SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER EVEN 2022/2023

Physics Undergraduate Study Program

Physics Department

Introduction to Particle Physics

MFF 3114/ 2 Credits

Lecturer Coordinator:

Mirza Satriawan, S.Si., M.Si., Ph.D.

UNIVERSITAS GADJAH MADA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
2022

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<tr><td rowspan="2"></td><td rowspan="2">Universitas Gadjah Mada
Faculty of Mathematics and Natural Science
Physics Department / Physics Undergraduate Study Program
Semester EVEN 2022/2023</td><td>Document Number :</td></tr>
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SEMESTER LEARNING ACTIVITY PLANS (SLAP)

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<tr><th>Code</th><th>Course Name</th><th colspan="2">Credits (Credits)</th><th>Semester</th><th>Status</th><th>Prerequisite</th></tr>
<tr><td>MFF 3114</td><td>Introduction to Particle Physics</td><td>T: 2</td><td>P: …</td><td>EVEN</td><td>Elective</td><td>Nuclear and Particle Physics II (MFF 3206)</td></tr>
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<tr><td>Short Description</td><td colspan="2">The Introduction to Particle Physics course (Courses) is an Optional 2 Credits (Theory) course in the 2022 Curriculum for the Physics Undergraduate Study Program, FMIPA UGM. The syllabus for this course is as follows: Elementary particles in the standard model. Elementary particle dynamics: electromagnetic interactions, weak interactions, and strong interactions. Relativistic Kinematics. Symmetry, group and conservation laws, flavor symmetry, C, P, and T symmetries. Bound states: Positronium, quarkonium, meson, and baryon. Cross-sections and half-life, Feynmann diagram calculations. Feynmann's rules for quantum electrodynamics, Quantum electrodynamics for hadrons and quarks. The Parton Model and Bjorken Scaling. Feynmann's rules for quantum chromodynamics asymptotic freedom. Weak interactions: weakly charged and neutral interactions for leptons and quarks. Electroweak bonding. Formulation of the local Tera field theory, the mass term, and the Higgs mechanism.
Learning is carried out based on a face-to-face schedule in class for 14 weeks, with meetings held for 2 x 50 minutes each week. Four weeks during the lecture period are used for Mid Semester Examinations and Final Semester Examinations, each of which is held on a scheduled basis for two weeks. Evaluation for students for course assessment is carried out in a summative and formative manner. This is manifested in the form of written exams, both Mid Semester Examinations and Final Semester Examinations, which take a maximum of 120 minutes. The formative evaluation is manifested as independent assignments for each student. The form of independent activity is the form of completing an assignment/homework given to students to complete independently. The monitoring process is carried out by looking at student activities during the lecture, such as attendance at lectures, questions and answers and discussion of the material being presented, and student performance in carrying out independent assignments in the form of homework given.</td></tr>
<tr><td rowspan="2">Program Learning Outcomes (PLO) Imposed on the Course</td><td>PLO 2</td><td>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>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="2">Course Outcomes (CO)</td><td colspan="2">After completing this course, students are expected to be able to:</td></tr>
<tr><td>CO1</td><td>Students can explain concepts and solve cases in elementary particles in standard models. Elementary particle dynamics: electromagnetic interactions, weak interactions, and strong interactions., Relativistic kinematics. Group symmetry and conservation law, flavor symmetry, C, P, and T symmetry, Bond states Positronium, quarkonium, meson, and baryon.</td></tr>
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<tr><td rowspan="3"></td><td>CO2</td><td colspan="3">Students can explain concepts and solve cases in cross-section and half-life, calculate Feynmann diagrams, Feynmann rules for quantum electrodynamics, Quantum electrodynamics for hadrons and quarks, Parton Model, and Bjorken Scaling.</td></tr>
<tr><td>CO3</td><td colspan="3">Students can explain concepts and solve cases in Feynmann's Rules for Quantum Chromodynamics and Asymptotic Freedom. Weak interactions: weakly charged and neutral interactions for leptons and quarks.</td></tr>
<tr><td>CO4</td><td colspan="3">Students can explain concepts and solve cases in electroweak unification, Lagrangian formulations, local Tera field theory, Mass terms, and the Higgs mechanism.</td></tr>
<tr><td rowspan="17">The Correlation of CO to Learning Materials and Methods, and Time Allocation</td><td></td><td>Learning Materials</td><td>Learning Methods</td><td>Time Allocation</td></tr>
<tr><td>CO 1</td><td>Elementary particles in the standard model. Elementary particle dynamics: electromagnetic interactions, weak interactions, and strong interactions.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 1</td><td>Relativistic Kinematics. Symmetry, group and conservation law, flavor symmetry, C, P, and T symmetry.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 1</td><td>Bound states: Positronium, quarkonium, meson and baryon.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 2</td><td>Cross-section and half-life, Feynmann diagram calculations.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 2</td><td>Feynmann's rules for quantum electrodynamics,</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 2</td><td>Quantum electrodynamics for hadrons and quarks.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 2</td><td>The Parton Model and Bjorken Scaling.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td colspan="4">Midterm exam/Project Task Results/Case Analysis Results</td></tr>
<tr><td>CO 3</td><td>Feynmann's rules for quantum chromodynamics,</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 3</td><td>Asymptotic freedom.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 3</td><td>Weak interactions: weakly charged and neutral interactions for leptons and quarks.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 4</td><td>Electroweak bonding.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 4</td><td>The formulation of the ban</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 4</td><td>Local Tera field theory</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 4</td><td>The mass term and the Higgs mechanism.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td colspan="4">Final exams/ Project Task Results/Case Analysis Results</td></tr>
<tr><td>Learning Methods</td><td colspan="4">SCL (Student Centered Learning): Project-based learning (Team-based Project)/Case-based learning/PBL/other SCL methods</td></tr>
<tr><td>Student Learning Experience</td><td colspan="4">Learn to analyze and study: Elementary particles in the standard model. Elementary particle dynamics: electromagnetic interactions, weak interactions, and strong interactions., Relativistic Kinematics. Symmetry, group and conservation laws, flavor symmetry, C, P, and T symmetries., Bonded states: Positronium, quarkonium, mesons, and baryons., Cross-sections and half-lives, Feynmann diagram calculations., Feynmann's rules for quantum electrodynamics, Quantum</td></tr>
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	electrodynamics for hadrons and quarks., Parton's Model and Bjorken Scaling., Feynmann's Rules for Quantum Chromodynamics, Asymptotic Freedom., Weak interactions: weakly charged and neutral interactions for leptons and quarks., Weak electro-coupling., Infringement formulations, Local Tera field theory, Mass tribe, and Higgs mechanism.
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	CO1	CO2	CO3	CO4
Assessment Methods and Synchronization with CO	**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. David J. Griffiths, 2008, Introduction to Elementary Particles, 2nd edition, John Wiley and Sons.. 2. Donald H. Perkins, 2000, Introduction to High Energy Physics, 4th edition Cambridge Univ. Press..
Lecturers (*Team Teaching*)	1. Mirza Satriawan, S.Si., M.Si., Ph.D.

	Date of Drafting	Lecturer Coordinator	Head of Curriculum Committee	Head of Study Program
Authorization		*Mirza Satriawan, S.Si., M.Si., Ph.D.*		*Dr. Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.*