

IOP Institute of Physics

Degree Accreditation Framework

Principles and key expectations

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Institute of Physics Degree Accreditation Scheme

Institute of Physics and degree accreditation

The Institute of Physics is the professional body and learned society for physics in the UK and Ireland, inspiring people to develop their knowledge, understanding and enjoyment of physics.

The Institute of Physics has carried out an assessment of physics and physics-related programmes in higher education throughout the UK and Ireland since the 1970s. Our formal degree accreditation process was introduced in 1993 and contributes to our Royal Charter obligation

to establish, uphold and advance the standards of qualification, competence and conduct of those who practise physics;

and

to promote, encourage, guide and cooperate in the education and training of those who wish to be or are practising as physicists or assistants to physicists or are interested in physics or in subjects connected therewith;

Our degree accreditation scheme is designed to promote good practice in the higher education of physicists and to support the development of graduates that are knowledgeable, skilled and competent as they enter employment.

About this document

This document describes the accreditation process including what is expected in an accredited degree programme and what type of degrees can be accredited. The accreditation framework consists of a set of principles and key expectations which set the baseline for accreditation. The accreditation framework will allow universities more flexibility in programme design, teaching and assessment.

The principles and key expectations are presented followed by specific requirements and examples as to how they may be met. Additional guidance and examples of good practice will be provided separately as these will be regularly updated.

It is the intention that degree accreditation be a supportive process and that the application be as streamlined as possible.

Benefits of accreditation

Degree accreditation is an externally validated mark of assurance that agreed standards are being met. Accreditation provides a marketing advantage for universities and ensures the needs of employers and students are considered. It provides credibility through peer review which is designed to evaluate and enhance physics programmes.

Accreditation process

The accreditation scheme is a peer review process run in collaboration with the higher education community. The process is overseen by the Degree Accreditation Committee (DAC) which is drawn from the academic community and also has employer representation.

Each application for accreditation is assessed by a trained panel consisting of two to four peer-assessors and one or two IOP staff assessors. The assessment panel will assess an application against the published accreditation criteria and make a recommendation to the DAC. The DAC makes the final decision based on the panel report.

Accreditation is granted for a maximum of five years. Continued accreditation throughout the period is dependent on the programmes meeting accreditation requirements. The responsibility lies with the accredited university to ensure that changes made to accreditation programmes do not adversely affect their accreditation. Universities must inform the Institute of Physics of any subsequent changes to their accredited programmes, especially if the structure or content changes. If the changes are major, we will carry out a light touch paper-based interim review to ensure that accreditation requirements are still being met. Failure to advise us of changes that are later found to breach accreditation requirements will result in the loss of accreditation from the point at which the change was made.

It is our intention that accreditation should be seen as beneficial and advantageous to universities and that this goes beyond the external mark of validation. We wish to encourage a wider engagement with us so we all work together to enhance the teaching of physics at university level. The interaction should be seen as two-way and that we are here to support and provide guidance as well as assess. We would encourage all departments to engage with us both directly and also through participation in the IOP Higher Education Group and our various networks.

Degree programmes covered

Degree accreditation is available to taught degree programmes at Bachelor or Master's (MPhys, MSci, MSc) level. The key expectations are clearly marked as to which need to be met by each type of programme.

Bachelor level accreditation (e.g. BSc, BA, MA, BEng)

Programmes at the Bachelor level are eligible for accreditation if they are honours degrees containing at least 50% physics, both overall and in the final year, and meet the key expectations.

Programmes accredited at the Bachelor level meet the educational requirements for Member of the Institute of Physics (MInstP) and for Registered Scientist (RSci) and partially fulfil the educational requirements for Chartered Physicist (CPhys) and Chartered Scientist (CSci).

Integrated Master's accreditation (e.g. MPhys, MSci, MEng)

Integrated Master's programmes are eligible for accreditation if they contain at least 50% physics, both overall and in the final year, and meet the relevant key expectations.

Accredited integrated Master's programmes meet the educational requirements for Member of the Institute of Physics (MInstP) and fulfil the educational requirements for Chartered Physicist (CPhys) and Chartered Scientist (CSci).

Master's accreditation (MSc)

Taught Master's programmes are eligible for accreditation if they follow an appropriate physics-based undergraduate programme and the taught content is at least 50% physics or physics-based.

Accredited Master's programmes meet the Master's equivalence requirement for Chartered Physicist (CPhys) and Chartered Scientist (CSci). When coupled with an Institute of Physics accredited undergraduate programme the educational requirements for CPhys and CSci are fully met.

