Module Descriptor

Title	Principle of Nuclear Physics		
Session	2025/26	**Status**	Published
Code	PHYS10016	**SCQF Level**	10
Credit Points	20	**ECTS (European Credit Transfer Scheme)**	10
School	**Computing, Engineering and Physical Sciences**		
Module Co-ordinator	Marcus Scheck		

Summary of Module

This module is one of the SCQF Level-10 core component BSc Honours Physics with Nuclear Technology programme and electoral subject for the BSc Honours Physics programme. This module is normally taken in the honours year (fourth year). The module covers concepts of Nuclear Physics. Some of the material covered is introduced in the core level-9 module PHYS09002 Atoms, Nuclei, and Particles.

The module covers the following topics: static properties of nuclei; the nuclear force; nuclear models; nuclear decay modes (including alpha-, beta-, gamma- decay and nuclear fission), and nuclear reactions.

The content can be summarised as follows:

1 The static properties of nuclei: mass, size, moments, spin, parity, shape

2 Nuclear force: the deuteron, spin dependence, charge independence, tensor force

3 Nuclear models; independent particle model (Fermi Gas and Shell Model), collective models (Vibrational, Rotational, Basics of the Random Phase Approximation)

4 Nuclear decay (α,β,γ), nuclear fission, proton emission

5 Nuclear reactions: particle-transfer, fusion evaporation, neutron-induced reactions.

6 If time allows a bonus of nuclear astrophysics is included

We have defined a set of Graduate Attributes that are the skills, personal qualities and understanding to be developed through your university experience that will prepare for life and work in the 21st century (https://www.uws.ac.uk/current-students/your-graduate-attributes/). The Graduate Attributes relevant to this module are listed below.

- Academic: critical thinker; analytical; inquiring; knowledgeable; digitally literate; problem solver; autonomous; incisive; innovative
- Personal: effective communicator; influential; motivated
- Professional: collaborative; research-minded; enterprising; ambitious; driven

Module Delivery Method	**On-Campus[1]** ☒		**Hybrid[2]** ☐	**Online[3]** ☐	**Work -Based Learning[4]** ☐	
Campuses for Module Delivery	☐ Ayr ☐ Dumfries		☐ Lanarkshire ☐ London ☒ Paisley		☐ Online / Distance Learning ☐ Other (specify)	
Terms for Module Delivery	Term 1	☒	Term 2	☐	Term 3	☐
Long-thin Delivery over more than one Term	Term 1 – Term 2	☐	Term 2 – Term 3	☐	Term 3 – Term 1	☐

Learning Outcomes	
L1	Demonstrate a broad knowledge and critical understanding of the basic concepts of modern-day nuclear physics
L2	Demonstrate a broad knowledge of the nuclear force, its properties, and the consequences of them for the nuclear many-body problem.
L3	Demonstrate a broad understanding of basic quantum-mechanical concepts and techniques used in nuclear physics as many-body quantum system.
L4	Demonstrate an ability to use understanding and knowledge in the solution of problems.
L5	Demonstrate the knowledge and understanding of current frontiers and problems in nuclear physics.

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	**During completion of this module, there will be an opportunity to achieve core skills in:**
Knowledge and Understanding (K and U)	**SCQF 10** Knowledge of state-of-the-art concepts of basic nuclear physics.

[1] Where contact hours are synchronous/ live and take place fully on campus. Campus-based learning is focused on providing an interactive learning experience supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus contact hours will be clearly articulated to students.

[2] The module includes a combination of synchronous/ live on-campus and online learning events. These will be supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus and online contact hours will be clearly articulated to students.

[3] Where all learning is solely delivered by web-based or internet-based technologies and the participants can engage in all learning activities through these means. All required contact hours will be clearly articulated to students.

