### Module code
SP-4308

### Module Title
Nuclear and Particle 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>
<th>Contact hours</th>
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<tbody>
<tr>
<td>4</td>
<td>10 hours/week</td>
<td>4 hours/week</td>
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### Prerequisite
None

### Anti-requisite
None

### Aims
The module is designed for students to understand the physics principles underpinning nuclear and particle physics.

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

**Lower order:** 20%
- describe the patterns of nuclear masses and sizes using simple models and identify the basic constituents of matter and the fundamental forces between them

**Middle order:** 50%
- apply calculations involving the energy released by important nuclear decays and reactions
- analyse various types of nuclear decay processes using quantitative calculations on radioactivity
- apply conservation laws to identify the forces responsible for particular reactions
- apply Feynman diagrams to represent elementary processes

**Higher order:** 30%
- interpret the results of analyses, and make an appropriate report for an effective communication
- present case studies or current issues or specific topics individually or collaboratively
- work co-operatively in a team

### Module Contents
**Nuclear Physics:**
- Rutherford Scattering, properties of nuclei- Mass, size, charge, magnetic moment
- Nuclear stability, binding energy and nuclear forces
- Nuclear models, The shell model and liquid-drop model, Radioactivity- half-life estimation
- Decay processes, Alpha, Beta & Gamma Decay
- Natural Radioactivity- carbon dating, radiation dosage

**Particle Physics:**
- Basic properties of cosmic rays, particle accelerators and detectors
- The four forces, the quest for unification and links with cosmology
- The Standard Model, fermions and their gauge bosons;
- Leptons and the electroweak force
- The Higgs mechanism and Higgs boson, The strong force, Quarks and gluons

### Assessment

<table>
<thead>
<tr>
<th>Formative assessment</th>
<th>In-class questions and feedback</th>
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<tbody>
<tr>
<td>Summative assessment</td>
<td>Examination: 40%</td>
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<tr>
<td></td>
<td>Coursework: 60%</td>
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<tr>
<td></td>
<td>2 work-based problems (20%)</td>
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<td>1 group project (10%)</td>
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<td>1 written assignment (10%)</td>
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<td>1 oral presentation (10%)</td>
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<td>1 class test (10%)</td>
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