Introduction to Solid State Physics

Module Name :	Introduction to Solid State Physics	
Module Level :	Undergraduate	
Code :	1306600064	
Sub-heading, if applicable :		
Classes, if applicable :		
Semester :	5^{th}	
Module coordinator :	Prof. Erfan Handoko, M.Si	
Lecturer(s) :	Prof. Erfan Handoko, M.Si Dr. Iwan Sugihartono, M.Si	
Language :	Bahasa Indonesia	
Classification within the curriculum :	Compulsory course	
Type of Teaching	Contact hours per week during the semester	Class Size
Lecture (Expository, discussion, exercise)	150 minutes	40
Workload	Total workload of this course 136 hours (4.3 ECTS) per semester which consist of 40 hours (1.3 ECTS) classroom activity, 48 hours (1.5 ECTS) structured task, and 48 hours (1.5 ECTS) per semester.	
Credit points :	4 ECTS	
Prerequisite course(s) :	Quantum Physics, Statistical Physics	
Course Outcomes :	After taking this course the student have ability to : CLO133. Demonstrate an understanding understanding of crystal structures: Describe and analyze the crystal structures of solids, including simple cubic, body-centered cubic, face-centered cubic, and other common crystal structures. Understand the relationships between crystal symmetry and physical properties. CLO134. Explain the principles of crystallography: Apply crystallographic principles to determine crystal symmetries, unit cells, lattice parameters, and crystal planes. Understand the Bragg's law and its application to X-ray diffraction. CLO135. Understand electronic band theory: Explain the concept of energy bands in solids, including valence and conduction bands. Describe the origin of band gaps and the distinction between conductors, insulators, and semiconductors. Analyze the effects of crystal symmetry and doping on electronic band structures. CLO136. Analyze lattice vibrations and phonons: Describe the behavior of lattice vibrations in solids using concepts of phonons. Understand the relationship between phonon properties, crystal structure, and thermal conductivity.	

	Interpret phonon dispersion relations and calculate specific heat capacities. CLO137. Explore electronic properties of solids: Investigate electronic transport phenomena, including electrical conductivity, Hall effect, and thermoelectric effects. Understand the concepts of charge carriers, carrier concentrations, and mobility in different solid-state materials. CLO138. Study magnetism and magnetic properties: Understand the principles of magnetism in solids, including ferromagnetism, antiferromagnetism, and paramagnetism. Analyze magnetic ordering, magnetic domains, and the effects of temperature and external fields on magnetic properties. CLO139. Investigate optical properties of solids: Analyze the behavior of light in solid-state materials, including reflection, absorption, and transmission. Understand the concept of bandgap and its role in determining the optical properties of semiconductors and insulators. Study optoelectronic devices and their applications. CLO140. Apply quantum mechanics to solid-state systems: Apply quantum mechanical principles to explain phenomena such as energy quantization, electronic states, and wave functions in solids. Understand the concept of energy bands and band theory as a manifestation of quantum mechanics in solid-state physics.
Content :	1. Introduction to solid state material structure (2 weeks) • Crystal structure and basic symmetry • Crystallography : Unit cells and lattice parameters • X-ray diffraction and bragg's law 2. Phonon in matters (2 weeks) • Lattice vibrations and thermal properties • Phonon dispersion relations • Electronic transport : conductivity and ohm's law • Carrier concentration mobility 3. Electronic structure in solid (5 weeks) • Energi band in solids : basics and band theory • Conductors, Insulators, and Semiconductors • Electronic band structures : Metal and Fermi Surfaces • Density of states and effective mass 4. Magnetism in solids (2 weeks) • Basic principle and magnetic ordering • Magnetics material classification : ferromagnetic, paramagnetic, diamagnetics 5. Special topics (2 weeks) • Superconductivity and Jossephson effect • Quantum hall effect

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<tr><td></td><td>6. Nanostructure (2 weeks)
Nanoscale material : basic and properties
Nanomaterial synthesis and characterization techniques</td></tr>
<tr><td>Study/exam achievements:</td><td>Examination are conducted as unit test, as following
<table>
<tr><th>No</th><th>Assesment Object</th><th>Assesment Technique</th><th>Weight</th></tr>
<tr><td>1</td><td>Projects Assignment</td><td>Material analysis and project report</td><td>50%</td></tr>
<tr><td>2</td><td>Midterm Test</td><td>Written test</td><td>20%</td></tr>
<tr><td>3</td><td>Final Test</td><td>Written test</td><td>20%</td></tr>
<tr><td>4</td><td>Attendance</td><td>Presence list</td><td>10%</td></tr>
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<tr><td>Media :</td><td>Power point presentation, textbook, learning management system (LMS)</td></tr>
<tr><td>Literatures :</td><td>Charles Kittel. 1996. Introduction to Solid State Physics, 6th Edition, John Wiley & Sons, Inc.
Omar, M.A. (1975). Elementary Solid State Physics: Principle and Applications. Addison Wesley Publishing company.
Ashcroft, N.W., Mermin, N.D. (1976). Solid State Physics. Sounders College Publishing.</td></tr>
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