UNIVERSITY OF LINCOLN

Programme Specification

Title:

Physics

Final Award: **Master of Physics (MPhys)**

With Exit Awards at:
Certificate of Higher Education (CertHE)
Diploma of Higher Education (DipHE)
Bachelor of Science with Honours (BSc (Hons))
Master of Physics (MPhys)

To be delivered from: 1 Sep 2015

Level	Date
Level 1 or Certificate of Higher Education (CertHE)	2019-20
Level 2 or Diploma of Higher Education (DipHE)	2020-21
Level 3 or Bachelor of Science with Honours (BSc (Hons))	2021-22
Level 4 or Master of Physics (MPhys)	2022-23

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1. Introduction

This document describes one of the University of Lincoln's programmes using the protocols required by the UK National Qualifications Framework as defined in the publication *QAA guidelines for preparing programme specifications*.

This programme operates under the policy and regulatory frameworks of the University of Lincoln.

2. Basic Programme Data

Final Award:	Master of Physics (MPhys)
Programme Title:	Physics
Exit Awards and Titles	Certificate of Higher Education (CertHE) Diploma of Higher Education (DipHE) Bachelor of Science with Honours (BSc (Hons)) Master of Physics (MPhys)
Subject(s)	Physics
Mode(s) of delivery	Full Time Part Time
Is there a Placement or Exchange?	Yes
UCAS code	F303
Awarding Body	University of Lincoln
Campus(es)	Lincoln Campus
School(s)	School of Mathematics and Physics
Programme Leader	Marco Pinna (MPinna)
Relevant Subject Benchmark Statements	
Professional, Statutory or Regulatory Body Accreditation	Institute of Physics (IOP)
Programme Start Date	2019-20

3. Programme Description

3.1 Overview

Physics is a fundamental science for understanding the world around us. It is an examination of the universe, from the largest galaxies to the smallest particles. Physics challenges our thinking and changes our lives through developments in new technologies, healthcare and how we live. It prepares graduates for a range of careers.

The Physics curriculum at Lincoln combines fundamental and applied physics with rigorous mathematics and computational training. It provides broad problem-solving skills, includes a substantial research component and the option of a placement in industry.

The programme includes a combination of compulsory and elective modules covering all components of core physics, as defined by the UK Institute of Physics (IOP), such as: mechanics, quantum physics, condensed matter, optics and waves, electromagnetism, optics, thermodynamics and statistical physics. That is complemented by a substantial set of additional physics modules, which topics reflect University of Lincoln's academic strength and interests. The training combines both theory and experiment and develops awareness of modern cutting-edge directions and applications of physics in contexts relevant to society and industry. A variety of individual and group learning modes combined with optional placements replicates real-world work environments. Research elements are introduced throughout the degree including a third year project and culminating in a substantial M-Level project in the final year. The final year includes also modules in advanced physics.

3.2 Aims and Objectives

General Aims:

• To provide a stimulating and supportive learning environment that inspires students in the study of physics

• To enable the development of a broad appreciation of the importance of physics in a variety of application contexts: academic, industrial, economic, environmental and social and its role in establishing a sustainable society;

• To be given an opportunity to develop a range of skills relating to professional practice in physics that are relevant both to physics and other graduate-level employment.

Main Aims:

• To provide students with a broad appreciation of key physical concepts and the interrelationship between discipline sub-fields in physics;

• To provide an opportunity to develop a skill set that enables the implementation of sound professional practice in physics that ensures safe operation in physical laboratory environments based on effective risk assessment;

• To provide an opportunity to the students to acquire a range of experiences that enable the effective application of defined methodologies to appropriate standards;

• To provide opportunities of acquiring knowledge of the application of physics in key sectors;

• To instill a broad range of knowledge and skills required for graduate-level employment or as a base for advanced level study in physics;

• To provide an opportunity to acquire knowledge and developing critical and intellectual abilities applicable to problem solving and problem setting in technologically and socially diverse environments;

• To offer ways ofdeveloping capabilities of learning effective methods for solving physics problems.

• To extend understanding of physical concepts and develop an in-depth appreciation of specialised areas in physics through engagement with advanced topics;

• To develop an ability to design scientific investigations, independently execute suitable experimentation and critically evaluate study outcomes;
• To develop capabilities to analyse unfamiliar problems and adapt defined methodologies to devise effective solutions;
• To develop an awareness of advances at the forefront of physics and instill an ability for critical assessment of research;
• To prepare students for professional careers or doctoral research employment through knowledge of advanced practices and topics.

EXTERNAL CONTEXTS:
The programme satisfies the need of the society in analytically and practically skilled work force capable of logical and analytical thinking combined with practical skills. The graduates will have been introduced to applications of physics, computing skills and the use of IT resources, The programme gives an opportunity to develop ability to work both independently and in collaborative groups. These are qualities which are in demand across a broad range of stimulating and rewarding careers in various walks of life where physical problems arise, including science and technology, engineering, computing, medicine, education, consultancy, business and finance, and administrative bodies. The degree also opens an opportunity to advanced post-graduate studies, with possibilities of participating in research. The optional placement year is designed to provide links with businesses or administrative bodies.

INTERNAL CONTEXTS:
The programme is available as four year award, or a five year award if the optional sandwich placement is also taken. The School is the home for research in computational materials science and computational physics. Study programmes have been structured to exploit this expertise and to ensure that wherever possible, teaching is informed by current research. Opportunities for students to become familiar with and ultimately involved in research activity are actively promoted. The School is located in the College of Science and integrates with other Colleges and Schools through collaboration at various levels. This integration is further consolidated through the College’s committee structures, through Research seminar programmes and through cross college staff and student development.

3.3 Variations to Standard Regulations and Guidance
none

4. Programme Outcomes

Programme-level learning outcomes are identified below.