Physics content

Straight physics degree programmes should contain at least 80% physics, major physics degrees should contain at least 65% physics and joint degrees must contain at least 50% physics. Modules containing physics content need not be taught by the physics department and can include relevant modules from other disciplines such as engineering, mathematics, and chemistry.

Accreditation framework

The framework consists of a set of five overarching principles and thirteen key expectations. The framework however does not sit in isolation and it should be viewed alongside external reference points such as national qualification frameworks and the [QAA Benchmark Statement for Physics, Astronomy and Astrophysics](#). To gain accreditation, universities must demonstrate how they and their degree programmes meet the principles and key expectations.

Employability comes from knowledge, understanding as well as discipline specific and transferable skills provision. Knowledge alone is insufficient and the accreditation process places skills on an equal footing to that of knowledge attainment.

Accreditation Principles

There are a number of overarching principles that accredited programmes and/or the awarding university must meet.

Principle 1 Accredited degree programmes must meet the criteria detailed within the key expectations.

Principle 2 Accredited degree programmes should provide a positive and engaging experience of physics and encourage students to foster and maintain an intellectual curiosity in the discipline.

Principle 3 Universities and physics departments must have robust quality assurance and quality enhancement mechanisms in place and ensure that quality and standards are not compromised.

Principle 4 Universities and physics departments must have a clear commitment to equality, diversity and inclusion and this should be evident within the university and departmental culture, environment and physics curriculum.

Principle 5 Universities must ensure that physics departments are provided with adequate resources to support their accredited degree programmes, to enable the adoption of good teaching practice and to provide students and staff with a supportive environment.

Standards for Institute of Physics accreditation

The criteria for accreditation are detailed in the following list of key expectations. These key expectations should be considered competence standards for physics programmes and as such need to be met by all graduates of accredited programmes. Universities will need to demonstrate how their programmes meet these expectations.

Key expectations (KE) for accreditation			BSc	IM	MSc
Breadth and depth of knowledge	KE1	Evidence that students study the fundamental areas of physics at appropriate times in the course	✓	✓	
	KE2	Evidence that students study the application of the fundamental principles to an appropriate selection of areas of physics relevant to the degree title	✓	✓	
	KE3	Students can demonstrate that they can apply their physics knowledge across topic boundaries and in unrehearsed contexts	✓	✓	✓
	KE4	Students can demonstrate the ability to use mathematics to model, describe and predict phenomena in the real world	✓	✓	✓
	KE5	The content builds on undergraduate knowledge of physics in areas appropriate to the degree title			✓
	KE6	Programmes allow students to demonstrate an appreciation of recent developments in physics	✓	✓	
	KE7	Students can demonstrate the ability to evaluate current research at the forefront of the discipline		✓	✓
Practical skills	KE8	Programmes provide an experience of the practical nature of physics and equip students with a range of practical skills necessary to plan, execute investigations and analyse data	✓	✓	
Investigative and project work	KE9	Programmes must include elements of independent investigative work of an open-ended nature	✓		
	KE10	Programmes must include a substantial project of an open-ended nature		✓	✓
Physics skills	KE11	Students can demonstrate the ability to formulate and tackle problems in physics	✓	✓	✓
Transferable and professional skills	KE12	Programmes must provide training in a broad range of transferable skills and their use should be demonstrated throughout the programme	✓	✓	✓
	KE13	Students can demonstrate appropriate professional skills	✓	✓	✓

Requirements

The following information is provided to assist universities in demonstrating that they meet the requirements for accreditation. Inevitably in attempting to be as concise as possible we cannot cover every eventuality or potential questions. Universities are strongly encouraged to contact the Institute of Physics for clarification where necessary.

Principle 1 Accredited degree programmes must meet the criteria detailed within the key expectations.

The key expectations are the competence standards for an accredited physics degree. They must be met by all students and any reasonable adjustment applied must not compromise this. It is expected that the key expectations will be assessed and contribute to the overall classification for the degree programme.

Refer to individual KEs for specific requirements and examples of how to meet them.

Principle 2 Accredited degree programmes should provide a positive and engaging experience of physics and encourage students to foster and maintain an intellectual curiosity in the discipline.

