

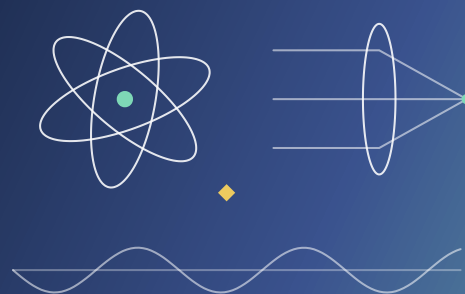
Module code

**SPP-2301**

Type of module

**Undergraduate: Applied Physics – Major Option**

# Nuclear and Particle Physics



Modular credits

**4**

Total student  
engagement

**56** hours

Prerequisite

**None**

Anti-requisite

**None**

## Aims

To provide students with a foundation in nuclear and particle physics, covering nuclear structure, decay, energy release, and the particles and forces of the Standard Model. Students will analyse subatomic phenomena, apply conservation laws and assess key applications.

## Module learning outcomes (MLO)

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

### MLO 1

Analyse the structure, properties, stability, and models of the atomic nucleus, including nuclear forces, binding energies, and decay processes.

### MLO 2

Evaluate nuclear reactions and radioactive decay quantitatively to determine energy release and implications for fission and fusion.

### MLO 3

Synthesise knowledge of fundamental particles, forces, and the Standard Model to explain particle interactions and phenomena.

### MLO 4

Interpret and construct representations of particle processes, including Feynman diagrams and quark model classifications, to predict allowed interactions.

## MLO 5

Assess and justify the scientific and technological applications of nuclear and particle physics in research, energy, medicine, and cosmology.

### Module contents

|                                                                     |                                                           |                                                                      |
|---------------------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------------------------|
| Nuclear Physics:                                                    | Discovery of the nucleus – Rutherford scattering          | Properties of nuclei – mass, size, charge, spin, magnetic moment     |
| Nuclear stability                                                   | Binding energy and nuclear forces                         | Nuclear models – liquid-drop model and shell model                   |
| Radioactivity – half-life determination and radioactive decay law   | Applications of radioactivity – radioactive carbon dating | Decay processes – alpha, beta, and gamma decay                       |
| Nuclear Fission and Fusion – basic principles and energy release    | 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       | Charged particles and the electromagnetic force                      |
| Leptons and the weak force                                          | The strong force, Quarks and gluons                       | Feynman diagrams, basic properties and allowed diagrams              |
| Quark model, multiplets and weight diagrams                         | The Higgs mechanism and Higgs boson                       |                                                                      |

### Assessment

60% 40%

Examination

Coursework



■ Examination — 60%

■ Work-based problems — 20%

■ Tests — 14%

■ Oral presentation — 6%

| Formative assessment           | Summative assessment |           |
|--------------------------------|----------------------|-----------|
| Weekly discussion and feedback | COMPONENT            | WEIGHTING |
|                                | Examination          | 60%       |
|                                | Coursework           | 40%       |
|                                | Individual           | 40%       |
|                                | Work-based problems  | 20%       |
|                                | Tests                | 14%       |
|                                | Oral presentation    | 6%        |

## Graduate attributes and skills

### Programme learning objectives (PLO) addressed

|          |                                             |          |                                                    |
|----------|---------------------------------------------|----------|----------------------------------------------------|
| <b>1</b> | PLO 1 (Core Disciplinary Knowledge)         | <b>2</b> | PLO 2 (Critical Thinking and Comparative Analysis) |
| <b>4</b> | PLO 4 (Numerical and Analytical Competence) | <b>6</b> | PLO 6 (Communication and Professionalism)          |

### Sustainability concept addressed

|          |                                               |
|----------|-----------------------------------------------|
| <b>7</b> | SDG 7 Affordable and Clean Energy             |
| <b>9</b> | SDG 9 Industry, Innovation and Infrastructure |

### Digital skills/software used (not limited to)

|                                                     |
|-----------------------------------------------------|
| Word processing software (e.g. Microsoft Word)      |
| Presentation software (e.g. PowerPoint)             |
| Web browsers (e.g. Internet Explorer)               |
| Learning Management Systems (e.g. Canvas)           |
| Communication Software (e.g. Microsoft Teams)       |
| Multimedia Applications (e.g. Windows Media Player) |

|                                          |                                                                                                                         |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Micro-credentialling option<br><b>No</b> | Stackable towards GenBESTARI Undergraduate Degree Programme or other relevant Lifelong Learning Programmes<br><b>No</b> |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|

### Document details

Office **ODVCE**    Document date **23 June 2026**    Status **New**    Approval **GBF (12/02/2026)**