Module Descriptor

Title	Atoms, Nuclei & Particles		
Session	2025/26	**Status**	Published
Code	PHYS09013	**SCQF Level**	9
Credit Points	20	**ECTS (European Credit Transfer Scheme)**	10
School	**Computing, Engineering and Physical Sciences**		
Module Co-ordinator	David O'Donnell		

Summary of Module

This is a core SCQF Level 9 module for the Physics Programmes presented in the second term.

The module covers intermediate-level aspects of atomic, nuclear, and particle physics, which were introduced at Levels 7 and 8. The content of the module is primarily delivered by lectures and tutorials, with some material reinforced in practical laboratory classes. Part of the practical element of the module will be the presentation of a formal laboratory report. A brief outline of the module syllabus is given below.

Atomic physics:

Atomic structure of the hydrogen atom; quantization of angular momentum; quantum numbers and notation; degeneracy; separation of variables; electron probability distributions; electron spin; spin- orbit coupling; many electron atoms.

Nuclear physics:

The Birth of nuclear physics, Rutherford's experiment; basic nuclear properties, nuclear composition (isotopes), nuclear radius, mass, spin; mass defect and nuclear binding (Bethe Weiszaecker formula); introduction of nuclear models (Shell Model); radioactive decay modes, alpha,beta and gamma decay; fusion and fission, nuclear energy and a brief introduction to nuclear reactions and detection techniques.

Particle physics:

Foundations of particle physics - quarks and leptons, the Eightfold way, standard model. The fundamental forces - QED and QCD and Feynman diagrams. Symmetries, conservation laws, parity violation. Relativistic kinematics and the creation of particles.

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.

• Graduate Attributes - Academic: critical thinker; analytical; inquiring; knowledgeable; digitally literate; problem solver; autonomous; incisive; innovative

• Graduate Attributes - Personal: effective communicator; influential; motivated

• Graduate Attributes - 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 knowledge and understanding of atomic, nuclear, and particle physics.
L2	Be able to apply the principles of advanced concepts in atomic, nuclear, and particle physics to solve relevant problems.
L3	
L4	
L5	

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 9** Demonstrate and work with a broad and integrated knowledge and understanding of the scope, main areas, and boundaries of atomic, nuclear, and particle physics. Demonstrate a critical understanding of a selection of the principal theories, concepts, and terminology.
Practice: Applied Knowledge and Understanding	**SCQF 9** Use a selection of the principal skills, techniques, practices enabling further studies of advanced subjects such as atomic physics, nuclear physics and particle 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

Generic Cognitive skills	**SCQF 9** Present and evaluate arguments, information and ideas in physics. Use a range of approaches to addressing problems and issues in physics.
Communication, ICT and Numeracy Skills	**SCQF 9** Use a wide range of routine skills and some advanced skills in physics. For example: • To convey ideas in well-structured and coherent form. • To use standard applications to process and obtain a variety of information and data. • To use a range of numerical and graphical skills in combination. • To use numerical and graphical data.
Autonomy, Accountability and Working with Others	**SCQF 9** Exercise some initiative and independence in carrying out defined activities associated with the study of the module material. Working towards deadlines.

Prerequisites	**Module Code**	**Module Title**
	PHYS08002	Optics & Electronics
	PHYS08004	Properties of Matter
	PHYS08006	Mathematics for Physics 1
	PHYS08007	Classical Mechanics
	PHYS08009	Modern Physics
	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.	
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
Tutorial / Synchronous Support Activity	12
Independent Study	152
Please select	
Please select	
Please select	

TOTAL	200

Indicative Resources

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

Krane, Kenneth S, Introductory Nuclear Physics, John Wiley and Sons (1987), [ISBN 047180553X] [ISBN13: 9780471805533] (still in print and available)

Beiser, Concepts of Modern Physics, McGraw Hill (2002) [ISBN: 978-0321204691]

Eisberg and Resnick, Quantum Mechanics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley and Sons, 2nd edition (1985) [ISBN: 978-0471873730] (still in print)

Introduction to Elementary Particles, D Griffiths, John Wiley and Sons 1987

VLE system at UWS, Aula page for "Atoms, Nuclei & Particles"

(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:

The School of Computing, Engineering and Physical Sciences considers attendance and engagement to mean a commitment to attending, and engaging in, timetabled sessions. You will scan your attendance via the scanners each time you are on-campus and you will log in to the VLE several times per week. Where you are unable to attend a timetabled learning session due to illness or other circumstance, you should notify that Programme Leader that you cannot attend. Across the School an 80% attendance threshold is set. If you fall below this, you will be referred to the Student Success Team to see how we can best support your studies.

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.

Aligned with the University's commitment to equality and diversity, this module supports equality of opportunity for students from all backgrounds and learning needs. Using the VLE, material will be presented electronically in formats that allow flexible access and manipulation of content. This module complies with University regulations and guidance on inclusive learning and teaching practice. This module has lab-based teaching and as such you are advised to speak to the Module Co-ordinator to ensure that specialist assistive equipment, support provision and adjustment to assessment practice can be put in place, in accordance with the University's policies and regulations.

(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	M. Gorman
Accreditation Details	Institute of Physics (IoP)
Module Appears in CPD catalogue	☐ **Yes** ☒ **No**
Changes / Version Number	2.0 Module descriptor amended to conform to the new template format. External examiner info updated.

Assessment (also refer to Assessment Outcomes Grids below)
Assessment 1
Class Test (60%)
Assessment 2
Coursework: Problem Sets (40%)
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	☒	☒	☐	☐	☐	60	2

Component 2							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Coursework	☒	☒	☐	☐	☐	40	0

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
Moved to new template	26/03/2025	D. O'Donnell
External examiner info updated	26/03/2025	D. O'Donnell
Moderator information updated	01/04/2025	D. O'Donnell