This aspect has always featured in degree accreditation. Universities must ensure that:

- accredited degrees are delivered by staff who are sufficiently knowledgeable in the areas of physics they are teaching
- the curriculum is designed to enthuse students and support their development into independent and questioning learners
- the degree title accurately reflects the content of the degree programme

Examples of ways to demonstrate this could include:

- show that staff have appropriate qualifications and are committed to ensuring their knowledge of what they are teaching is up to date
- ensuring the curriculum has breadth and is regularly refreshed to include areas of emerging research
- a variety of teaching methods and assessment is used throughout
- assessment mapping to ensure that students are not over assessed or subject to competing deadlines
- undertaking regular evaluations of programmes and modules with student input
- evidence of consultation with employers of physics graduates
- having a peer observation and support process

Principle 3 Universities and physics departments must have robust quality assurance and quality enhancement mechanisms in place and ensure that quality and standards are not compromised.

This aspect has always been covered within degree accreditation and is now being stated explicitly. Universities must ensure that:

- standards are maintained through clear, transparent, equitable assessment, progression and classification regulations that do not include processes that could act to undermine overall standards or lead to grade inflation
- policies such as compensation or condonement should not compromise the attainment of the key expectations or overall programme learning outcomes
- external examiners are appropriately trained and at least one is employed and currently involved with teaching at a university offering IOP accredited physics degrees
- assessment processes are robust with effective oversight and moderation procedures
- there is appropriate consideration of discipline specific requirements when setting policy or procedures that are university wide

Examples of ways to demonstrate this could include:

- provision of assessment, progression and classification regulations
- having one consistent method for calculating degree classifications that is clear and equitable
- evidence of giving due consideration to the comments from external examiners and other external reviews
- having an effective assessment and examination setting and moderation procedure that is adhered to
- provision of detailed assessment marking criteria for each assessment that allows for effective allocation of grades
- having a monitoring process to ensure that examination papers are sufficiently different from year to year
- evidence that discipline specific exemptions have been permitted in policies or procedures

Principle 4 Universities and physics departments must have a clear commitment to equality, diversity and inclusion and this should be evident within the university and departmental culture, environment and physics curriculum.

A requirement to demonstrate a commitment to diversity and inclusion has been present in the accreditation scheme for some time but this is now being enhanced. Universities must ensure that:

- an active commitment to equality, diversity and inclusion is expected of all in the physics department with evidence of actions taken
- robust policies and procedures are in place to protect staff and students and that these are publicised and enforced
- the curriculum reflects the diversity of people who have contributed to physics and that physics is a global endeavour
- the curriculum does not have compulsory or elective elements where students could be discriminated against or be made to feel unwelcome e.g. placements or field trips to countries where women are not treated equally or being LGBTQ+ is illegal
- the curriculum is inclusive and activities are accessible to all students, or where this is not possible, suitable alternatives have been developed that meet the same learning outcomes and as far as possible replicates the student experience

Examples of ways to demonstrate this could include:

- university and/or departmental engagement with diversity schemes, with an action plan and evidence of changes made as a result
- evidence of relevant policies and procedures, their publication and communication to staff and students and data kept on usage
- all staff undertake gender, racism, bullying and harassment awareness training
- lecture capture is in place and used by all staff
- results of diversity and inclusion reviews into module content and changes made as a result
- ensuring that material selected for reading lists include examples of work from global cultures
- proactive inclusivity assessments have been made for all activities with alternatives designed and available should they be needed
- students are actively asked to highlight areas of concern over the curriculum or aspects of the operation of the department where equality, diversity or inclusion could be improved
- development of an accessibility and inclusive teaching plan
- monitoring of student progression and attainment data by gender, ethnicity and declared disability

Principle 5 Universities must ensure that physics departments are provided with adequate resources to support their accredited degree programmes, to enable the adoption of good teaching practice and to provide students and staff with a supportive environment.

This aspect has always been assumed within degree accreditation and is now being stated explicitly. Universities must ensure that:

- the facilities used are appropriate for the teaching of physics
- there is access to appropriate supporting material including textbooks, journals, databases
- computing and laboratory provision is appropriate
- staff are given adequate time and resources to develop their teaching and to engage with continuing professional development (CPD)
- there is a system in place to enable the identification, evaluation and adoption of effective pedagogies
- scholarship of teaching and learning is valued and supported
- there are appropriate student support and feedback mechanisms in place

Examples of ways to demonstrate this could include:

- lecture theatres used by physics are suitable for demonstrations
- experimental laboratories have a wide variety of different experiments with up-to-date equipment
- computer provision is good, regularly updated and students are able to access relevant physics packages, programmes and database offsite using their own equipment
- there is a transparent and equitable work allocation model that is trusted by staff
- time is made available for staff to engage with CPD and budget is available for staff to attend relevant teaching and pedagogy conferences and events
- evidence that staff have updated their teaching and are actively encouraged to try new or innovative teaching methods