Refer to *Appendix I – Curriculum Map* for details of how outcomes are deployed across the programme.

4.1 Knowledge and Understanding

On successful completion of this programme a student will have knowledge and understanding of:

1 Physics terminology, conversions and units.
2 Fundamental physics principles.
3 Molecular and bulk properties of various matter.
4 Principles and procedures used in physics experiments.
5 Industrial, economic, social and environmental contexts that demonstrate the importance of physics and their interface with other disciplines in tackling future challenges in these contexts.
6 Methods used in various physics fields and limits of their applicability.
7 Applied methods of various branches of mathematics and limits of their applicability.
8 Algorithms and their computational implementations designed for solving problems in physics.
9 The professional, legal, moral and ethical issues and considerations involved in applications of physics.
10 Basic elements of physics research.
11 Deep fundamental aspects of advanced physics and its applications.
12 Research methodology and specialist knowledge within the physics research field.

4.2 Subject Specific Intellectual Skills

On successful completion of this programme a student will be able to:

101 Solve qualitative and quantitative physics problems.
102 Recognise and analyse problems and plan strategies for their solution.
103 Evaluate, interpret and synthesise physics information and data from a variety of sources.
104 Use mathematical models, computational methods and data processing relating to physics.
105 Communicate scientific material and arguments in a variety of forms.
106 Assimilate, critically evaluate and present research results objectively.
107 Adapt and apply methodology to the solution of unfamiliar problems.
108 Undertake a research project the outcome of which is of a quality that is potentially publishable.

4.3 Subject Specific Practical Skills

On successful completion of this programme a student will be able to:

201 Perform calculations and mathematical manipulations relating to specific problem.
202 Use computer for numerical solution of physics problems.
203 Carry out documented laboratory procedures involved in physics experiments.
204 Operate standard physical instrumentation.
205 Plan, design and execute experiments taking into account the results of the previous experimental work.
206 Use advanced techniques for solving physics problems.

4.4 Transferable Skills and Attributes

On successful completion of this programme a student will be able to:

301 Formulate problems in precise terms and to identify key issues.
302 Try different approaches in order to make progress on challenging problems.
303 Develop the ability to find information by using textbooks and other available literature, by searching databases and the Internet, and through discussions with colleagues.
304 Communicate complex information effectively and concisely by means of written documents, presentations or discussion.
305 Develop ability to grasp complex concepts, to understand and interpret data precisely and to construct logical arguments.
306 Develop computing and IT skills in a variety of areas including the preparation of documents, information searches, numerical calculations, and the manipulation and presentation of data.
307 Work independently, to use their initiative and to organise themselves to meet deadlines.
308 Effectively work in a group and be able to interact constructively with other people.
309 Demonstrate high ethical standards and gain an appreciation of what constitutes unethical scientific behaviour.
310 Demonstrate independent learning ability required for continuing professional development.

For details of each module contributing to the programme, please consult the module specification document.

5. Learning, Teaching and Assessment Strategies

5.1. Learning and Teaching Strategy

5.1.1. The teaching and learning strategy complies with the QAA Academic Infrastructure and aligns with the principles of Student as Producer (see 5.1.4 below). The strategy derives from the programme learning outcomes and is influenced by the school strengths in research. Teaching mode consist in lectures, tutorial, seminars, workshops, laboratories, group study and projects. The primary source of new material delivered to students are lectures where fundamental concepts are introduced, laws are stated with or without detailed derivations, and numerous examples are used to illustrate all the steps in a specific topic. At the lectures students will also be directed towards recommended reading materials and online resources. Algorithms of solutions are explained for typical problems arising in a given discipline. During the tutorials the students are engaged in solving exercises, revising lecture material under supervision and with assistance of the lecturer or tutor. At the tutorials students will be encouraged to attempt related problem in advance of the session and to be prepared to ask and answer questions relating to the material. Tutorials are accompanied with homework assignments that are designed to assist students in the student-centred learning, the completion of coursework and exam preparation. Some of the tutorials are conducted in computer laboratories, where students will have the opportunity to learn to use software designed for solving applied problems. Computer laboratories classes are supervised by the module tutor or their assistants. Team-work learning is introduced in year 1 as a group-study module component. In year 2 the students are engaged in group projects. Elements of independent research tasks are introduced. The optional placement between year 2 and 3 will provide links with businesses or administrative bodies with prospects of future employment. In year 3 and 4 the students will be involved in advanced experimental or theoretical physics project in a research related topic. A significant proportion of time is spent within a teaching laboratory and students gain experience in handling a range of physical equipment and instruments. Organisation of laboratory class will ensure that demonstrators are available to support small groups of students. University research laboratories and equipments facilities will be available for project work. Elements of independent research tasks are introduced in the projects where appropriate. The project in year 4 is double the size of project of year 3 and is at M-level.

The optional work placement year aims to provide links with businesses or administrative bodies. Provision of a work placement year will be governed by the University's Placement Policy and regulations as outlined in Section 14 of Quality Assurance Manual. Placement providers will be approved by the University and will be bound by specific agreements setting out rights, responsibilities and obligations of the parties. Placement provision will be managed by a dedicated placement officer conducting ongoing monitoring the quality and effectiveness of the educational process, as well as legal and health and safety aspects.

The optional Pedagogy module in year 3, delivered by School of Education, aims to give an insight into the teaching of Physics at secondary school level by combining university lectures with an experience of a placement in a secondary school. Such a placement will be governed by the University's Placement Policy and regulations as outlined in Section 14 of Quality Assurance Manual. Students will be under the supervision of the class teacher at all times and the schools will sign an agreement on responsibilities and obligations of the parties.

Mathematics and physics Support Group will be conducting diagnostic tests at the beginning of year 1 to determine gaps or weaknesses in basic skills. The outcome of these tests will be taken into account in issuing recommendations for the delivery of modules and in providing help to students via tutorials or problem-solving sessions.

