University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Nuclear & Particle Physics			
Code: PHYS10001	**SCQF Level: 10 (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:	Marcus Scheck		

Summary of Module

This is a core SCQF Level-10 module for all physics programmes.

The module covers concepts of **Nuclear** and **Particle Physics**. Some of the material covered is introduced in the core level-9 module PHYS09002 **Atoms and Nuclei**.
The nuclear-physics part of this 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);
The particle physics part of the module covers the following topics: the basic building blocks of nature (quarks and leptons) and their interactions; the organization of quarks into baryons and mesons; a discussion of colour; basic concepts of QED and QCD with an emphasis on the use of Feynman diagrams; decays, conservation laws and symmetries, including parity non-conservation in the weak interaction.
The content can be summarised as follows:

1. The static properties of nuclei: mass, size, moments, spin, parity
2. Nuclear force: the deuteron, spin dependence, charge independence, tensor force
3. Nuclear models; independent particle model, collective models
4. Nuclear decay (α,β,γ), nuclear fission
5. Foundations of particle physics - quarks and leptons, the Eightfold way, standard model
6. The fundamental forces - QED and QCD and Feynman diagrams
7. Symmetries, conservation laws, parity violation
8. 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 broad knowledge and critical understanding of the basic concepts of modern-day nuclear physics
L2	Demonstrate integrative knowledge and critical understanding of the basic concepts of modern-day particle physics
L3	Demonstrate broad understanding of basic quantum mechanical concepts and techniques used in nuclear and particle physics.
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 and particle 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 Level **10** Knowledge of state-of-the-art concepts of basic nuclear and particle physics. Demonstrate a critical understanding of the strong as well as weak interaction.	
Practice: Applied Knowledge and Understanding	SCQF Level **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). Practice up-to-date literature searches of relevant topics in nuclear and particle physics. Understanding of the concepts of the most important questions in modern-day nuclear- and particle-physics research.	
Generic Cognitive skills	SCQF Level **10** Critical appreciation of underlying complex mathematical and group theoretical concepts. Problem analysis, evaluation, solving and appreciation.	
Communication, ICT and Numeracy Skills	SCQF Level **10** Use of computers for advanced studies (programming, simulation, data mining). Use of scientific database systems for literature searches. Literary skills, enabling the communication of abstract concepts in written and verbal form.	
Autonomy, Accountability and Working with others	SCQF Level **10** 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.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code: PHYS09003 PHYS09007 PHYS09008 PHYS09011	**Module Title:** Electromagnetism Thermodynamics & Statistical Physics Quantum Mechanics Atoms & Nuclei
	Other:	or equivalent
Co-requisites	**Module Code:**	**Module Title:**

*Indicates that module descriptor is not published.

Learning and Teaching

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** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	24
Tutorial/Synchronous Support Activity	12
Independent Study	164
	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:

Introductory Nuclear Physics, K Krane, John Wiley and Sons

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

Basic ideas and Concepts in Nuclear Physics, K.L.G. Heyde, IoP publishing

Introduction to high-energy physics, Donald H. Perkins, Cambridge University Press

(**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	Physical Sciences
Assessment Results (Pass/Fail)	Yes ☐No ☒
School Assessment Board	Physical Sciences
Moderator	Sreenivasa Nara Singh Bondili
External Examiner	H Boston
Accreditation Details	Institute of Physics
Changes/Version Number	**5.0** Module descriptor amended to conform to the new template format and to reflect outcomes from ILR 2023.

Assessment: (also refer to Assessment Outcomes Grids below)
The assessment is split in two categories, a written class test worth 80% of the final grade and two pieces of coursework:1x nuclear physics worth 12% of the final grade and 1x particle physics worth 8% of the final grade.
Assessment 1 Class Test 80%
Assessment 2 Coursework 20%
(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)	Learning Outcome (4)	Learning Outcome (5)	Weighting (%) of Assessment Element	Timetabled Contact Hours
Exam	✔	✔	✔	✔		80	2

Component 2							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Course work	✔	✔	✔	✔	✔	20	0
					Combined Total for All Components	100	2