SEMESTER LEARNING ACTIVITY PLANS
(SLAP)
SEMESTER ODD 2022/2023

Group Theory for Physicist

MFF5005 / 2 Credits

Lecturer Coordinator:

Dr.rer.nat. Muhammad Farchani Rosyid, M.Si.

UNIVERSITAS GADJAH MADA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
2022

Universitas Gadjah Mada
Faculty of Mathematics and Natural Science
Physics Department / Study Program Master Physics
Semester Odd 2022/2023

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (credits)	Semester	Status	Prerequisite
MFF5005	*Group Theory for Physicist*	*2*	*Odd*	*Elective*	*None*

Short Description

Group Theory for Physicist course is Elective course 2 credits (Theory) in the 2022 Curriculum Master Physics Study Program, Faculty of Mathematics and Natural Science UGM.

The syllabus of this course is as follows:
1. Semigroups and groups: Binary operations, binary operation associations, semigroups, identity elements, inverse elements, group boundaries, examples of important groups in physics, subgroups, characterization of subgroups, normal subgroups, conjugations, and conjugate classes, costs, factor groups, direct product, semi-direct product.
2. Homomorphism: Limitation of homomorphism, isomorphism, homomorphism properties, homomorphism kernel, homomorphism shadow, factor group of homomorphism, representation (representative).
3. Action Group: action limitation, action kernel, stabilizer, rigid point, action orbit, free action, effective action, transitive action, action effect bijection.
4. Matrix Lie Groups: matrix sequence convergence, Matrix Lie group boundary, examples, exponential matrix, matrix exponential properties, how to calculate exponential matrix, single parameter subgroups, single parameter subgroup generator, Lie Matrix Algebra, and its properties.
5. Representation theory: group representation, representative space, dimensional representation, representative reduction, Schur's lemma, matrix representation, unitary representation, regular representation.
6. Applied in physics: applied in quantum mechanics, applied in crystals, applied in particle physics, applied in geometric mechanics.

The courses are held in class for 14 weeks, each week's session last for 2 x 50 minutes. Four weeks of course period is used for Midterm Exam and Final Exam, each held for two weeks as scheduled.

Student evaluation for course assessments is performed summative and formative. The summative evaluation is implemented as written exams, both Midterm and Final Exam, which take a maximum of 120 minutes. The formative evaluation is implemented as individual assignments for each student in the form of completing an assignment individually. Monitoring is carried out by observing student activities during the course, such as attendance, Q&A and discussion about the material presented, and student performance in completing individual assignments.

Program Learning Outcomes (PLO) Imposed on the Course

PLO 3	Mastering further knowledge of classical and modern physics theory, and its relationship with other disciplines, and has mastered an advanced field of physics specialization that allows him to keep up with the latest international research developments.
PLO 4	Mastering various mathematical disciplines related to an advanced field of physics, and able to develop physical models using various mathematical and computational tools with an inter or multidisciplinary approach to solving problems related to an advanced field of physics.

	PLO 6	Able to apply knowledge to analyze, synthesize, formulate problems and solve problems comprehensively in one of advanced field of physics, through experimental or theoretical research, then be able to classify and draw conclusions about their findings for the development of science and technology.

Course Outcomes (CO)	**Upon completion of this course, students should be able to:**	
	CO1	Understand and master the basic concepts of group theory and important examples in physics.
	CO2	Understand and master the concepts of homomorphism and group isomorphism.
	CO3	Understand and master the concept of group action and its types and group representation theory.
	CO4	Understand and master the concept of group and matrix Lie algebra along with their properties as well as important examples that are well-known in their application in physics.
	CO5	Understand the application of group theory in modeling, explaining, and solving problems in physics.
	CO6	
	CO7	
	CO8	

The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO1			2 x 50 minutes
	CO1			2 x 50 minutes
	CO1			2 x 50 minutes
	CO2			2 x 50 minutes
	CO2			2 x 50 minutes
	CO2			2 x 50 minutes
	CO2			2 x 50 minutes
	CO3			2 x 50 minutes
	CO3			2 x 50 minutes
	CO3			2 x 50 minutes
	CO4			2 x 50 minutes

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<tr><td></td><td>CO4</td><td></td><td></td><td>2 x 50 minutes</td></tr>
<tr><td></td><td>CO4</td><td></td><td></td><td>2 x 50 minutes</td></tr>
<tr><td></td><td>CO4</td><td></td><td></td><td>2 x 50 minutes</td></tr>
<tr><td></td><td colspan="4">Final Exam/ Project Task Results/ Case Analysis Results</td></tr>
<tr><td>Learning Methods</td><td colspan="4"></td></tr>
<tr><td>Student Learning Experience</td><td colspan="4">Learn to analyze and review: , , , , , , , , , , , , , .</td></tr>
<tr><td>Access to Learning Media/ LMS and Offline and Online Percentage</td><td colspan="4"></td></tr>
<tr><td>Assessment Methods and Synchronization with CO</td><td colspan="4">
<table>
<tr><th>Assessment Methods</th><th>Assessment Percentage</th><th>Criteria/Indicators</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Participatory Activity*</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project Results/ Case Study Results/ PBL Results*</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="7">Cognitive</td></tr>
<tr><td>Assignment</td><td>30%</td><td></td><td>7,5%</td><td>7,5%</td><td>7,5%</td><td>7,5%</td></tr>
<tr><td>Quiz</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Midterm Exam</td><td>35%</td><td></td><td>17,5%</td><td>17,5%</td><td></td><td></td></tr>
<tr><td>Final Exam</td><td>35%</td><td></td><td></td><td></td><td>17,5%</td><td>17,5%</td></tr>
<tr><td colspan="7">*) 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%.</td></tr>
</table>
</td></tr>
<tr><td>References</td><td colspan="4">Main references:
1. Brian C. Hall, 2015, Lie groups, Lie algebras, and representations: an elementary introduction, Substation Text in Mathematics 222, Springer Verlag, Berlin.
2. J. F. Cornwell, 1999, Group Theory in Physics, Academic Press, New York.</td></tr>
<tr><td>Lecturers (Team Teaching)</td><td colspan="4">1. Dr.rer.nat. Muhammad Farchani Rosyid, M.Si.
2.
3.
4.</td></tr>
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Authorization	Date of Drafting	Lecturer Coordinator	Head of Curriculum Committee	Head of Study Program
		Dr.rer.nat. Muhammad Farchani Rosyid, M.Si.	Dr.Ing. Ari Setiawan	Mirza Satriawan, M.Si., Ph.D