All modules host a site on the Virtual Learning environment where students can access information such as lecture slides, workshop tasks, hand-in dates for assignment work etc. Programme briefing documents and additional study materials are delivered via the VLE as part of a responsive, locally managed, service.

Knowledge and understanding are developed in a number of ways: student engagement and participation in scheduled activities such as lectures, workshops, laboratories and tutorials; following directed reading and undertaking wider reading and study; through primary and secondary research activity such as using the physical library or the stock of on-line journals and e-books.

Subject specific intellectual skills are developed in a number of ways: by engaging with the formative and summative assessment tasks; by peer review, self-appraisal and self-evaluation; being challenged to justify assumptions and recommendations made.

Subject specific practical skills are developed in a number of ways: by using experimental equipment, software tools and packages; using various applications for generation of documents; developing research techniques to analyse, evaluate and justify solutions.

Transferable skills and attributes are developed in a number of ways: planning and executing activities; undertaking project work; managing time in routine and deadline situations; working as a member and/or as a leader of a team.

5.1.2. Tutoring.
Each student is assigned a personal tutor at the start of their programme. Students will have a regularly scheduled meeting with their tutor to discuss progress and to monitor performance and engagement and aims to provide a forum for frank exchange and to ask questions and raise issues. Meetings will often take place in small groups of approximately six students but could occasionally be on an individual basis to promote open and free discussion.

5.1.3. Dynamics of teaching and learning approaches.
In the early stages of the programme emphasis is placed on managed approaches to knowledge acquisition and the development of core understanding. The primary delivery vehicles at this stage are lectures. Plenary workshop activities, tutorial and laboratory provide an opportunity for review of material and practical application. These devices attempt to establish important conceptual frameworks; to foster an appropriate value set and to provide a map of the discipline and those aspects that will be key points for further study. Workshops and practical exercises more usually support skill development curricula and learning materials are used extensively to facilitate individually paced skill acquisition and development. The programme is largely common with other programmes, giving a broad basis of understanding, and the possibility to interact with students in other related programmes.
As the study programme progresses project-based and student-led/tutor directed approaches are introduced to encourage the notion of learner independence and to promote application of developing competencies. These include the group project in year 2 and more substantial project in years 3 and 4. The tendency at this stage is for more modules to challenge student assimilation, ability to apply and critique. Options are introduced, allowing students to tune the programme to their own interests and abilities, drawing upon the material available from other programmes in the School.
Throughout all levels of study students are presented with opportunities to engage in tutorial support, either physically or virtually to ensure appropriate transferable and subject specific skills are

appropriately developed. Learning in project based modules is typically negotiated between supervisor and student in an effort to establish scope and to specify assessment requirements. Opportunities for students to become familiar with and ultimately involved in research activity are actively promoted and supported by the University's "Student As Producer" initiative. Students are offered the opportunity to attend University based seminars and workshops either directly or indirectly connected to their programme of study.

5.1.4. Student as Producer Principles
The programme implements many elements of the Student as Producer framework. Problem solving is one of the most important parts of the teaching, learning and assessment strategy. In lectures, tutorials and assignments throughout the programme students will encounter a variety of problems, both of familiar and unfamiliar nature. In individual and group projects student will also encounter open-ended research problems. Problem solving is traditionally an active method of learning the core material and all core modules will incorporate tutorials which mostly address problem solving and development of problem-solving skills. These tutorial seminars provide opportunity for students to work individually or in groups and for peer collaboration and tutoring. Core module assignments and examinations will assess problem solving learning outcomes. Outputs of group study at level 1, of group projects at level 2 and individual projects at level 3 and 4 will consist of reports and presentations to student audiences thus encouraging students' criticism and evaluation. Team work in group projects will be encouraged to reflect the variety of environments likely to be encountered by graduates in employment.

Modules at level 3 and 4 are informed by academic staff research. Parts of lectures will be based on personal research activities. Research papers will be used as part of the teaching material for individual and group projects, in which students will works as researchers. Team work on these tasks will be encouraged along with independent work to reflect the variety of environments likely to be encountered by graduates in employment. Project based learning plays a significant role starting from level 2. Student may also be involved in applications specialistic knowledges in various external placements during the optional "sandwiched" year. Students will be involved in the planning and design of the project and will present their findings using a range of formats thus providing a full experience of working as a researcher.
• Technology will be widely used in teaching and learning, as well as in students' experience. Blackboard will be used to provide module information and teaching material and to engage with students through discussion groups and on-line teaching activities. Computational modules will use a range of software packages. Databases of libraries, review journals and publishers will be extensively used.
• The learning environment includes computer-aided projectors, as well as traditional "chalk-and-talk" methods on white boards. Access to the on-campus computing will facilitate using on-line resources including software packages.
• Learning is supported by a core pack of textbooks covering all modules. A range of other supporting texts and journals are available through the library. The library also provides a range of workshops to support learning skills and these are made available to all students.
• A number of mechanisms are used to obtain student views about their learning. Subject committees are an important forum for obtaining feedback through elected student representations however representations are encouraged to work closely with programme teams throughout the academic year to ensure that issues are resolved in a timely manner. Other mechanisms for obtaining feedback include meetings with academic tutors, student meetings with external examiners, module evaluation forms and discussion groups.
• Employability of graduates is an integral part of the curriculum, which gives an opportunity to

develop in students both specific skills and general capabilities of logical and analytical thinking.

The graduates will have been introduced to applications of computing skills and the use of IT resources, and will be given opportunities to develop ability to work both independently and in collaborative groups. These are qualities which are in demand across a broad range of stimulating and rewarding careers in various walks of life where analytical problems arise, including science and technology, engineering, computing, medicine, education, consultancy, business and finance, and administrative bodies. The degree also opens an opportunity to advanced and post-graduate studies, with possibilities of participating in research. The optional placement year gives opportunity to provide links with businesses or administrative bodies and enhance opportunities of finding employment or/and sources of funding.

