SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER EVEN 2022/2023

Physics Undergraduate Study Program

Physics Department

Solid State Physics I

MFF 2601/ 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 / Physics Undergraduate Study Program Semester EVEN 2022/2023	**Document Number :** ……

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Code	Course Name	Credits (Credits)		Semester	Status	Prerequisite
MFF 2601	*Solid State Physics I*	*T: 2*	*P: …*	*EVEN*	*Compulsory*	*Quantum Physics I (MFF2034)*
Short Description	The Solid State Physics I course is a compulsory subject for the Bachelor of Physics study program at Gadjah Mada University, which is the first part of a series of Solid Substance Physics lectures. Students can take this course in the odd semester of the third year of study or earlier with the supervisor's approval. Before taking this course, students must have passed the Quantum Physics I course (MFF 2034). A deep understanding of Solid Matter Physics is needed for a physics student, especially those who will study Condensed Matter Physics and Applied Physics. With the Solid State Physics I course, students are expected to be able to understand the theoretical basis of various phenomena that occur in solid systems and be able to apply them to a particular case involving solid systems. Solid-state physics is a part or branch of the study of condensed matter physics, which specializes in solid-state systems. The study of the properties of solids will involve atomic-scale phenomena, so quantum physics will play a significant role. The fundamental theories that apply to solid-state systems are the theoretical basis underlying materials science, which also has direct applications, for example, in electronic, magnetic, thermo-, and optoelectronic device technology, and so on. Solid materials are composed of atoms in a specific pattern that interact with each other. This interaction produces several essential properties closely related to their use in today's technology, namely mechanical properties (hardness and elasticity) and thermal, electrical, magnetic, and optical properties of solids. Depending on the materials involved and the conditions under which they are formed, the atoms can be arranged in specific geometric patterns to form crystalline solids or irregular systems found in amorphous solids. Much of Solid-State Physics focuses on crystalline systems because crystalline materials have electrical, magnetic, optical, or mechanical properties that can be exploited for engineering purposes. To assist students in understanding the topic of study in this lecture, the process of deepening the lecture material is also often added with visual depictions to reduce the difficulty of abstraction in understanding the lecture material. In addition, the learning process is regularly equipped with the provision of assignments or homework or assignments to students to improve problem-solving skills and understanding of course material. Learning is carried out based on a face-to-face schedule in class for 14 weeks, with each week consisting of 100 minutes. 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 by the Academic Section of FMIPA UGM. Evaluation for students for course assessment is carried out summatively and formatively. This is manifested in the form of written exams, both the Mid-Semester Examination and the Final Semester Examination, which take a maximum of 120 minutes. The formative evaluation is realized through independent assignments for each student. The form of independent activity is completing an assignment given to students to be discussed in groups and then completed independently at home in the form of a written report for each assignment. The monitoring process is carried out by looking at student activities during the lecture, such as attendance at lectures, questions and answers and discussions on the material being presented, and student performance in carrying out independent assignments in the form of homework given.					

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 have the ability in Physics Skills, namely how to formulate and describe (to describe) the physical phenomena being studied and reveal important information in the physics problem through various tricks or specific mathematical procedures and utilizing various approaches (approximations).		
	CO2	Students have the ability in Analytical Skills, namely how to pay attention to physics problems in detail, analyze problems and build arguments logically and carefully.		
	CO3	Students have the ability in Investigative Skills, namely how to search for physics problems from various sources and references to understand important information.		
	CO4	Students have the ability in Problem-Solving Skills, namely how to solve a problem with a structured solution (well-defined solutions), formulate a problem carefully, and try other approaches (approaches) to improve solving a challenging problem (challenging problems).		
The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO 1, CO 2, CO 3, CO 4	Crystal Structure: (i) Type and crystal lattice. (ii) Crystal directions and planes	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	An explanation of the dynamics of quantum systems and the time-dependent Schrodinger equation	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	X-Ray Diffraction: (i) Bragg's law (ii) Back lattice (iii) Brillouin zone	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	X-Ray Diffraction: (iii) Brillouin zone (iv) Factor of geometric structure	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	Bonds in crystals: (i) Interaction Forces and Bond types (ii) Bonding energies in ionic and noble gas bonds	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	Lattice Vibrations: (i) One and two-dimensional lattice vibrations, (ii) Phonons	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	Lattice Vibration: (iii) Phonons (iv) Heat capacity, classical theory, Einstein model, Debye model.	TCL-SCL mixed	***2X50 minutes***
	Midterm exam/Project Task Results/Case Analysis Results			
	CO 1, CO 2, CO 3, CO 4	The theory of free electrons in metals: (i) Summerfields. quantum theory	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	Energy band theory: (i) Bloch's theorem (ii) Kronig - Penney model	TCL-SCL mixed	***2X50 minutes***

	CO 1, CO 2, CO 3, CO 4	Energy band theory: (iii) Speed and effective mass of electrons (iv) Classification of materials: metals, insulators, and semiconductors	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	Energy band theory: (iii) Speed and effective mass of electrons (iv) Classification of materials: metals, insulators, and semiconductors	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	Energy band theory: (iii) Speed and effective mass of electrons (iv) Classification of materials: metals, insulators, and semiconductors	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	Semiconductors :(i) Intrinsic Semiconductors	TCL-SCL mixed	***2X50 minutes***
	CO 1, CO 2, CO 3, CO 4	Semiconductors:(i) Extrinsic Semiconductors.	TCL-SCL mixed	***2X50 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	**Learn to study and examine physical systems as well as examples of problem-solving procedures**
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
Participatory Activity*						
Project Results/ Case Study Results/ PBL Results*						
Cognitive						
Assignment	**40**		√	√	√	√
Midterm Exam	**30**		√	√	√	√
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>References</td><td colspan="4">Main References;
1. C..Kittel, Solid State Physic, Edisi 8, 2005..
2. R.K. Puri , V.K. Babbar, 1997, Solid State Physic, S. Chand & Company LTD, New Delhi..</td></tr>
<tr><td>Lecturers (Team Teaching)</td><td colspan="4">1. Moh. Adhib Ulil Absor, S.Si., M.Sc., Ph.D
2. Dr.. Ari Dwi Nugraheni, M.Sc.</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>
<tr><td></td><td>Moh. Adhib Ulil Absor, S.Si., M.Sc., Ph.D</td><td></td><td>Dr. Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.</td></tr>
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