KE1	Evidence that students study the fundamental areas of physics at appropriate times in the course	BSc and IM
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Universities must ensure that:

- programmes are designed to introduce, develop and enhance the fundamental areas of physics which are electromagnetism, quantum and classical mechanics, statistical physics and thermodynamics, wave phenomena and the properties of matter
- the fundamental areas are addressed from a clearly physics-based perspective
- students gain a good conceptual understanding of the fundamental areas of physics
- selected elements of the fundamental areas are covered to a sufficiently advanced level to enable students to engage with current scientific research literature

Examples of ways to demonstrate this could include:

- learning outcomes for degrees explicitly include these areas
- module syllabuses and lecture notes demonstrating coverage
- student assessments covering the fundamental areas that demonstrate both knowledge and conceptual understanding
- a strategy for vertical integration and development of the fundamental areas

The *Core of Physics* associated with the previous accreditation scheme is no longer in use. However, if departments find it useful, they may wish to use it as a general resource to inform their teaching of the fundamental areas of physics.

It is appreciated that some physics degrees may differ in the extent to which some of these fundamental areas are covered and the depth reached e.g. Medical Physics or Environmental Physics. The onus will be on the department to highlight this and to explain how less focus on a fundamental area is justified by the degree title and the aims and objectives of the degree.

Classical Physics is deemed to include special relativity and properties of matter is deemed to be macroscopic properties (mechanical, electrical, magnetic and thermal).

KE2	Evidence that students study the application of the fundamental principles to an appropriate selection of areas of physics relevant to the degree title	BSc and IM
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Universities must ensure that:

- an appropriate range and depth of material is included beyond the fundamental areas
- where appropriate, the fundamental areas are applied to other disciplines
- the choice of areas included, and the extent of their coverage, enables some meaningful engagement with current relevant research material
- the additional areas covered must be relevant to the degree title

Examples of ways to demonstrate this KE could include:

- the additional areas being reflected in the learning outcomes of the degrees
- programme specifications (or equivalent) detailing the additional areas covered
- assessments that cover the additional areas demonstrating both knowledge and conceptual understanding

It is expected that all degrees will be taught to a far richer curriculum beyond the fundamental areas covered by KE1. The QAA Benchmark Statement lists possible areas that may be covered and these include, but need not be limited to, atomic physics, environmental physics, fluids, hard and soft condensed matter, materials, medical physics, nuclear and particle physics, optics, and plasmas. Astronomy and Astrophysics degrees apply physics principles to cosmology, stars and galaxies, planetary systems and high energy phenomena. These are examples and universities are free to cover other areas they deem relevant to their degrees. Interdisciplinary content is to be encouraged.

Straight physics degrees will be expected to cover a wider range of areas beyond the fundamentals than major and joint programmes which may have a reduced selection providing appropriate depth is reached in the areas chosen.

KE3	Students can demonstrate that they can apply their physics knowledge and understanding across topic boundaries and in unrehearsed contexts	BSc , IM and MSc
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Universities must ensure that:

- programmes are designed to demonstrate that physics is a coherent and interlinked body of knowledge and skills and not merely a collection of discrete sub-topics
- programmes highlight that a number of physics principles apply across traditional topic boundaries

Examples of ways to demonstrate this KE could include:

- evidence of the application of physics principles in different modules and contexts
- evidence that students are shown connections between the content of one module to that of others
- assessing students through problem sheets containing cross-module questions
- tutorials covering more general problems that cross module boundaries
- problem-based learning encouraging the application of knowledge from more than one topic area

Most degree programmes consist of modules (or equivalent) focusing on one specific area. Degrees must be designed to help students draw links between the content in different modules and appreciate that knowledge and techniques can be applied in other contexts.

It is important that students gain experience in synoptic problem solving and applying their knowledge in unfamiliar and unrehearsed contexts. While a general paper is an established way of achieving this, it is not mandatory.

Examples of physics principles that apply across traditional topic boundaries are conservation, diffusion, equilibrium, fields and potentials, degrees of freedom, transformations and symmetries, and measurement uncertainty.

It is understood that MSc programmes have less time available and the expectations for this key expectation will take that into account.

