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

Topology and Geometry for Physicist

MFF5007 / 2 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 / Study Program Master Physics Semester Odd 2022/2023

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (credits)	Semester	Status	Prerequisite
MFF5007	*Topology and Geometry for Physicist*	*2*	*Odd*	*Elective*	*None*

Short Description

Topology and Geometry 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:
Topology: Limitations of topology and topological space, open and closed set, examples of topological space, inheritance topology, product topology, closed set properties, mapping between topological spaces, homeomorphism, topological invariance, connectivity, compactness. Differentiable assortment: map or local coordinate system with n dimensions in topological space, differentiable assortment: map or local coordinate system with dimensions in topological space, compatibility of two local coordinate systems, atlas in topological space, the equivalence of two atlases, differential structure and differential diversity concept, differential mapping, differentiated functions, differential curves, local representation or coordinate representation of differential mapping, Lie group limitation.
Vector fields and covector fields: tangent vectors, tangent spaces, companion tangent spaces, covectors, local representatives of tangent vectors and covectors, tangent strands and covectors, vector fields and covector fields, integral curves, single parameter local groups, systems of differential equations, distributions, manifold integral distribution.Tensor fields: tensors, covariance and contravariant tensors, tensor algebra, tensor space, tensor strands, tensor fields. Pseudo-Riemann geometry: tensor metric fields, pseudo-Riemann metrics, and their properties, curve lengths, energy functions, geodesics, Christoffel symbols, metric connections and covariance derivatives, Riemann curvature tensor fields, Ricci tensors, Ricci scalars.
Connections and curvature: general connections on tangent strands, general covariance derivatives, curvature, and Riemann curvature tensor, torsion and torsion tensor fields, Ricci tensor fields and Ricci scalars, Bianchi identity.
Applied Physics: space-time theory and 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 and main theorems of topology.
	CO2	Understand and master the concept of continuous mapping between topological spaces, homeomorphisms, and their properties.
	CO3	Understand and master the concepts of coordinate systems, atlases, differential structures, and differential manifolds.
	CO4	Understand and master the concept of differentiability mapping between differentiable manifolds.
	CO5	Understand and master the concepts of curves, functions (scalar fields), tangent vectors, covectors, tangent bundles and companion tangents, vector fields and covector fields.
	CO6	Understand and master the concept of tensors, tensor strands on a manifold, and tensor fields.
	CO7	Understand and master semi-Riemannan geometry and symplectic geometry.
	CO8	Understand and master the role and application of geometry in physical studies: general relativity and geometric mechanics.

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
	CO4			2 x 50 minutes
	CO4			2 x 50 minutes
	CO4			2 x 50 minutes
	Final Exam/ Project Task Results/ Case Analysis Results			

Learning Methods	
Student Learning Experience	Learn to analyze and review: , , , , , , , , , , , , , .
Access to Learning Media/ LMS and Offline and Online Percentage	
Assessment Methods and Synchronization with CO	

Assessment Methods	**Assessment Percentage**	**Criteria/Indicators**	**CO1**	**CO2**	**CO3**	**CO4**
Participatory Activity*						
Project Results/ Case Study Results/ PBL Results*						
Cognitive						
Assignment	30%		7,5%	7,5%	7,5%	7,5%
Quiz						
Midterm Exam	35%		17,5%	17,5%		
Final Exam	35%				17,5%	17,5%

*) 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:** Jeffrey M. Lee, 2009, Manifolds and Geometry Differential, Graduate Studies in Mathematics 104, American Mathematical Society, New York.
Lecturers	1. Dr.rer.nat. Muhammad Farchani Rosyid, M.Si.

(*Team Teaching*)	2. 3. 4.			
Authorization	**Date of Drafting**	**Lecturer Coordinator**	**Head of Curriculum Committee**	**Head of Study Program**
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