Stellar atmospheres, stellar evolution, interstellar medium, galactic dynamics, large scale structure, cosmology.

GENERAL AND SPECIFIC SKILLS

GENERAL SKILLS:
- CT1 Analytical and synthetic thinking.
- CT2 Planning and organizing.
- CT3 Oral and written communication.
- CT6 Problem solving.
- CT8 Critical reasoning.
- CT9 Independent learning.

SPECIFIC SKILLS:
- CE1 Knowledge of the most important physical theories and phenomena.
- CE5 Modelling of complex phenomena, transferring physical problems to a mathematical formalism.

GOALS (EXPECTED KNOWLEDGE BY THE END OF THE COURSE)

- Ability to use the knowledge acquired in different areas in a multidisciplinary field.
- Understanding stellar physics and the evolution of stars.
- Understanding astrophysics of galaxies and the interstellar medium.
- Understanding the different cosmological models.
- Get prepared for astrophysical research.
- Knowledge of the techniques of data acquisition and interpretation of astronomical data.
- Get familiar with astrophysical modelling techniques.

CONTENTS

THEORETICAL CONTENTS:

- **Topic 1: Radiative transport in stellar atmospheres.** Radiative transport equation. Formal solution. Local thermodynamical equilibrium (LTE). Diffusion approximation. Other solutions. Formation of spectral lines. Non-LTE.
- **Topic 2: Stellar structure, evolution and nucleosynthesis**. Characteristic stellar time-scales. Thermonuclear reaction. Energy transport in stars. Equations of stellar structure. Star formation and evolution. Compact objects and supernovae.
- **Topic 3: Morphology and classification of galaxies,** The Hubble classification of galaxies. Other classifications. The Milky Way. Interstellar medium: HI and HII regions, molecular clouds.
- **Topic 4: Galactic dynamics**. Rotation curve of spiral galaxies and dark matter. Stellar motion in galaxies. Lindblad resonances. Spiral arms and bars. Formation and evolution of galaxies.
- **Topic 5: Large scale structure of the Universe**. The Local Group. Galaxy clusters. Interaction of galaxies. Superclusters. Large scale structure of the universe.
- **Topic 6: Cosmology.** Cosmological models and equations. The Big Bang: inflation and primordial nucleosynthesis. Cosmic microwave background. Acceleration of the expansion of the Universe. Cosmological parameters: Inventory of matter and energy.

PRACTICAL CONTENTS:

Seminars
- Seminars given by professionals about current topics of interest in astrophysics.
- Seminars given by students about topics of their particular interest and/or topics that broaden the

content of the theoretical lectures.

Practical session and problems: One or several of the practical sessions will be carried out the students.

Practical session 1. Determination of the distance and age of stellar clusters.
Practical session 2. Calculation of models of the stellar structure of ZAMS.
Practical session 3. The distance-redshift relation of Hubble-Lemaitre.
Practical session 4. Large scale structure of the universe.

Problems and exercises related to the theoretical content of the lectures.

BIBLIOGRAPHY

BASIC BIBLIOGRAPHY:

- Böhm-Vitense, E.: Introduction to Stellar Astrophysics (Vol. 1-3). Cambridge University Press
- Bowers, R. Deeming, T.,: Astrophysics Vol. I & II. Jones and Bartlett Publishers Inc.
- Carroll, B.W., Ostlie, D.A.: "An introduction to Modern Astrophysics". Addison-Wesley Publishing Company
- Clayton, D.D.: Principles of Stellar Evolution and Nucleosynthesis. University Chicago Press.
- Gray, D.F.: The Observation and Analysis of Stellar Photospheres. Cambridge University Press
- Sparke, L.S., Gallagher, J.S.: Galaxies in the Universe. Cambridge University Press
- Schneider, P.: Extragalactic Astronomy and Cosmology, Springer Verlag

COMPLEMENTARY BIBLIOGRAPHY:

- Binney, J., Merrifield, M.: Galactic Astronomy. Princeton University Press.
- Binney, J., Tremaine, S., Galactic Dynamics, Princeton Series in Astrophysics
- Kippenhahn, R., & Weigert, A.: Stellar Structure and Evolution. Springer Verlag.
- Longair, M.S., Galaxy Formation. Springer Verlag

WWW LINKS

NASA/IPAC Extragalactic Database (NED): http//nedwww.ipac.caltech.edu
Astronomical Database: http://simbad.u-strasbourg.fr/simbad
Specialized astrophysical articles: http://adsabs.harvard.edu/abstract_service.html
Sociedad Española de Astronomía: http://www.sea-astronomia.es/
Instituto de Astrofísica de Andalucía: http://www.iaa.es/divulgacion/
Instituto de Astrofísica de Canarias: http://www.iac.es/divulgacion.php
Astronomy Picture of the Day: http://antwrp.gsfc.nasa.gov/apod/astropix.html

TEACHING METHODS

Class room activities (40%)

- Theoretical lectures (CT1, CT8, CE1) 1.2 ECTs
- Problem classes (CT1, CT2, CT3, CT6, CT8, CT9, CE1) 0.3 ECTs

- Practical classes/seminars and/or presentations (CT1, CT2, CT3, CT6, CT8, CT9, CE1, CE5) 0.8 ECTs
- Exams (CT1, CT2, CT3, CT6, CT8, CE1) 0.1 ECTs

Activities outside the classroom
- Studying theory and solving problems (CT1, CT2, CT6, CT8, CT10, CE1) 2.5 ECTs
- Preparation of presentations and practical sessions (CT1, CT2, CT3, CT6, CT10, CE1, CE5) 1.1 ECTs

ASSESSMENT (TOOLS, CRITERIA, WEIGHTS, etc)

The student assessment and final score will take into account the presentation of seminars, the work in problem solving and practical sessions and the final exam, in which the students have to show the skills acquired during the course.

- Exam: 60%
- Practical sessions and problems: 30-40%
- Seminars: 0-10%

The evaluation process in the extraordinary exam is the same as in the Final Assessment Test and allows the student to achieve 100% of the final score.

DESCRIPTION OF THE ASSESSMENT PROCEDURES THAT WILL BE REALIZED AS PART OF THE FINAL ASSESSMENT TEST THAT IS ESTABLISHED IN THE "NORMATIVA DE EVALUACIÓN Y DE CALIFICACIÓN DE LOS ESTUDIANTES DE LA UNIVERSIDAD DE GRANADA"

The students that, according to the rules of the UGR and within the fixed time frame, choose to have a final assessment test, will make a theoretical and a practical exam which will allow a complete assessment of their knowledge. The relative weight of both exams is the same as indicated above.

ADITIONAL INFORMATION