KE4	Students can demonstrate the ability to use mathematics to model, describe and predict phenomena in the real world	BSc and IM
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Universities must ensure that:

- an appropriate programme of study in mathematics is provided and that this is linked to the scientific needs of the degrees
- students have a sufficient mathematical toolbox to engage with the physics in a rigorous and quantitative manner
- students are required to use mathematics to describe and predict phenomena in the real world by both expressing physical phenomena in mathematical terms and interpreting mathematical expressions in terms of physical phenomena

Examples of ways to demonstrate this KE could include:

- assessing students on their ability to use mathematics through a variety of methods throughout the programme
- describing the mathematical toolkit students are expected to develop and how this is developed through the years
- student assessments in mathematical modelling
- testing and improving a mathematical model rather than using it to produce data

Given their title, theoretical or mathematical physics degrees will be expected to offer a greater amount of mathematical sophistication.

KE5	The content builds on undergraduate knowledge of physics in areas appropriate to the degree title	MSc
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Universities must ensure that:

- MSc programmes include physics content that is above undergraduate level

Examples of ways to demonstrate this KE could include:

- highlighting areas of physics that are beyond the majority of undergraduate programmes
- applying undergraduate physics knowledge or skills to unfamiliar areas such as interdisciplinary contexts
- clear definition of Master's level and identification of such material
- highlighting physics content that is at the forefront of the discipline

To be eligible for accreditation MSc programmes must contain Master's level physics that expands on undergraduate level physics. The areas of physics that are expanded or built upon will depend on the flavour of the MSc.

It is expected that entry requirements will require a physics undergraduate degree, a degree from a closely related subject such as engineering or mathematics or equivalent through a combination of qualifications and/or experience.

MSc programmes can be general, specific or interdisciplinary, but at least half the taught programme must be physics or physics-based. The IOP would normally expect eligible programmes to be offered by physics departments with accredited undergraduate programmes or with substantial input from physics departments.

Modules designated as Master's level can be shared with integrated Master's programmes but should not be available as a compulsory element in BSc programmes.

The QAA Benchmark Statement applying to integrated Master's can be used as a guide to standards expected.

KE6	Programmes allow students to demonstrate an appreciation of recent developments in physics	BSc and IM
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Universities must ensure that:

- recent developments are covered within the curriculum, with the choice of developments up to the university
- students are introduced to topics at the boundaries of current research knowledge in physics at appropriate points within the curriculum

Examples of ways to demonstrate this KE include:

- detailing the recent developments chosen
- assessments or student activities where students are introduced to recent developments
- detailing where it is demonstrated that physics knowledge can be applied to recent developments in other areas

The recent developments may include those involving genuinely new physics or may include the application of well-established physics to contemporary areas of research such as the development of modern photovoltaics, nuclear fusion reactors, or climate change.

KE7	Students can demonstrate the ability to engage with current research at the forefront of the discipline	IM and MSc
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Universities must ensure that:

- students are trained in research methods
- all programmes provide engagement with topics at the boundaries of current research knowledge
- students are required to critically engage with research literature and adopt suitable approaches to solving open problems

Examples of ways to demonstrate this KE include:

- describing where and how students receive training in research methods and how they are supported to improve their research skills
- detailing which topics at the boundaries of current knowledge are covered within each programme
- ensuring that elements of research skills are embedded throughout the programme enabling students to develop their skills in this area prior to the project or investigative work undertaken towards the end of their studies
- providing student assessments or activities where students are expected to demonstrate such skills

KE8	Programmes provide an experience of the practical nature of physics and equip students with a range of practical skills necessary to plan, execute investigations and analyse data	BSc and IM
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For experimental degrees, universities must ensure that:

- students develop appropriate practical skills through undertaking a variety of experiments covering the breadth of the subject and, where relevant, reflecting degree specialisms
- students are appropriately trained in health and safety and have this reinforced in laboratory and project work including explicit training in conducting risk assessments and safe experimental design
- students gain experience in using a variety of apparatus, acquiring robust data and identifying sources of error and uncertainty, processing, interpreting and analysing data, and presenting experimental results
- students have the opportunity to evaluate and iteratively improve the design of experimental process
- reasonable adjustments are prepared to enable all students on experimental degrees to participate in laboratory work

For theoretical or mathematical physics degrees, universities must ensure that:

- programmes allow students to appreciate that physics is an experimental science
- programmes that do not contain laboratory work develop students' experimental skills and understanding in other ways such as computer simulation, modelling, data analysis exercises or case studies using experimental data banks
- students should develop skills in processing, interpreting and analysing data including an appreciation of approximations, uncertainties and errors, and presenting theoretical results and comparing them with experimental results
- students should have the opportunity to evaluate and iteratively improve the design of modelling or computer simulations

