SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER ODD 2022/2023

Physics Undergraduate Study Program

Physics Department

Introduction to Astrophysics and Cosmology

MFF 4043/ 3 Credits

Lecturer Coordinator:

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UNIVERSITAS GADJAH MADA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
2022

	Universitas Gadjah Mada Faculty of Mathematics and Natural Science Physics Department / Physics Undergraduate Study Program Semester ODD 2022/2023	**Document Number :** ……

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Code	Course Name	Credits (Credits)		Semester	Status	Prerequisite
MFF 4043	*Introduction to Astrophysics and Cosmology*	*T: 3*	*P: …*	*ODD*	*Elective*	*Core and Particle oh Physics I (MFF 2205)*

Short Description	The Introductory Course in Astrophysics and Cosmology is a 3 Credits elective course in the 2021 curriculum of the Gadjah Mada University Physics Study Program, which can be taken in odd semesters. To take this course, students are recommended to complete the Theory of Relativity and Core Physics and particle I courses. In the 2021 Curriculum of the Physics Undergraduate Study Program, this course is associated with competencies in Aspects of Knowledge (PLO 2), Aspects of Special Skills (PLO 4), and Aspects of Long-Life Learning/self-development (PLO 5).	
Program Learning Outcomes (PLO) Imposed on the Course	***PLO 2***	Knowledge. Able to explain theoretical concepts and principles of classical and modern physics and able to apply basic concepts of physics and related mathematical methods in finding solutions to physical problems.
	PLO 4	Special Skills. Able to design and carry out experiments/theoretical reviews, able to identify a physical problem based on the results of observations and experiments, and able to operate related technologies.
	PLO 5	Long Life Learning. Able to analyze various alternative solutions to physical problems and conclude them for appropriate decision-making, both in familiar and new problems.
Course Outcomes (CO)	**After completing this course, students are expected to be able to:**	
	CO1	Knowing and Understanding Stellar Astrophysics
	CO2	Knowing and understanding the Galaxy
	CO3	Knowing and understanding Cosmology

		Learning Materials	Learning Methods	Time Allocation
The Correlation of CO to Learning Materials and Methods, and Time Allocation	***CO 1***	Stellar Astrophysics: Continuous radiation from the stars (star brightness, star color, black body radiation, stellar distance, luminosity, and absolute magnitude)		***3X50 minutes***
	CO 1	Stellar Astrophysics: b. Line spectrum and its formation (Bohr-Summerfield atomic model, line spectrum formation, Hertzsprung-Russel diagram), Telescopes and other detectors (optical telescopes, other wavelength regions, neutrinos, and gravitational waves		***3X50 minutes***

	CO 1	Stellar Astrophysics: d. Binary stars and star parameters (Kepler's Laws, mass-luminosity relation, star radius)		***3X50 minutes***
	CO 1	Stellar Astrophysics: e. Star atmosphere and radiation transport, main sequence stars and stellar structure (stellar structure equations, Eddington luminosity and convective instability, Eddington standard model, stellar stability, stellar variables).		***3X50 minutes***
	CO 1	Stellar Astrophysics: Nuclear Processes in stars (Sources of energy in stars, fundamental interactions, thermonuclear reactions, significant nuclear combustion reactions, solar neutrinos)		***3X50 minutes***
	CO 1	Stellar Astrophysics: Endpoints of stellar evolution (Sirius B observations, degenerative Fermi gas pressure, Chandrasekar white dwarfs and limits, supernovae, pulsars, and Neutron stars)		***3X50 minutes***
	CO 1	Stellar Astrophysics: Black Holes (Schwarzschild metric, gravitational radiation from pulsars, thermodynamics, and evaporation of Black Holes).		***3X50 minutes***
	Midterm exam/Project Task Results/Case Analysis Results			
	CO 2	Galaxies: Star formation and interstellar medium (interstellar dust, interstellar gas, star formation)		***3X50 minutes***
	CO 2	Galaxies: Star clusters (evolved globular clusters, virial masses, Hetzsprung-Russel masses in clusters)		***3X50 minutes***
	CO 2	Galaxy: Galaxy (Milky Way, regular and active galaxies, non-thermal radiation)		***3X50 minutes***
	CO 3	Cosmology: a. An introduction to the universe on a large scale (problems on the static Newtonian universe, cosmological principles, expansion of the universe and Hubble's laws).		***3X50 minutes***
	CO 3	Cosmology: b. Cosmological model (Friedmann's equations, scale dependencies on various forms of energy, cosmological model with one energy component, ACDM model)		***3X50 minutes***
	CO 3	Cosmology: c. Young universe (thermal history of the universe, Big		***6X50 minutes***

		Bang Nucleosynthesis, structure formation, CMB, inflation)			
	Final exams/ Project Task Results/Case Analysis Results				
Learning Methods	**SCL (Student Centered Learning): Project-based learning (Team-based Project)/Case-based learning/PBL/other SCL methods**				
Student Learning Experience	**Listen, ask, answer questions and discuss**				
Access to Learning Media/ LMS and Offline and Online Percentage	Offline (LCD, PPT Slide, Whiteboard, Laptop) and Online (Zoom Meeting, Google Meet, Google Classroom)				

Assessment Methods and Synchronization with CO

Assessment Methods	Assessment Percentage	Criteria/ Indicators	CO1	CO2	CO3
Participatory Activity*					
Project Results/ Case Study Results/ PBL Results*					
Cognitive					
Assignment	**10**		√	√	√
Quiz	**10**		√	√	√
Midterm Exam	**40**		√	√	
Final Exam	**40**			√	√
Total	**100**				

*) can also be obtained from the Midterm or Final Exam as the result of participatory activities or project/ case study results. According to IKU 7, the percentage of project results/ case study/ PBL results is at least 50%.

References

Main References;

1. Arnab Rai Choudhuri, Astrophysics for Physicists, 2010, Cambridge University Press .
2. Francis Leblanc, An Introduction to Stellar Astrophysics, 2010, John Wiley and Sons, Ltd .
3. David Lyth, Cosmology For Physicists, 2017, Taylor & Francis Group, LLC .
4. Ryden, B. Introduction of Cosmology, 2016, Department of Astronomy, The Ohio State University .
5. Raine, D.J & Thomas, E.G, An Introduction To The Science Of Cosmology, 2001, IOP Publishing. .
6. M. Kachelrieß, A Concise Introduction to Astrophysics, 2011, Institutt for fysikk NTNU, Trondheim Norway.

Lecturers (*Team Teaching*)

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2. Romy Hanang Setya Budhi, S.Si., M,Sc., Ph.D.

Authorization	Date of Drafting	Lecturer Coordinator	Head of Curriculum Committee	Head of Study Program
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