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

Physics Undergraduate Study Program

Physics Department

Mathematical Physics I

MFF 1020/ 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 :** ……………

SEMESTER LEARNING ACTIVITY PLANS (SLAP)					
Code	**Course Name**	**Credits (Credits)**		**Semester**	**Status**	**Prerequisite**
MFF 1020	*Mathematical Physics I*	*T: 3*	*P: …*	*ODD*	*Compulsory*	*None*

Short Description	Mathematical Physics I course is a compulsory subject for the Bachelor of Physics study program at Gadjah Mada University. This course can be taken by students in the even semester of their first year of study with the approval of the instructor. Before taking this course, students are strongly advised to take the Calculus course. This is because, in Mathematical Physics I (and Mathematical II and III) courses, Calculus is used as a foundation to understand Mathematics (for) Physics better so that it will make it easier to understand Physics and Advanced Physics. By studying Mathematical Physics I (II and III) as an instrument, students are expected to understand better the theoretical foundations of various Physics and Advanced Physics phenomena.

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.

Course Outcomes (CO)	**After completing this course, students are expected to be able to:**	
	CO1	Explain the concepts of Complex Algebra, Complex Roots, Powers of Complex Numbers, and Trigonometric Functions and their hyperbolic functions.
	CO2	Explain Harmonic Series and Complex Series.
	CO3	Explain Partial Derivative, Total Derivative, and Height/Extremum Value Derivation.
	CO4	Explaining two-dimensional (parabola, ellipse, and hyperbola) and three-dimensional (paraboloid, ellipsoidal, and hyperboloidal) Geometry analytics.
	CO5	Explains Vector algebra, dot product, and cross product.
	CO6	Explains vector calculus, vector derivation, and integration.
	CO7	Explaining vector, gradient, divergence, and rotation operators and cylindrical and spherical coordinates.
	CO8	Explain the integration of lines, planes, and volumes.
	CO9	Explain gradient integration, divergence, and rotation as well as Stokes' theorem and Gauss' theorem.

The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO 1	1. Introduction (Lecture rules, exams, and assessments). 2. Complex numbers (concept of complex numbers, complex number algebra, complex	TCL-SCL mixed	*3X50 minutes*

		conjugates, polar representation,		
CO 1	de Moivre's theorem, complex roots, polynomial equations, logarithms, and powers of complex numbers	TCL-SCL mixed	*3X50 minutes*
CO 1	hyperbolic functions: definition, hyperbolic trigonometric functions, hyperbolic identities, hyperbolic equations, inverse hyperbolic functions, calculus of hyperbolic functions),	TCL-SCL mixed	*3X50 minutes*
CO 2	Series, harmonic or complex series.	TCL-SCL mixed	*3X50 minutes*
CO 3	Partial Derivatives (multivariable functions, definitions of partial derivatives, total and differential derivatives, exact and inexact differentials, essential theorems, chain rule, variable changes, Taylor series, extreme values),	TCL-SCL mixed	*3X50 minutes*
CO 4	Analytical Geometry (curves and surfaces, parametric, implicit, and explicit equations.	TCL-SCL mixed	*3X50 minutes*
CO 4	Conic sections (parabola, hyperbola, ellipse), three-dimensional shapes (parabola, hyperbola, ellipsoid, spheroid).	TCL-SCL mixed	*3X50 minutes*
Midterm exam/Project Task Results/Case Analysis Results			
CO 5	Vector Algebra (scalars and vectors, vector addition and subtraction, multiplication by scalars, basis vectors and vector components, magnitude of a vector, dot product, cross product, equation of line, equation of plane, surface of a sphere, determining distance to vector, reverse vector),	TCL-SCL mixed	*3X50 minutes*
CO 6	Vector calculus (vector derivative concerning a parameter, vector integration concerning a parameter, curves, and surfaces in space, vector fields and scalar fields, isoscalar surfaces,	TCL-SCL mixed	*3X50 minutes*
CO 7	Vector operators: gradient, divergence, rotation. important formulas, cylindrical coordinates and spherical coordinates, curved coordinate systems,	TCL-SCL mixed	*3X50 minutes*
CO 8	Line and surface integrals, connectivity of a region, Green's	TCL-SCL mixed	*3X50 minutes*

	CO 8	Integral forms of gradient, divergence, and rotation	TCL-SCL mixed	*3X50 minutes*
		theorem on a plane, sustainable and potential fields, volume integral		
	CO 8	Integral forms of gradient, divergence, and rotation	TCL-SCL mixed	*3X50 minutes*
	CO 9	(continued) gradient, divergence, and integral rotation forms.	TCL-SCL mixed	*3X50 minutes*
	CO 9	Stokes and Gauss theorem	TCL-SCL mixed	*3X50 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	**Listen and understand, ask questions (discussion), and download teaching materials (copy slides).**
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**	**CO**								
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Participatory Activity*											
	Project Results/ Case Study Results/ PBL Results*											
	Cognitive											
	Assignment	**20**		√	√	√	√	√	√	√	√	√
	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. K. F. Riley, M. P. Hobson and S. J. Bence, 2006, Mathematical methods for physics and engineering, edisi ketiga, Cambridge University Press, Cambridge. . 2. Tom M. Apostol, Calculus, jilid I, edisi kedua, John Wiley & Sons, 1967.. 3. Tom M. Apostol, Calculus, jilid II, edisi kedua, John Wiley & Sons, 1967. . **Additional References:** 1. Boas, M.L., 1983, Mathematical Methods in the Physical Sciences, edisi 2, John Willey & Sons, NY. 2. Thomas G.B. dan Finney R.L., 1995, Calculus and Analytic Geometry, Addison Wesley.

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