Module code: SP-2301
Module Title: Concepts in Modern Physics
Degree/Diploma: Bachelor of Science (Applied Physics)
Type of Module: Major Option

<table>
<thead>
<tr>
<th>Modular Credits</th>
<th>Total student Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>8 hours/week</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Anti-requisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>SP-2202 Concepts in Modern Physics</td>
</tr>
</tbody>
</table>

Aims
This module aims to introduce students to post-Newtonian concepts in physics that involve theories that were developed in the twentieth century.

Learning Outcomes
On successful completion of this module, a student will be expected to be able to:

**Lower order:** 30%
- understand the basic principles related to modern physics, which includes relativity, matter waves, energy quantisation, x-ray and also laser generation, and the nuclear structure

**Middle order:** 60%
- evaluate the effects of special relativity on time and length measurements
  - explain and apply equations developed to the effects of relativity on momentum and energy
  - explain and apply the concept of matter wave and wave-particle duality
  - apply the concept of atomic energy quantization to the electronic structure of atoms
  - explain the electronic transition process for x-ray generation and atomistic process for laser generation
  - explain quantized properties of nuclei contents

**Higher order:** 10%
- communicate concepts effectively
- work independently and also participate as a team member in group discussions and problem solving sessions

Module Contents
- Einstein’s special theory of relativity.
- Lorentz transformation equations to cover mechanics at all speeds, from which a basis for developing effects of relativity on other physical quantities like velocity, momentum, and energy will be established.
- Development of the idea of rest energy and a new definition of kinetic energy leading to the development and evaluation of Einstein’s mass-energy relationship (E=mc²).
- An introduction to the concepts photons, matter waves, and wave-particle duality.
- Wave function and the consideration of Schrödinger’s equation to represent electron trap.
- The concept of quantization of atomic energies and the use of quantum numbers in describing energy states as well as a discussion of the periodic table.
- The electronic and atomistic process for x-ray and laser generation.
- An exploration of the quantum nature of the nuclear contents and their applications in NMR and MRI.

Assessment
<table>
<thead>
<tr>
<th>Formative assessment</th>
<th>Summative assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussions, tutorials and feedback</td>
<td>Examination: 60%</td>
</tr>
<tr>
<td></td>
<td>Coursework: 40%</td>
</tr>
<tr>
<td></td>
<td>- 2 tests (20%)</td>
</tr>
<tr>
<td></td>
<td>- 1 report and 2 assignments (20%)</td>
</tr>
</tbody>
</table>