5.2. Assessment Strategy

A variety of assessment methods are used that enable students to demonstrate attainment of the programme learning outcomes. Methods include:

- time-constrained examinations;
- problem based assignments;
- on-line tests;
- laboratory books and reports;
- observation of practical skills;
- individual and group project reports;
- oral and/or poster presentations;
- essays;
- project artefacts such as computer programs or electronic circuits;
- peer and self assessment.

Assessment is a fundamental component of the teaching and learning process and is used to enable the student to confirm their achievement of learning outcomes. It is seen, therefore, as having two functions – formative and summative. Formative assessment is primarily delivered in small group tutorials, or team-based settings relating to continuous assessment of problem-solving activities or project work. Formative feedback forms the basis for routine structured feedback to students. Summative assessment is derived from examinations, and written assignments and reports as final module assessments. Summative feedback also provides a vehicle for student feedback, either through discussion of individual pieces or as part of overall performance profiling within personal academic tutoring.

The assessment modes for each module are chosen to appropriately respond to subject content and learning outcomes and also to acknowledge the maturity and sophistication of the candidate group. Lecture-based modules are usually assessed through a mixture of examinations as tests of knowledge and understanding and coursework. Submissions of coursework items take place either in written form to the lecturer, or by upload to the Virtual Learning Environment (VLE). Wherever appropriate, submissions are subject to plagiarism detection software: students are made aware of this and are provided with support and guidance concerning plagiarism and other academic offences. Tutors mark coursework either in written form on the students' homework scripts or via the VLE, and feedback to students is provided through the same medium. In Levels 3 and 4 students undertake a substantial project activity that affords the opportunity for significant practical and research focused activity and individual.

• Knowledge and understanding.
Summative assessment of knowledge and understanding is achieved through traditional-style examinations that are used at each stage of the course. At Level 3 and 4, reports on the results of work on individual projects are used as summative assessment vehicles, primary scientific literature is used for assessing abilities to engage with, and critically evaluate research level material.

• Subject specific intellectual skills.
Analysis of information and problem solving is assessed through a range of methods primarily problem-solving exercises in continuous assessment and examinations. Problem-solving activities are assessed continuously through tutorials and homework, which are a primary vehicle for student feedback and reflection. Individual and group projects also incorporate problem-solving activities; problems in these contexts are open-ended and contribute to the development and assessment of research and transferable skills.

• Subject specific practical skills.
In physical studies practical skills include skills of using computers for problem-solving, for experimental laboratory, for preparing presentations, for using word-processing software, and using library and on-line bibliography resources. A variety of assessment types are used for assessment of these skills. Using computers for problem-solving is assessed within the overall ambient procedures related to coursework and assignments. Competence in data acquisition, recording and analysis is assessed through inspection of project and coursework outputs. Student portfolios are used to verify the acquisition of manipulative and practical skills. Familiarity with a range of formal reporting methods is assessed through formally submitted reports, which also form the basis for summative assessment in individual and group projects.

• Research skills are assessed through individual projects.
These include project planning through a portfolio of tasks, execution of the planned work that is assessed continuously by the project supervisor and through the written report, analysis and interpretation of results that are assessed by the written report and individual or group presentation.

• Presentation and written communication skills are assessed at all levels.
Written skills are assessed using a range of written tasks that include coursework homework assignments, refereeing of scientific articles, literature reviews, writing up reports. Feedback to students is provided throughout the programme, which will teach students to produce written outputs corresponding to recognised professional practice. These outputs include presentations, structure and quality of writing that would satisfy the criteria for publication. Oral presentations are assessed formatively in group-working and seminar contexts. These include both individual and group presentations. Summative assessment of presentation skills is through group and individual presentations of the reports. Peer assessment of presentation skills is additionally used for informal feedback.

The Assessment Map gives a top-level indication of the scheduling and distribution of assessment modes within the programme. Details of module assessment strategy are included with each module specification.

6. Programme Structure

The total number of credit points required for the achievement of Certificate of Higher Education (CertHE) is 120.
The total number of credit points required for the achievement of Diploma of Higher Education (DipHE) is 240.
The total number of credit points required for the achievement of Bachelor of Science with Honours (BSc (Hons)) is 360.
The total number of credit points required for the achievement of Master of Physics (MPhys) is 480.

Level 1

Title	Credit Rating	Core / Optional
Laboratory 1 2019-20	15	Core
Geometrical Optics, Waves and Mechanics 2019-20	15	Core
Electricity, Magnetism, Thermal and Quantum Physics 2019-20	15	Core
Calculus 2019-20	15	Core
Probability and Statistics 2019-20	15	Core
Linear Algebra 2019-20	15	Core
Computer Algebra and Technical Computing 2019-20	15	Core
Professional Skills and Group Study 2019-20	15	Core

Level 2

Title	Credit Rating	Core / Optional
Electrodynamics 2020-21	15	Core
Scientific Computing 2020-21	15	Core
Lagrangian and Hamiltonian Mechanics 2020-21	15	Core
Condensed Matter Physics 2020-21	15	Core
Laboratory 2 2020-21	15	Core
Differential Equations 2020-21	15	Core
Group Project 2020-21	15	Core
Industrial and Econo-Physics 2020-21	15	Core

Level 3

Title	Credit Rating	Core / Optional
Quantum Mechanics 2021-22	15	Core
Statistical Mechanics 2021-22	15	Core
Physics of the Universe 2021-22	15	Core
Numerical Methods 2021-22	15	Core
Fluid Dynamics 2021-22	15	Optional
Methods of Mathematical Physics 2021-22	15	Optional
Physics Pedagogy 2021-22	15	Optional
Physics Project 2021-22	30	Core
Advanced Topics of Physics and Physics Seminar 2021-22	15	Core

Level 4

Title	Credit Rating	Core / Optional
Molecular Modelling 2022-23	15	Core
Theoretical Physics Laboratory 2022-23	15	Optional
Advanced Instrumentation 2022-23	15	Optional
Nano-Physics 2022-23	15	Core
Financial Kinetics 2022-23	15	Core
Physics Masters Project 2022-23	60	Core

Appendix I - Curriculum Map

This table indicates which modules assume responsibility for delivering and ordering particular programme learning outcomes.

