

## Subject Description Form

<b>Subject Code</b>	AP20006
<b>Subject Title</b>	Quantum Mechanics for Scientists and Engineers
<b>Credit Value</b>	3
<b>Level</b>	2
<b>Pre-requisite/ Co-requisite/ Exclusion</b>	AP10009
<b>Objectives</b>	The aims of this subject are to introduce some of the main concepts of quantum theory and its applications to some important physical systems including solids and semiconductors.
<b>Intended Learning Outcomes</b>	<p>Upon completion of the subject, students will be able to:</p> <ul style="list-style-type: none"> <li>(a) articulate the experimental basis for attributing particle properties to waves and wave properties to particles; elaborate on the de Broglie theory of matter waves; apply Heisenberg's uncertainty principle to simple systems;</li> <li>(b) elaborate on the various forms of Schrödinger's equation and identify the meaning of each term in the equation(s); solve Schrödinger's equation for the problem of particle in a box;</li> <li>(c) formulate time-independent Schrödinger's equations for the hydrogen molecular ion, the hydrogen molecule and other complex molecules; and</li> <li>(d) describe the scientific ideas behind the historical atomic models and recognize and justify the various modifications of classical ideas as new experimental evidences emerged; use Bohr's semiclassical model to interpret energy levels and spectra and recognize the limitations of the model.</li> </ul>
<b>Subject Synopsis/ Indicative Syllabus</b>	<p><b>Particle properties of waves:</b> photoelectric effect, wave-particle duality, Compton effect, photons.</p> <p><b>Wave properties of particles:</b> de Broglie hypothesis, uncertainty principle.</p> <p><b>Schrödinger's equation:</b> time-independent and time-dependent Schrödinger's equations, rigid box, non-rigid box, three-dimensional Schrödinger equation, angular momentum, harmonic oscillator.</p> <p><b>Atomic physics:</b> Atomic spectra of gases, Bohr's model, quantum model, wave functions, quantum numbers, exclusion principle, periodic table, spontaneous and stimulated lasers.</p> <p><b>Electron spin:</b> spin angular momentum, magnetic moments, the Zeeman effect and spin magnetic moments.</p>
<b>Teaching/Learning Methodology</b>	<b>Lecture:</b> the fundamentals in quantum mechanics will be explained. Examples will be used to illustrate the concepts and ideas in the lecture. The students are free to request help. Homework problem sets will be given. The students are encouraged to solve problems and to use their own knowledge to verify their solutions before seeking assistance.

**Student-centered Tutorial:** students work on sets of problems in the tutorials. Students are encouraged to solve problems before seeking assistance. These problem sets provide them opportunities to apply the knowledge gained from the lecture's. They also help the students to consolidate what they have learned. Furthermore, students can develop a deeper understanding of the subject in relation to daily life phenomena or experience.

**e-learning:** in order to enhance the effectiveness of teaching and learning processes, electronic means and multimedia technologies would be adopted for presentations of lectures; communication between students and lecturer; delivery of handouts, homework and notices etc.

**Assessment Methods in Alignment with Intended Learning Outcomes**

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
(1) Continuous assessment	40	✓	✓	✓	✓
(2) Examination	60	✓	✓	✓	✓
Total	100				

**Continuous assessment:**

The continuous assessment includes assignments, quizzes and test(s) which aim at checking the progress of students study throughout the course, assisting them in fulfilling the learning outcomes.

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 assimilate and consolidate the materials taught in the classes.

**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.