

Subject Description Form

Subject Code	AP30011
Subject Title	Solid State Physics
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	AP20006
Objectives	The objectives of this subject are to provide the fundamental knowledge of crystal structures; and an introduction of the theories for describing the physical phenomena associated with bonding; X-ray diffraction, lattice vibration and related thermal properties; electronic transport properties and magnetic properties of solids.
Intended Learning Outcomes	<p>Upon completion of the subject, students will be able to:</p> <ul style="list-style-type: none"> (a) describe crystal structure based on the concepts of lattice, basis, unit cell and reciprocal space; (b) describe covalent bond, ionic bond, metallic bonding and van der Waals bonding in solids; (c) interpret x-ray diffraction data for identifying a crystal structure; (d) describe crystal vibration, sound speed and density of vibrational modes, acoustic and optical branches, Brillouin zone, temperature dependence of specific heat capacity and thermal conductivity of crystals; (e) apply Bloch's theory to describe the wave functions of electrons in a crystal, tight-binding approximation to explain the formation of electron bands, and derive the effective mass of a charge carrier in a crystal; (f) describe density of electron states, and specific heat capacity due to conduction electrons in a metal; and (g) identify various magnetisms of a crystal, including paramagnetism and ferromagnetism.
Subject Synopsis/ Indicative Syllabus	<p>Crystal structure: lattice and basis; lattice vectors; unit cell; crystal symmetry; Bravais lattice systems; lattice plane and Miller indices; reciprocal lattice space; lattice spacing.</p> <p>Bonding in solids: covalent bond; ionic bond; metallic bonding and van der Waals bonding.</p> <p>X-ray diffraction: formulation of the intensity of diffracted x-ray beam from a crystal; atomic form factor and structure factor; determination of crystal structure.</p> <p>Lattice vibration and phonon: vibration of monatomic and diatomic linear chains; Brillouin zone; density of vibrational modes; phonon; Einstein and Debye models; heat capacity and thermal conductivity of crystals.</p> <p>Electron states: Bloch Theorem; reduced zone scheme; nearly free electron model; tight-binding model; formation of electron bands; Fermi surface, specific heat capacity due to conduction electrons.</p> <p>Magnetism: g-factor; paramagnetism; ferromagnetism, Curie temperature, ferromagnetic domains; magnetic resonance.</p>

Teaching/Learning Methodology	<p>Lecture: Delivery of lectures interactively to enable students to participate actively in acquiring knowledge, and to raise questions and discuss for clarifying their doubts generated in their learning process. Examples in relation to real life and engineering practices are given to enable the student to alert applications of the subject contents to real life problems.</p> <p>Tutorial: To be run in small groups for the students to consolidate the contents of lectures. Students are properly guided to participate actively in solving problems, raising questions and discussion.</p> <p>e-learning: Electronic means and multimedia technologies would be adopted for presentations of lectures; communication between students and lecturer; delivery of handouts, homework and notices etc. in order to enhance the effectiveness of teaching and learning processes.</p>																																												
Assessment Methods in Alignment with Intended Learning Outcomes	<table border="1"> <thead> <tr> <th rowspan="2">Specific assessment methods/tasks</th> <th rowspan="2">% weighting</th> <th colspan="7">Intended subject learning outcomes to be assessed (Please tick as appropriate)</th> </tr> <tr> <th>a</th> <th>b</th> <th>c</th> <th>d</th> <th>e</th> <th>f</th> <th>g</th> </tr> </thead> <tbody> <tr> <td>(1) Continuous assessment</td> <td>40</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>(2) Examination</td> <td>60</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Total</td> <td>100</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Continuous assessment: Assignments in general include end-of-chapter problems, which are used to reinforce and assess the concepts and skills acquired by the students; and to let them know the level of understanding that they are expected to reach. At least one test would be administered during the course of the subject as a means of timely checking of learning progress by referring to the intended outcomes, and as means of checking how effective the students digest and consolidate the materials taught in the class.</p> <p>Examination: This is a major assessment component of the subject. It would be a closed-book examination. Complicated formulas would be given to avoid rote memory, such that the emphasis of assessment would be put on testing the understanding, analysis and problem solving ability of the students.</p>		Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)							a	b	c	d	e	f	g	(1) Continuous assessment	40	✓	✓	✓	✓	✓	✓	✓	(2) Examination	60	✓	✓	✓	✓	✓	✓	✓	Total	100							
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Reading List and References	<p>“Solid state physics : principles and applications” R. Asokamani. Tunbridge Wells: Anshan; New Delhi: Anamaya Pub., 2007.</p>																																												

	<p>“Introduction to solid state physics” by Charles Kittel. New York: J. Wiley, 2005.</p>
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