Key: ✓ Delivered and Assessed Delivered ✓ Assessed

Level 1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Calculus 2019-20							✓					
Computer Algebra and Technical Computing 2019-20							✓	✓				
Electricity, Magnetism, Thermal and Quantum Physics 2019-20	✓	✓	✓			✓						
Geometrical Optics, Waves and Mechanics 2019-20	✓	✓				✓						
Laboratory 1 2019-20	✓			✓		✓						
Linear Algebra 2019-20							✓					
Probability and Statistics 2019-20							✓					
Professional Skills and Group Study 2019-20								✓	✓			

	PO101	PO102	PO103	PO104	PO105	PO106	PO107	PO108	PO201	PO202	PO203	PO204
Calculus 2019-20									✓			
Computer Algebra and Technical Computing 2019-20				✓					✓	✓		
Electricity, Magnetism, Thermal and Quantum Physics 2019-20	✓	✓							✓			
Geometrical Optics, Waves and Mechanics 2019-20	✓	✓							✓			
Laboratory 1 2019-20			✓	✓	✓						✓	✓
Linear Algebra 2019-20									✓			

Probability and Statistics 2019-20	✓			✓					✓			
Professional Skills and Group Study 2019-20			✓	✓	✓					✓		

	PO205	PO206	PO301	PO302	PO303	PO304	PO305	PO306	PO307	PO308	PO309	PO310
Calculus 2019-20							✓					
Computer Algebra and Technical Computing 2019-20				✓			✓	✓				
Electricity, Magnetism, Thermal and Quantum Physics 2019-20			✓	✓			✓					
Geometrical Optics, Waves and Mechanics 2019-20							✓					
Laboratory 1 2019-20			✓			✓	✓		✓			
Linear Algebra 2019-20							✓					
Probability and Statistics 2019-20				✓			✓					
Professional Skills and Group Study 2019-20					✓			✓	✓	✓		

Level 2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Condensed Matter Physics 2020-21	✓	✓	✓			✓						
Differential Equations 2020-21							✓					
Electrodynamics 2020-21	✓	✓				✓						
Group Project 2020-21		✓								✓		
Industrial and Econo-Physics 2020-21	✓	✓			✓							
Laboratory 2 2020-21				✓		✓						
Lagrangian and Hamiltonian Mechanics 2020-21	✓	✓				✓	✓					
Scientific Computing 2020-21								✓				

	PO10	PO10	PO10	PO10	PO10	PO10	PO10	PO10	PO20	PO20	PO20	PO20

	1	2	3	4	5	6	7	8	1	2	3	4
Condensed Matter Physics 2020-21	✓	✓							✓			
Differential Equations 2020-21		✓							✓			
Electrodynamics 2020-21	✓								✓			
Group Project 2020-21		✓	✓		✓					✓		✓
Industrial and Econo-Physics 2020-21	✓		✓	✓					✓			
Laboratory 2 2020-21	✓		✓	✓	✓						✓	✓
Lagrangian and Hamiltonian Mechanics 2020-21	✓	✓							✓			
Scientific Computing 2020-21	✓	✓		✓						✓		

	PO205	PO206	PO301	PO302	PO303	PO304	PO305	PO306	PO307	PO308	PO309	PO310
Condensed Matter Physics 2020-21							✓					
Differential Equations 2020-21				✓			✓					
Electrodynamics 2020-21							✓					
Group Project 2020-21			✓		✓	✓	✓			✓	✓	
Industrial and Econo-Physics 2020-21							✓					
Laboratory 2 2020-21			✓			✓	✓		✓			
Lagrangian and Hamiltonian Mechanics 2020-21							✓					
Scientific Computing 2020-21				✓				✓				

Level 3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Advanced Topics of Physics and Physics Seminar 2021-22	✓	✓	✓			✓						
Fluid Dynamics 2021-22	✓	✓	✓			✓	✓					
Methods of Mathematical Physics 2021-22	✓						✓					
Numerical Methods 2021-22							✓	✓				

Physics of the Universe 2021-22	✓	✓				✓						
Physics Pedagogy 2021-22					✓				✓			
Physics Project 2021-22										✓		
Quantum Mechanics 2021-22	✓	✓				✓						
Statistical Mechanics 2021-22	✓	✓				✓						

	PO101	PO102	PO103	PO104	PO105	PO106	PO107	PO108	PO201	PO202	PO203	PO204
Advanced Topics of Physics and Physics Seminar 2021-22			✓		✓				✓			
Fluid Dynamics 2021-22	✓			✓					✓			
Methods of Mathematical Physics 2021-22	✓	✓							✓			
Numerical Methods 2021-22	✓	✓	✓	✓					✓	✓		
Physics of the Universe 2021-22	✓								✓			
Physics Pedagogy 2021-22		✓			✓							
Physics Project 2021-22	✓	✓	✓	✓	✓	✓						
Quantum Mechanics 2021-22	✓	✓		✓					✓			
Statistical Mechanics 2021-22	✓	✓		✓					✓			

