University of the West of Scotland

Module Descriptor

Session: 2024/2025

Title of Module: Atoms, Nuclei & Particles			
Code: PHYS09013	**SCQF Level: 9 (Scottish Credit and Qualifications Framework)**	**Credit Points: 20**	**ECTS: 10 (European Credit Transfer Scheme)**
School:	School of Computing, Engineering and Physical Sciences		
Module Co-ordinator:	David O'Donnell		

Summary of Module

This module is a core module at Level 9 on Institute of Physics (IoP) accredited Physics programmes. The content of the module is primarily delivered by lectures and tutorials. A brief outline of the module syllabus is given below.

Atomic physics:
Atomic structure of the hydrogen atom; quantum numbers and notation; degeneracy; separation of variables; electron probability distributions; electron spin; spin-orbit coupling; many electron atoms, Pauli exclusion principle, electron configurations and periodic table.

Nuclear physics:
Birth of nuclear physics, Rutherford's experiment; basic nuclear properties, nuclear composition (isotopes), nuclear radius, mass, spin; mass defect and nuclear binding (Bethe Weizsacker 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					
Face-To-Face	**Blended**	**Fully Online**	**HybridC**	**Hybrid 0**	**Work-Based Learning**
☒	☐	☐	☐	☐	☐
See Guidance Note for details.					

Campus(es) for Module Delivery						
The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit) (tick as appropriate)						
Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
☒	☐	☐	☐	☐	☐	Add name

Term(s) for Module Delivery					
(Provided viable student numbers permit).					
Term 1	☐	Term 2	☒	Term 3	☐

Learning Outcomes: (maximum of 5 statements) **These should take cognisance of the SCQF level descriptors and be at the appropriate level for the module.** At the end of this module the student will be able to:	
L1	Demonstrate knowledge and understanding of core principles of atomic physics.
L2	Understand key aspects of nuclear physics, including the shell model.
L3	Appreciate the standard model of particle physics and classify particles by their properties.

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 Level **9** • Demonstrating and working with a broad and integrated knowledge and understanding of the scope, main areas, and boundaries of atomic, nuclear, and particle physics. • A critical understanding of a selection of the principal theories, concepts, and terminology.

Practice: Applied Knowledge and Understanding	SCQF Level **9** • Using a selection of the principal skills, techniques, practices, and materials associated with understanding advanced concepts in physics. • Practicing methods of enquiry and research.	
Generic Cognitive skills	SCQF Level **9** • Undertaking critical analysis, evaluation, and synthesis of ideas, concepts, information, and issues. • Identifying and analysing problems and issues. • Drawing on a range of sources in making judgement.	
Communication, ICT and Numeracy Skills	SCQF Level **9** Using a range of routine skills and some advanced and specialised skills in support of established practices in physics, for example: • Use a range of IT applications to support and enhance work. • Interpret, use, and evaluate numerical and graphical data.	
Autonomy, Accountability and Working with others	SCQF Level **9** • Exercising autonomy and initiative in some activities at a professional level. • Working towards deadlines. • Balancing workloads from multiple projects simultaneously.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code: PHYS08002 PHYS08004 PHYS08006 PHYS08007 PHYS08009	**Module Title:** Optics & Electronics Properties of Matter Mathematics for Physics 1 Classical Mechanics 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** (Normally totalling 200 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
	200 Hours Total

****Indicative Resources: (eg. Core text, journals, internet access)**

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.

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.

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 and Physical Sciences
Assessment Results (Pass/Fail)	Yes ☐No ☒
School Assessment Board	Physical Sciences
Moderator	Michael Bowry
External Examiner	H Boston
Accreditation Details	Institute of Physics
Changes/Version Number	**1.0** This is a new module that will run for the first time in 2024-25.

Assessment: (also refer to Assessment Outcomes Grids below)
There are two formal assessed aspects to the module: invigilated closed-book class test and coursework. The class test is at the end of the term whilst the assessments which form the coursework part run throughout the term. The class test is worth 60% of the total mark. The class test covers all aspects of the taught provision, and the questions are equally balanced between atomic, nuclear and particle physics. A formula sheet will be provided.
Assessment 1 – Invigilated closed-book class test (60%)
Assessment 2 – Written Coursework (40%)
(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.)

Assessment Outcome Grids (See Guidance Note)

Component 1					
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Invigilated closed-book class test	✔	✔	✔	60	2

Component 2					
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Portfolio of written work	✔	✔	✔	40	0
Combined Total for All Components				100	2