COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
Selected Topics in Astrophysics	

Lecturer(s)	Department(s) where the course unit (module) is delivered
Coordinator: dr. Arūnas Kučinskas **Other(s): dr. Kastytis Zubovas, dr. Donatas Narbutis, dr. Jonas Klevas, prof. dr. Vladas Vansevičius**	Faculty of Physics

Study cycle	Type of the course unit (module)
Second (Master course)	Optional

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
Face-to-face	Semester 3	Lithuanian/English

Requirements for students	
Prerequisites: Stellar Atmospheres, Specroscopic Instruments and Methods, Methods of Spectroscopic Analysis	**Additional requirements (if any): -**

Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
5	140	64	76

Purpose of the course unit (module): programme competences to be developed		
Aim of this course is to get the students acquainted with the research methods and softawere packages that are used in the modern studies of stars and stellar populations.		
Learning outcomes of the course unit (module)	**Teaching and learning methods**	**Assessment methods**
Comprehension of the physical principles that are used to build the one-dimensional hydrostatic and three-dimensional hydrydonamical model atmospheres.	Lectures, seminars, autonomous work	Cumulative mark of seminars, written and oral examination
Practical skills of using software packages for modelling stellar atmospheres and spectral synthesis computations.	Lectures, seminars, autonomous work	Cumulative mark of seminars, written and oral examination
Ability to model the observable properties of star clusters, skills to assess the reliability of the determined cluster evolutionary parameters.	Lectures, seminars, autonomous work	Cumulative mark of seminars, written and oral examination
Practical skills of using dynamical modeling tools for solving the N-body problems, knowldedge about the limitations of this approach and its practical uses for the interpretation of observational data.	Lectures, seminars, autonomous work	Cumulative mark of seminars, written and oral examination
Ability to critically assess the scientific importance of modern astrophysical problems and the stuitability of various research methods in their study.	Lectures, seminars, autonomous work	Cumulative mark of seminars, written and oral examination

Content: breakdown of the topics	Contact hours							Self-study work: time and assignments	
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work placement	**Contact hours**	**Self-study hours**	**Assignments**
1. Numerical models of stellar atmospheres. One-dimensional hydrostatic, three-dimensional hydrodynamical model atmospheres. Spectral synthesis. Software packages for modeling stellar atmospheres: ATLAS9 and CO5BOLD. Software packages for spectral synthesis: SYNTHE, MULTI, Linfor3D.	8		4		8		**20**	**24**	Analysis of the literature, preparation for the seminars and laboratory work
2. Initial mass function, modeling of the observable properties of star clusters, determination of cluster evolutionary parameters, reliability of the determined parameters. Clusters as indicators of star formation in galaxies. Formation of star clusters. Cluster populations in galaxies. Modeling of the cluster properties with the SimClust code, interpretation of the color-magnitude diagram, determination of structural and evolutionary parameters of star clusters. Modeling of cluster dynamical evolution with the Nbody6 code. The role of mass segragation and binary stars in shaping the cluster structure. Cluster kinematics in the gravitational field of the galaxy, tidal tails, collisions of clusters with molecular clouds.	8		4		10		**22**	**28**	Analysis of the literature, preparation for the seminars and laboratory work
3. Color-magnitude diagrams and spectra of stellar populations: theoretical background, observational data. Simple stellar populations (SSPs). Methods for the determination of metallicity, age, interstellar extinction, and distance of the SSPs. Composite stellar populations, methods for the investigation of their star formation histories. Unresolved stellar populations and methods for their studies. Modeling of the SSPs with the IAC-star code. Modeling of the composite stellar populations with the IAC-pop code.	8		4		10		**22**	**24**	Analysis of the literature, preparation for the seminars and laboratory work
Total	**24**		**12**		**28**		**64**	**76**	

Assessment strategy	Weight, %	Deadline	Assessment criteria
Examination	50%	Exam session	Understanding of the main course topics
Seminars	20%	Study semester	Undestanding of the seminar topic, ability to critically assess connections between the physical phenomena and processes discussed at the seminar, understanding of their role and importance in the broader astrophysical context
Laboratory work	30%	Study semester	Practical skills in using the software packages, understanding of the assigned research tasks for the laboratory work and and quality of the written summary of each assigned reaserach task

Author	Year of publication	Title	Issue of a periodical or volume of a publication	Publishing place and house or web link
Compulsory reading				
Hubeny, I., Mihalas, D.	2015	Theory of Stellar Atmospheres		Princeton University Press
Cassisi, S., Salaris, M.	2013	Old Stellar Populations		Wiley-VCH
		Scientific papers from various research journals (ARA&A, ApJ, AJ, MNRAS, AA, etc.)		
Optional reading				