UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè
ACADEMIC YEAR	2019/2020
MASTER'S DEGREE (MSC)	PHYSICS
SUBJECT	ASTROPHYSICS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50338-Astrofisico, geofisico e spaziale
CODE	01500
SCIENTIFIC SECTOR(S)	FIS/05
HEAD PROFESSOR(S)	REALE FABIO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**REALE FABIO** Tuesday 12:30 14:30 Ufficio, Via Archirafi 36 Thursday 12:30 14:30 Ufficio, Via Archirafi 36

DOCENTE: Prof. FABIO REALE

PREREQUISITES	The prerequisites for profitable learning of astrophysics and for achieving the objectives which it is intended are astronomy, basic physics and calculus.
LEARNING OUTCOMES	Knowledge and understanding: Basic skills, including mathematical settings, on the physics of stellar atmospheres, plasma and optically thin radiation. Applying knowledge and understanding: The skills are preparatory to research insights in astrophysics. Making judgments: self-rating of a stellar spectrum and its components, setting up problems on Plasma Physics Communication skills: acquisition of astrophysicist language through direct interaction with the student in the examination Learning skills: Capacity and tools to undertake paths of research and analysis in the context of many astrophysical problems.
ASSESSMENT METHODS	The grading is based on the outcome of the oral exam, in which the student answers questions that range on all topics of the course. The answers can take advantage of writing down on paper. It is ascertained the knowledge, management, physical approach on the astrophysical topics, and the correct use of language and ability of expression. Grading: 30-30 cum laude: Excellent knowledge of the topics, excellent use of language, good analytical ability, the student is able to apply the knowledge to solve problems proposed 26-29: Good mastery of the subjects, full use of the language, the student is able to apply knowledge to solve problems proposed 24-25: Basic knowledge of the main topics, discrete properties of language, with limited ability to independently apply the knowledge to the solution of the proposed problems 21-23: He/she does not have full mastery of the main issues but he/she has knowledge, satisfactory use of the language, poor ability to independently apply the knowledge acquired 18-20: Minimum basic knowledge of the main topics and the technical language, very little or no ability to independently apply the knowledge acquired Insufficient: He/she does not have an acceptable knowledge of the contents of the topics covered in the course
EDUCATIONAL OBJECTIVES	The teaching aims at providing the student with knowledge regarding topics on Astrophysics, and in particular radiative transfer and stellar atmospheres, plasma physics and magnetohydrodynamics, and radiation from thin plasmas, appropriate to the master degree in Physics.
TEACHING METHODS	The course is half-year long and takes place in the second semester of the first year of CdLM in Physics. The teaching consists of lectures, highly interactive, divided into three parts, stellar atmospheres, plasma physics and optically thin plasma. During the lectures quantitative examples are illustrated. The exam is oral and individual after the end of the course.
SUGGESTED BIBLIOGRAPHY	Testi consigliati [Atmosphere Stellari/Stellar Atmospheres] - E. Boehm-Vitense, Introduction to Stellar Astrophysics: Vol.2, Stellar Atmospheres, Cambridge: Cambridge University Press; [Fisica del Plasma/Plasma Physics] - H. C. Spruit, Essential magnetohydrodynamics for astrophysics, http://www.mpa-garching.mpg.de/~henk/mhd12.pdf; Testi di approfondimento [Fisica del Plasma/Plasma Physics] - Porter Wear Johnson, Lectures in Plasma Physics, http://mypages.iit.edu/~johnsonpo/plasmaweb.pdf [Fisica del Plasma/Plasma Physics] -Alessandro Marconi, Fluidodinamica dei processi astrofisici, http://www.arcetri.astro.it/~marconi/Lezioni/IntAst15-16/Lezione08-Fluidi.pdf [Plasmi sottili/Thin Plasmas] - K. Phillips, Solar Radiation and Plasma Diagnostics, https://www.ucl.ac.uk/mssl/solar/summerschool13/lectures/SolarRadiationlecture.pdf, 2013

SYLLABUS

Hrs	Frontal teaching
2	Introduction: description, structure, content, exams, texts. Abstract: flux, magnitudes, classifications, temperatures
2	Stellar Atmospheres: Spectral colors. Radiative transfer: basic equation, source function, emission and absorption
2	Stellar Atmospheres: Transport in plane atmospheres, limb darkening

SYLLABUS

Hrs	Frontal teaching
2	Stellar Atmospheres: Fluxes, Eddington-Barbier relation, density of radiation
2	Stellar Atmospheres: Dependence of the transport on the depth: absorption trends, radiative balance
2	Stellar Atmospheres: Temperature curve, absorption processes, Boltzmann equation. Ionization: Saha equation
2	Stellar Atmospheres: Contributions of absorption in the continuum: edges of hydrogen, helium, other elements, Rayleigh and Thompson scattering
2	Stellar Atmospheres: Absorption in the continuum: diagnostics from the edge of Balmer, the spectrum distortion, color-color diagram
2	Stellar Atmospheres: Average absorption, pressure stratification
2	Stellar Atmospheres: Pressure with optical depth, electron pressure. Spectral lines: generalities.
2	Stellar Atmospheres: Spectral lines: optical depths in thin lines, natural broadening, thermal broadening, Voigt's profile
2	Stellar Atmospheres: Spectral lines: thin and thick lines, curve of growth
2	Stellar Atmospheres: Hydrogen lines; spectral analysis
2	Plasma physics: generalities, Debye length, plasma frequency
2	Plasma physics: ideal MHD, magnetic induction, induced current, Lorentz force
2	Plasma physics: Freezing plasma-field, Alfven theorem, amplification of the magnetic field, the magnetic pressure and tension
2	Plasma physics: magnetic tension tensor, total pressure, plasma beta
2	Plasma physics: force-free fields, twisting, helicity, onde: basic equations
2	Plasma physics: Alfven waves, magnetosonic waves
2	Plasma physics: Poynting flux, magnetic diffusion, application to solar corona
2	Plasma Physics: sound waves, shock waves
1	Plasma Physics: Rankine-Hugoniot conditions, Sedov waves, applications
2	Thin plasmas: equilibrium and Einstein relations, non-local thermal equilibrium
3	Thin plasmas: coronal emission, emission lines, emission measure, continuum emission, emission vs temperature, examples of thermal spectra of astrophysical plasmas