SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER ODD 2022/2023

Physics Undergraduate Study Program

Physics Department

Nuclear and Particle Physics II

MFF 3206/ 2 Credits

Lecturer Coordinator:

UNIVERSITAS GADJAH MADA

FACULTY OF MATHEMATICS AND NATURAL SCIENCE

2022

<table>
<tr><td rowspan="2"></td><td rowspan="2" colspan="5">Universitas Gadjah Mada
Faculty of Mathematics and Natural Science
Physics Department / Physics Undergraduate Study Program
Semester ODD 2022/2023</td><td>Document Number :</td></tr>
<tr><td>…………</td></tr>
<tr><td colspan="7">SEMESTER LEARNING ACTIVITY PLANS (SLAP)</td></tr>
<tr><td>Code</td><td>Course Name</td><td colspan="2">Credits (Credits)</td><td>Semester</td><td>Status</td><td>Prerequisite</td></tr>
<tr><td>MFF 3206</td><td>Nuclear and Particle Physics II</td><td>T: 2</td><td>P: …</td><td>ODD</td><td>Compulsory</td><td>Nuclear and Particle Physics (MFF2205)</td></tr>
<tr><td>Short Description</td><td colspan="6">This course studies the dynamic properties of the nucleus, namely nuclear decay and reactions. Nuclear and Particle Decay: study decay, including general decay properties, alpha, beta, and gamma decay. Alpha decay includes Gamow Teller's theory, Decay conditions, energies and spectra, and nuclear states related to alpha emission. Beta decay includes Weak interactions, beta energy, spectrum, Decay conditions, classification of beta-rays, and nuclear states related to beta emission. Gamma decay includes Gamma energy and spectrum, Decay conditions, and classification of gamma rays. They study the interaction of radiation with matter: Gamma interaction with matter: absorption, photoelectric effect, Compton scattering, pair production, Bremsstrahlung, and electron conversion. Beta interaction with matter: range, ionization, and excitation. Alpha interaction with matter. Low energy reactions(direct nuclear reactions, compound reactions, cross-section nuclear reactions), Fission and Fusion Reactions, and High energy reactions(particle scattering reactions). Weak interaction and strong interaction: Weak interaction and strong interaction according to the old concept: Weak interaction according to the concept of Fermi theory, Strong interaction according to Yukawa's meson model. Weak interaction and strong interaction according to the new concept: Weinberg-Salam weak interaction according to the electroweak model. Strong interaction according to the quark model and QCD theory. Lagrangian Formalism, Symmetry, and Interaction: Lagrangian Formalism for elementary particle physics fields: Euler Lagrange equation for elementary particle fields. Noether's theorem for continuous symmetry. Lorentz symmetry and tera symmetry in Lagrangian. Discrete Symmetry in Elementary Particle Physics (PCT): Parity Symmetry, Charge Conjugation Symmetry. Time reversal symmetry. Standard model: Tera symmetry standard model, Matter particles and interacting carrier particles and their properties, Higgs mechanism for mass formation. Feynman diagram: Feynman diagram is a diagram of the continuity of various currents. Use of Feynman diagrams to understand elementary particle reactions qualitatively.</td></tr>
<tr><td rowspan="2">Program Learning Outcomes (PLO) Imposed on the Course</td><td>PLO 2</td><td colspan="5">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.</td></tr>
<tr><td>PLO 5</td><td colspan="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.</td></tr>
<tr><td rowspan="5">Course Outcomes (CO)</td><td colspan="6">After completing this course, students are expected to be able to:</td></tr>
<tr><td>CO1</td><td colspan="5">Describes the interaction of radiation with matter and uses it as a method for detecting nuclei.</td></tr>
<tr><td>CO2</td><td colspan="5">Describe radioactivity</td></tr>
<tr><td>CO3</td><td colspan="5">Explain the general properties of decay and alpha, beta and gamma decay.</td></tr>
<tr><td>CO4</td><td colspan="5">Explain the mechanism of weak and strong interaction based on old models: Yukawa's meson model for solid interactions and Fermi's weak interaction model.</td></tr>
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	CO5	Explain the mechanism of weak and strong interactions based on new models: the quark and QCD models for solid interactions and the Weinberg-Salam electroweak model for interactions.		
	CO6	Explaining Lagrangan's formalism in elementary particle physics.		
	CO7	Describe the various continuous symmetries in Lagrangian and their relationship to the continuous flow (Noether's theorem).		
	CO8	Qualitatively explain discrete symmetry in elementary particle physics, parity symmetry, charge conjugation, and time reversal (PCT).		
	CO9	Using Feynman diagrams qualitatively to analyze various kinds of elementary particle reactions.		
	CO10	Explain in outline the content of the particles and the properties of the particles in the standard model.		
	CO11	Describe the process of mass formation in the Higgs mechanism qualitatively.		
The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO1	Interaction of Radiation with matter	TCL-SCL mixed	***2X50 minutes***
	CO2	Radioactivity	TCL-SCL mixed	***2X50 minutes***
	CO3	Alpha decay	TCL-SCL mixed	***2X50 minutes***
	CO3	Gamma decay	TCL-SCL mixed	***4X50 minutes***
	CO3	Beta decay	TCL-SCL mixed	***4X50 minutes***
	Midterm exam/Project Task Results/Case Analysis Results			
	CO4	Weak interaction and strong interaction according to old theory.	TCL-SCL mixed	***2X50 minutes***
	CO5, CO7	Weak interaction and strong interaction according to the strong theory.	TCL-SCL mixed	***2X50 minutes***
	CO6	Lagrangian formalization for elementary particle physics.	TCL-SCL mixed	***2X50 minutes***
	CO8	Discrete Symmetry in Elementary Particle Physics.	TCL-SCL mixed	***2X50 minutes***
	CO10, CO11	Standard Models	TCL-SCL mixed	***2X50 minutes***
	CO9	Feynmann diagrams	TCL-SCL mixed	***2X50 minutes***
	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	**Learn to examine and study physical systems as well as examples of problem-solving procedures**			
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	Assessment Percentage	Criteria/ Indicators	CO										
				1	2	3	4	5	6	7	8	9	10	11
Assessment Methods and Synchronization with CO	**Participatory Activity***	**10**		√	√	√	√	√	√	√	√	√	√	√
	Project Results/ Case Study Results/ PBL Results*													
	Cognitive													
	Assignment	**15**		√	√	√	√	√	√	√	√	√	√	√
	Midterm Exam	**35**		√	√	√								
	Final Exam	**35**					√	√	√	√	√	√	√	√
	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. Arya, Atam H.,1966, Fundamental of Nuclear Physics, Allen and Bacon Inc.
2. Martin, R Brian, 2006, Nuclear and particle Physics, An Introduction, John Wiley & Sons, Ltd, England.
3. Krane, KS, 1988, Introductory Nuclear Physics, John Wiley & Sons.
4. Meyerhoff,W.E.,1989, Elemen of Nuclear Physics,McGraw Hill Book Co.
5. David Griffiths, 2004: Introduction to elementary particles, Wiley-VCH.

Lecturers (*Team Teaching*)

1. Dra. Eko Tri Sulistyani, M.Sc.
2. Dr. Mirza Satriawan

Authorization

Date of Drafting	Lecturer Coordinator	Head of Curriculum Committee	Head of Study Program
	Dra. Eko Tri Sulistyani, M.Sc.		*Dr. Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.*