	PO205	PO206	PO301	PO302	PO303	PO304	PO305	PO306	PO307	PO308	PO309	PO310
Advanced Topics of Physics and Physics Seminar 2021-22			✓		✓	✓	✓					
Fluid Dynamics 2021-22			✓	✓			✓					
Methods of Mathematical Physics 2021-22			✓				✓					
Numerical Methods 2021-22			✓	✓			✓	✓				
Physics of the Universe 2021-22			✓				✓					
Physics Pedagogy 2021-22							✓		✓			
Physics Project 2021-22			✓	✓	✓	✓			✓		✓	
Quantum Mechanics 2021-22			✓	✓			✓					
Statistical Mechanics 2021-22			✓	✓			✓					

Level 4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Advanced Instrumentation 2022-23				✓		✓					✓	
Financial Kinetics 2022-23	✓						✓				✓	
Molecular Modelling 2022-23	✓	✓	✓			✓		✓			✓	
Nano-Physics 2022-23	✓	✓	✓			✓					✓	
Physics Masters Project 2022-23	✓	✓		✓		✓		✓			✓	✓
Theoretical Physics Laboratory 2022-23	✓	✓				✓	✓				✓	

	PO101	PO102	PO103	PO104	PO105	PO106	PO107	PO108	PO201	PO202	PO203	PO204
Advanced Instrumentation 2022-23	✓	✓	✓		✓		✓				✓	✓
Financial Kinetics 2022-23		✓		✓					✓			
Molecular Modelling 2022-23	✓	✓		✓	✓		✓			✓		
Nano-Physics 2022-23	✓	✓		✓					✓			
Physics Masters Project 2022-23	✓	✓	✓	✓	✓	✓	✓	✓				
Theoretical Physics Laboratory 2022-23	✓	✓	✓		✓		✓		✓			

	PO205	PO206	PO301	PO302	PO303	PO304	PO305	PO306	PO307	PO308	PO309	PO310
Advanced Instrumentation 2022-23	✓	✓	✓			✓	✓					✓
Financial Kinetics 2022-23		✓					✓					
Molecular Modelling 2022-23		✓		✓		✓	✓	✓	✓			✓
Nano-Physics 2022-23		✓					✓					
Physics Masters Project 2022-23	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Theoretical Physics Laboratory 2022-23		✓					✓					✓

Appendix II - Assessment Map

This table indicates the spread of assessment activity across the programme. Percentages indicate assessment weighting.

Level 1

	01	02	03	04	05	06	07	08	09	10	11	12
Calculus 2019-20												40
Computer Algebra and Technical Computing 2019-20												
Electricity, Magnetism, Thermal and Quantum Physics 2019-20												
Geometrical Optics, Waves and Mechanics 2019-20											50	
Laboratory 1 2019-20												
Linear Algebra 2019-20												
Probability and Statistics 2019-20												
Professional Skills and Group Study 2019-20												

	13	14	15	16	17	18	19	20	21	22	23	24
Calculus 2019-20				60								
Computer Algebra and Technical Computing 2019-20												
Electricity, Magnetism, Thermal and Quantum Physics 2019-20												
Geometrical Optics, Waves and Mechanics 2019-20				50								
Laboratory 1 2019-20												
Linear Algebra 2019-20												
Probability and Statistics 2019-20												
Professional Skills and Group Study 2019-20	50											

	25	26	27	28	29	30	31	32	33	34	35	36
Calculus 2019-20												
Computer Algebra and Technical Computing 2019-20							100					
Electricity, Magnetism, Thermal and Quantum Physics 2019-20						50						
Geometrical Optics, Waves and Mechanics 2019-20												
Laboratory 1 2019-20								100				
Linear Algebra 2019-20							40					
Probability and Statistics 2019-20						40						
Professional Skills and Group Study 2019-20								50				

	37	38	39	40	41	42	43	44	45	46	47	48
Calculus 2019-20												
Computer Algebra and Technical Computing 2019-20												
Electricity, Magnetism, Thermal and Quantum Physics 2019-20												
Geometrical Optics, Waves and Mechanics 2019-20												
Laboratory 1 2019-20												
Linear Algebra 2019-20												
Probability and Statistics 2019-20												
Professional Skills and Group Study 2019-20												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Calculus 2019-20						
Computer Algebra and Technical Computing 2019-20						

Electricity, Magnetism, Thermal and Quantum Physics 2019-20												50
Geometrical Optics, Waves and Mechanics 2019-20												
Laboratory 1 2019-20												
Linear Algebra 2019-20												60
Probability and Statistics 2019-20												60
Professional Skills and Group Study 2019-20												

Level 2

	01	02	03	04	05	06	07	08	09	10	11	12
Condensed Matter Physics 2020-21												
Differential Equations 2020-21												40
Electrodynamics 2020-21												40
Group Project 2020-21												
Industrial and Econo-Physics 2020-21												
Laboratory 2 2020-21												
Lagrangian and Hamiltonian Mechanics 2020-21											40	
Scientific Computing 2020-21												

	13	14	15	16	17	18	19	20	21	22	23	24
Condensed Matter Physics 2020-21												
Differential Equations 2020-21				60								
Electrodynamics 2020-21				60								
Group Project 2020-21												
Industrial and Econo-Physics 2020-21												
Laboratory 2 2020-21												
Lagrangian and Hamiltonian Mechanics 2020-21				60								
Scientific Computing 2020-21												

	25	26	27	28	29	30	31	32	33	34	35	36
Condensed Matter Physics 2020-21				40								
Differential Equations 2020-21												
Electrodynamics 2020-21												
Group Project 2020-21								100				
Industrial and Econo-Physics 2020-21	70						30					
Laboratory 2 2020-21				100								
Lagrangian and Hamiltonian Mechanics 2020-21												
Scientific Computing 2020-21							80				20	

