SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER EVEN 2022/2023

Physics Undergraduate Study Program

Physics Department

Thermodynamics

MFF 1053/ 3 Credits

Lecturer Coordinator:

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

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 EVEN 2022/2023	**Document Number :** …………

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (Credits)		Semester	Status	Prerequisite
MFF 1053	*Thermodynamics*	*T: 3*	*P: …*	*EVEN*	*Compulsory*	*Basic Physics I (MFF1011), Calculus I (MMM1101), Mathematical Physics II (MFF1021)*

Short Description	Thermodynamics is the science of transferring, transforming, and storing energy. Thus, to understand the workings of various tools based on processes involving the transfer, transformation, and storage of energy, it is necessary to master the science of thermodynamics. The science of Thermodynamics is based on experiments. The physical laws in thermodynamics are compiled from observation and experience, so physical quantities, called macroscopic quantities, are generally physical quantities that can be measured. Macroscopic quantities of a thermodynamic system can be related to microscopic quantities, which are the properties or behavior of the atoms or molecules that make up the system, with a branch of science called Statistical Thermodynamics. For students very close to engineering science, thermodynamics that is suitable to be presented is engineering thermodynamics, which analyzes thermodynamic systems with macroscopic quantities without discussing statistical mechanics, or statistical thermodynamics in detail. The prerequisite for this course is the Physics Concept course, with the code MFF1000. Thus, the depth level of this Thermodynamics course, with the code MFF 1051, is slightly higher than Basic Physics but does not reach Thermodynamics which contains statistics, because to get to that level, adequate prerequisites for Basic Physics and Calculus are required.

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 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.
Course Outcomes (CO)	**After completing this course, students are expected to be able to:**	
	CO1	Students can describe the state of balance of a system and the dynamics of its changes to changes in related variables.
	CO2	Students can describe typical processes in changing the state of a system (forms: solid, liquid, and gas) in 2D diagrams.
	CO3	Students can use exact and inexact differential equations to solve the problem of changing the system's state.
	CO4	Students can apply the Laws of Thermodynamics I in reversible and non-reversible processes and their use in thermodynamic machines.
	CO5	Students can apply the Laws of Thermodynamics II and the TDS Equation in calculating the entropy change of the universe and its use in thermodynamic machines.
	CO6	Students can apply the concept of Thermodynamic Potential (including free energy and enthalpy) and its role in thermodynamic systems.

		Learning Materials	Learning Methods	Time Allocation
The Correlation of CO to Learning Materials and Methods, and Time Allocation	***CO 1***	Basic Concepts: (1). System, environment, boundary. Definitions: Thermodynamic equilibrium: Macroscopic quantities. (2). State of a thermodynamic system Processes and cycles Basic principles of temperature, scale, and temperature measurement, Hk. 0th thermodynamics. (3). Pressure, Energy	TCL-SCL mixed	***3X50 minutes***
	CO 1	Basic Concepts: (1). System, environment, boundaries. Definitions: Thermodynamic equilibrium: Macroscopic quantities. (2). The state of a thermodynamic system Processes and cycles Basic principles of temperature, scale, and temperature measurement, Hk. 0th thermodynamics. (3). Pressure,Energy	TCL-SCL mixed	***3X50 minutes***
	CO 2	Equation of State	TCL-SCL mixed	***3X50 minutes***
	CO 2	Situation Equation	TCL-SCL mixed	***3X50 minutes***
	CO 3	(1). Partial Derivative. (2). Application of Partial Derivatives to Thermodynamic Systems: Coefficients of Cubic Expansion and Condensation. (3). Exact differential	TCL-SCL mixed	***3X50 minutes***
	CO 4	(1). Work or Effort (2). Internal Power (Dakhil Power) (3). Heat / Heat Flow (4). Heat capacity, specific heat (5). First Law of Thermodynamics (6). Adiabatic Process (7). Carnot cycle.	TCL-SCL mixed	***3X50 minutes***
	CO 4	(1). Work or Effort (2). Internal Energy (Dakhil Energy) (3). Heat Flow / Heat (4). Heat capacity, specific heat (5). First Law of Thermodynamics (6). Adiabatic Process (7). Carnot Cycle.	TCL-SCL mixed	***3X50 minutes***
	Midterm exam/Project Task Results/Case Analysis Results			

	CO 5	2nd Law of Thermodynamics	TCL-SCL mixed	***3X50 minutes***
	CO 5	Entropy	TCL-SCL mixed	***3X50 minutes***
	CO 5	Statements about the 2nd Law of Thermodynamics	TCL-SCL mixed	***3X50 minutes***
	CO 5	Thermodynamic machines	TCL-SCL mixed	***3X50 minutes***
	CO 6	Helmholtz function and Gibbs function	TCL-SCL mixed	***3X50 minutes***
	CO 6	balance and terms	TCL-SCL mixed	***3X50 minutes***
	CO 6	3rd Law of Thermodynamics	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	**(1) Reading and studying texts, mandatory and supporting reading materials.** **(2) Doing tasks.** **(3) Participate in class discussion.**			
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	CO1	CO2	CO3	CO4	CO5	CO6
Participatory Activity*	**10**		√	√	√	√	√	√
Project Results/ Case Study Results/ PBL Results*	**15**		√	√	√	√	√	√
Cognitive								
Assignment	**10**		√	√	√	√	√	√
Quiz	**10**		√	√	√	√	√	√
Midterm Exam	**25**		√	√	√	√	√	√
Final Exam	**30**		√	√	√	√	√	√
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%.

<table>
<tr><td rowspan="1">References</td><td colspan="4">Main References;
1. Greiner, W., dkk. 1997, Thermodynamic and Statistical Mechanics, Springer, New York..
2. Sears, F.W.,and Salinger, G.L, 1982, Thermodynamics, Kinetic Theory, and Statistical Thermodynamics, Addison-Wesley, Reading, massachussetts. .
3. Zemansky,M.W., dan Ditman, 1984, Heat and Thermodynamics, McGraw-Hill, New York..
4. Dimsiki Hadi, Termodinamika, Diktat LPTK.</td></tr>
<tr><td>Lecturers (Team Teaching)</td><td colspan="4">1. Prof. Dr. Harsojo, SU., M.Sc.
2. Mirza Satriawan, S.Si., M.Si., Ph.D.</td></tr>
<tr><td rowspan="2">Authorization</td><td>Date of Drafting</td><td>Lecturer Coordinator</td><td>Head of Curriculum Committee</td><td>Head of Study Program</td></tr>
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