[4] Learning activities where the main location for the learning experience is in the workplace. All required contact hours, whether online or on campus, will be clearly articulated to students

	Demonstrate a critical understanding of the nuclear force, containing both parts: strong as well as weak interaction.
Practice: Applied Knowledge and Understanding	**SCQF 10** Use a selection of skills, techniques, and practices applicable to employment in nuclear-related areas or enabling further study (such as MSc or PhD). Be able to draw cross connections between different points, e.g., connect the model description and properties of the many-body quantum system. Understanding of the concepts of the most important questions in modern-day nuclear-physics research.
Generic Cognitive skills	**SCQF 10** Problem analysis, evaluation, solving and appreciation, e.g., critical appreciation of underlying complex mathematical and group theoretical concepts.
Communication, ICT and Numeracy Skills	**SCQF 10** Use of scientific database systems for literature searches. Literary skills, enabling the communication of abstract concepts in written and verbal form. Finding of appropriate resources.
Autonomy, Accountability and Working with Others	**Please select SCQF Level** Individual study and retrieval of scientific literature. Working towards deadlines and accountability for scientific conducts such as referencing. Interaction with peers in discussion of subject matter.

Prerequisites	**Module Code**	**Module Title**
	PHYS09003	Electromagnetism
	PHYS09008	Quantum Mechanics
	PHYS09012	Mathematics for Physics 2
	PHYS09013	Atoms, Nuclei & Particles
	Other Or equivalent	
Co-requisites	**Module Code**	**Module Title**

Learning and Teaching
In line with current learning and teaching principles, a 20-credit module includes 200 learning hours, normally including a minimum of 36 contact hours and maximum of 48 contact hours. The delivery of the PHYS10001 Nuclear and Particle Physics module is primarily lecture based. The lectures are complemented with worked examples, often integrated within the lectures. The examples address the mathematical and conceptual aspects of the material taught. A reading list is provided in the early lectures to direct the students towards relevant books and papers. Students are encouraged to read up-to-date literature on research topics in this field using, for example, online literature searches and online journals. Furthermore, the students are provided with links to online given research seminars of forefront nuclear and particle physics research. Material supporting the lectures will be available on the Virtual

Learning Environment. It is expected that students will carry out private study commensurate with a 20-point Level-10 module.	
Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture / Core Content Delivery	36
Independent Study	164
Please select	
Please select	
Please select	
Please select	
TOTAL	

Indicative Resources
The following materials form essential underpinning for the module content and ultimately for the learning outcomes: Introductory Nuclear Physics, K Krane, John Wiley and Sons Basic ideas and Concepts in Nuclear Physics, K.L.G. Heyde, IoP publishing Nuclear and Particle Physics, W. Demtroeder, Springer
(N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements
In line with the Student Attendance and Engagement Procedure, Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time. **For the purposes of this module, academic engagement equates to the following:** Attendance of lectures Addressing the coursework problems in a timely manner

Equality and Diversity
The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code. The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code. Please ensure any specific requirements are detailed in this section. Module Co-ordinators should consider the accessibility of their module for groups with protected characteristics.

(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	**Engineering Physical Sciences**
Overall Assessment Results	☐ **Pass / Fail** ☒ **Graded**
Module Eligible for Compensation	☐ **Yes** ☒ **No** **If this module is eligible for compensation, there may be cases where compensation is not permitted due to programme accreditation requirements. Please check the associated programme specification for details.**
School Assessment Board	Mathematics and Physics
Moderator	N. S. Bondili
External Examiner	TBC
Accreditation Details	Institute of Physics
Module Appears in CPD catalogue	☐ **Yes** ☒ **No**
Changes / Version Number	1.0

Assessment (also refer to Assessment Outcomes Grids below)
Assessment 1
Class Test 80%
Assessment 2
Coursework 20%
Assessment 3
(N.B. (i) Assessment Outcomes Grids for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed. (ii) An indicative schedule listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.)

Component 1							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Class Test	☒	☒	☒	☒	☒	80	2

Component 2							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Coursework	☒	☒	☒	☒	☒	20	

Component 3							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
	☐	☐	☐	☐	☐		
Combined total for all components						100%	2 hours

Change Control

What	When	Who
New module introduced in 2025/26 AY		