	37	38	39	40	41	42	43	44	45	46	47	48
Condensed Matter Physics 2020-21												
Differential Equations 2020-21												
Electrodynamics 2020-21												
Group Project 2020-21												
Industrial and Econo-Physics 2020-21												
Laboratory 2 2020-21												
Lagrangian and Hamiltonian Mechanics 2020-21												
Scientific Computing 2020-21												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Condensed Matter Physics 2020-21						60
Differential Equations 2020-21						
Electrodynamics 2020-21						
Group Project 2020-21						
Industrial and Econo-Physics 2020-21						
Laboratory 2 2020-21						

Lagrangian and Hamiltonian Mechanics 2020-21												
Scientific Computing 2020-21												

Level 3

	01	02	03	04	05	06	07	08	09	10	11	12
Advanced Topics of Physics and Physics Seminar 2021-22												
Fluid Dynamics 2021-22											40	
Methods of Mathematical Physics 2021-22											40	
Numerical Methods 2021-22												
Physics of the Universe 2021-22												
Physics Pedagogy 2021-22												100
Physics Project 2021-22												
Quantum Mechanics 2021-22											40	
Statistical Mechanics 2021-22												

	13	14	15	16	17	18	19	20	21	22	23	24
Advanced Topics of Physics and Physics Seminar 2021-22												
Fluid Dynamics 2021-22				60								
Methods of Mathematical Physics 2021-22				60								
Numerical Methods 2021-22	50											
Physics of the Universe 2021-22											50	
Physics Pedagogy 2021-22												
Physics Project 2021-22												
Quantum Mechanics 2021-22				60								
Statistical Mechanics 2021-22												

	25	26	27	28	29	30	31	32	33	34	35	36
Advanced Topics of Physics and Physics						100						

Seminar 2021-22												
Fluid Dynamics 2021-22												
Methods of Mathematical Physics 2021-22												
Numerical Methods 2021-22								50				
Physics of the Universe 2021-22							50					
Physics Pedagogy 2021-22												
Physics Project 2021-22								100				
Quantum Mechanics 2021-22												
Statistical Mechanics 2021-22					40							

	37	38	39	40	41	42	43	44	45	46	47	48
Advanced Topics of Physics and Physics Seminar 2021-22												
Fluid Dynamics 2021-22												
Methods of Mathematical Physics 2021-22												
Numerical Methods 2021-22												
Physics of the Universe 2021-22												
Physics Pedagogy 2021-22												
Physics Project 2021-22												
Quantum Mechanics 2021-22												
Statistical Mechanics 2021-22												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Advanced Topics of Physics and Physics Seminar 2021-22						
Fluid Dynamics 2021-22						
Methods of Mathematical Physics 2021-22						
Numerical Methods 2021-22						
Physics of the Universe 2021-22						
Physics Pedagogy 2021-22						

Physics Project 2021-22												
Quantum Mechanics 2021-22												
Statistical Mechanics 2021-22												60

Level 4

	01	02	03	04	05	06	07	08	09	10	11	12
Advanced Instrumentation 2022-23												
Financial Kinetics 2022-23											40	
Molecular Modelling 2022-23												100
Nano-Physics 2022-23											40	
Physics Masters Project 2022-23												
Theoretical Physics Laboratory 2022-23												

	13	14	15	16	17	18	19	20	21	22	23	24
Advanced Instrumentation 2022-23	100											
Financial Kinetics 2022-23				60								
Molecular Modelling 2022-23												
Nano-Physics 2022-23				60								
Physics Masters Project 2022-23												
Theoretical Physics Laboratory 2022-23	100											

	25	26	27	28	29	30	31	32	33	34	35	36
Advanced Instrumentation 2022-23												
Financial Kinetics 2022-23												
Molecular Modelling 2022-23												
Nano-Physics 2022-23												
Physics Masters Project 2022-23								100				
Theoretical Physics Laboratory 2022-23												

	37	38	39	40	41	42	43	44	45	46	47	48

Advanced Instrumentation 2022-23												
Financial Kinetics 2022-23												
Molecular Modelling 2022-23												
Nano-Physics 2022-23												
Physics Masters Project 2022-23												
Theoretical Physics Laboratory 2022-23												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Advanced Instrumentation 2022-23						
Financial Kinetics 2022-23						
Molecular Modelling 2022-23						
Nano-Physics 2022-23						
Physics Masters Project 2022-23						
Theoretical Physics Laboratory 2022-23						

Appendix III - Benchmark Analysis

This table maps programme learning outcomes to relevant QAA subject benchmark statements or PSRB guidelines.

Knowledge and Understanding

	PAAHons01	PAAHons02	PAAHons03	PAAHons04	PAAHons05	PAAHons06	PAAHons07	PAAHons08	PAAHons09
PO1	✓								✓
PO2	✓	✓							✓
PO3	✓								✓
PO4			✓	✓					
PO5	✓								
PO6									✓
PO7									
PO8					✓	✓			
PO9	✓								✓
PO10			✓			✓			
PO11									
PO12									

	PAAHons10	PAAHons11	PAAHons12	PAAHons13	PAAHons14	PAAHons15	PAAHons16	PAAHons17	PAAMstr01
PO1									
PO2									
PO3									
PO4		✓	✓						
PO5									
PO6									
PO7	✓					✓			
PO8					✓				
PO9									

PO10									
PO11									✓
PO12									

	PAAMstr02	PAAMstr03	PAAMstr04	PAAMstr05	PAAMstr06	PAAMstr07	PAAMstr08	PAAMstr09
PO1								
PO2								
PO3								
PO4								
PO5								
PO6								
PO7								
PO8								
PO9								
PO10								
PO11	✓	✓				✓		
PO12						✓		

Subject Specific Intellectual Skills

	PAAHons01	PAAHons02	PAAHons03	PAAHons04	PAAHons05	PAAHons06	PAAHons07	PAAHons08	PAAHons09
PO101		✓	✓						
PO102		✓							
PO103			✓		✓			✓	
PO104					✓	✓			
PO105							✓		
PO106									
PO107		✓							
PO108									

	PAAHons10	PAAHons11	PAAHons12	PAAHons13	PAAHons14	PAAHons15	PAAHons16	PAAHons17	PAAMstr01
PO101	✓								
PO102									
PO103				✓				✓	
PO104				✓					
PO105							✓		
PO106		✓					✓		
PO107									
PO108									

	PAAMstr02	PAAMstr03	PAAMstr04	PAAMstr05	PAAMstr06	PAAMstr07	PAAMstr08	PAAMstr09
PO101								
PO102								
PO103								
PO104								
PO105								
PO106						✓	✓	
PO107			✓	✓				
PO108			✓			✓		✓

Subject Specific Practical Skills

	PAAHons01	PAAHons02	PAAHons03	PAAHons04	PAAHons05	PAAHons06	PAAHons07	PAAHons08	PAAHons09
PO201									
PO202					✓	✓			
PO203				✓					
PO204									
PO205									
PO206									

	PAAHons10	PAAHons11	PAAHons12	PAAHons13	PAAHons14	PAAHons15	PAAHons16	PAAHons17	PAAMstr01
PO201	✓				✓	✓			
PO202				✓	✓				
PO203			✓						
PO204			✓						
PO205									
PO206									

	PAAMstr02	PAAMstr03	PAAMstr04	PAAMstr05	PAAMstr06	PAAMstr07	PAAMstr08	PAAMstr09
PO201								
PO202								
PO203								
PO204								
PO205			✓	✓				
PO206	✓				✓	✓		

Transferable Skills and Attributes

	PAAHons01	PAAHons02	PAAHons03	PAAHons04	PAAHons05	PAAHons06	PAAHons07	PAAHons08	PAAHons09
PO301		✓							
PO302		✓	✓						
PO303								✓	
PO304							✓		
PO305									
PO306					✓				
PO307									
PO308									
PO309									

PO310									

	PAAHons10	PAAHons11	PAAHons12	PAAHons13	PAAHons14	PAAHons15	PAAHons16	PAAHons17	PAAMstr01
PO301									
PO302									
PO303								✓	
PO304							✓		
PO305	✓	✓							
PO306				✓					
PO307								✓	
PO308							✓	✓	
PO309							✓	✓	
PO310									

	PAAMstr02	PAAMstr03	PAAMstr04	PAAMstr05	PAAMstr06	PAAMstr07	PAAMstr08	PAAMstr09
PO301								
PO302								
PO303								
PO304								
PO305								
PO306								
PO307								
PO308								
PO309								
PO310								✓

Appendix IV:
Benchmark Benchmark Statement(s)

PAAHons01 - *Demonstrate a basic knowledge and understanding of physical laws and principles, and some application of these principles.*

PAAHons02 - *An ability to identify relevant principles and laws when dealing with problems.*

PAAHons03 - *The ability to execute and analyse the results of an experiment or investigation...*

PAAHons04 - *A familiarity with basic laboratory apparatus if on an experimental programme.*

PAAHons05 - *Competent use of appropriate ICT packages/systems for the analysis of data and the retrieval of appropriate information.*

PAAHons06 - *An ability in numerical manipulation and the ability to present and interpret information graphically.*

PAAHons07 - *An ability to communicate scientific information, in particular through scientific reports.*

PAAHons08 - *An ability to manage their own learning and to make use of appropriate texts and learning materials.*

PAAHons09 - *Demonstrate a knowledge and understanding of most fundamental physical laws and principles, and competence in the application of these principles to diverse areas of physics.*

PAAHons10 - *An ability to solve problems in physics using appropriate mathematical tools. Students should be able to identify the relevant physical principles and make approximations necessary to obtain solutions.*

PAAHons11 - *The ability to execute and analyse critically the results of an experiment or investigation and draw valid conclusions...*

PAAHons12 - *A sound familiarity with laboratory apparatus and techniques if on experimental programmes.*

PAAHons13 - *Effective use of appropriate ICT packages/systems for the analysis of data and the retrieval of appropriate information.*

PAAHons14 - *An ability in numerical manipulation and the ability to present and interpret information graphically.*

PAAHons15 - *An ability to use mathematical techniques and analysis to model physical behaviour.*

PAAHons16 - *An ability to communicate scientific information. In particular, students should be able to produce clear and accurate scientific reports.*

PAAHons17 - *An ability to manage their own learning and to make use of appropriate texts, research-based materials or other learning resources.*

PAAMstr01 - *Demonstrated an understanding of most fundamental laws and principles of physics, along with their application to a variety of areas in physics, some of which are at (or are informed by)*

the forefront of the discipline.

PAAMstr02 - *Demonstrated an ability to solve advanced problems in physics using appropriate mathematical tools...*

PAAMstr03 - *Demonstrated the ability to use mathematical techniques and analysis to model physical behaviour and interpret mathematical descriptions of physical phenomena.*

PAAMstr04 - *Demonstrated the ability to plan and execute under supervision an experiment or investigation, analyse critically the results and draw valid conclusions...*

PAAMstr05 - *Demonstrated experimental skills showing the competent use of specialised equipment, the ability to identify appropriate pieces of equipment and to master new techniques and equipment (applies to students on experimental programmes)*

PAAMstr06 - *Demonstrated effective use of ICT skills at the level needed for project work; for example, a familiarity with a programming language, simulation software, or the use of mathematical packages for manipulation and numerical solution of equations.*

PAAMstr07 - *Demonstrated a working knowledge of a variety of experimental, mathematical and/or computational techniques applicable to current research within physics.*

PAAMstr08 - *Demonstrated the ability to communicate complex scientific ideas, the conclusions of an experiment, investigation or project concisely, accurately and informatively.*

PAAMstr09 - *Demonstrated the ability to manage their own learning and to make use of appropriate texts, research articles and other primary sources.*