Examples of ways to demonstrate this KE include:

- detailing where students develop the ability to plan an experiment or investigation, analyse data using appropriate techniques including error analysis, and report and defend the results or conclusions of their work
- requiring students to carry out an independent risk assessment
- student laboratory books demonstrating good experimental practice, recording and critical analysis of results including analysis of errors and uncertainties
- an experimental skills strategy that clearly defines what skills are developed and where and how they are built on in later years

Experimental degrees will need to include an appropriate amount of laboratory work to enable the required experimental skills to be developed and demonstrated. We are not prescriptive to the extent that we are setting a minimum number of credits that must be included, but as a guide we think it unlikely that the required skills could be developed in less than 30 CATS (or equivalent). It is also thought unlikely that adequate development can be shown by only having experimental work in the first year. Major or joint degrees may have a reduced amount of practical work but they must include sufficient laboratory experience for the required experimental skills to be developed and demonstrated.

Theoretical degrees will need to include an appropriate amount of coverage of experimental understanding in order to meet this key expectation and as a guide we think it unlikely the required skills could be developed in less than 15 CATS (or equivalent).

All students on experimental degrees must undertake laboratory work. Reasonable adjustments, such as providing a helper to take directions from students, should be made for those unable to carry out the work themselves for reasons of disability.

The use of remote or virtual experiments is acceptable to support skills development and to enhance inclusivity but it would not normally be expected to comprise the entirety of the experimental provision for any student.

KE9	Programmes must include elements of independent investigative work of an open-ended nature	BSc
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Universities must ensure that:

- all students undertake independent investigative work that must be passed
- the work is open-ended to the extent that the outcome of the work is not pre-determined
- students must plan and manage an investigation of a physics or physics-based problem, to include informed analysis of data, maintaining records of their work and generating, presenting and critically evaluating conclusions
- investigative work is sufficiently resourced, and students have access to relevant equipment
- assessment outcomes are auditable
- marking criteria are clear and transparent, discipline specific, and sufficiently detailed to minimise differences of interpretation

Examples of ways to demonstrate this KE include:

- detailing the investigative work undertaken throughout the programmes
- highlighting where students have developed the skills to undertake open-ended work
- providing student reports, posters, or other outputs and associated marking sheets and criteria
- evidence of consistent marking that does not result in wide disparities between markers

It is possible to meet this key expectation through undertaking a traditional project or through a portfolio of work demonstrating skills development achieved over a longer space of time. Investigative literature reviews can meet this requirement as can school placements where teaching and lesson planning is assessed. Extended and open-ended practical investigations with the laboratory can also count if they are specifically designed to meet this key expectation.

Normally such work will be undertaken in the final year but earlier work may count, particularly if part of a placement year. If work undertaken on a placement is used, the supervision and assessment of the work must be as robust as it would be if conducted at the university.

It is also possible to meet this key expectation through work undertaken in a group project providing there is an element of independent work that can be evidenced.

Physics-based problems can be interpreted very widely as it is the investigative skills that are being covered by this key expectation. Therefore, interdisciplinary work is to be actively encouraged as is work in physics education, sustainability and the environment, diversity and inclusion within physics, the role of science in society, outreach and engagement, and science policy.

Investigative work assesses a student's ability to undertake an investigation as well as communicate their findings and the two should be marked independently. The project supervisor, or equivalent, may contribute marks for the progress of the project or investigation, but must not mark the final report or assessment which should be marked by at least two independent markers.

KE10	Programmes must include a substantial project of an open-ended nature	IM and MSc
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Universities must ensure that:

- all Master's programmes include a substantial project that must be passed
- students must plan and manage an investigation into a physics or physics-based problem to include informed analysis of data, maintaining records of their work and generating, presenting and critically evaluating conclusions
- projects are assessed appropriately, and the distribution of marking responsibilities should ensure that no one individual contributes an excessive amount of the marks
- appropriate supervisory capacity and a safe working environment is provided
- project work is sufficiently resourced, and students have access to relevant equipment
- that the projects available span a wide range of physics and physics-related areas
- assessment outcomes are auditable
- marking criteria are clear and transparent, discipline specific, and sufficiently detailed to minimise differences of interpretation

Examples of ways to demonstrate this KE include:

- project reports, notebooks, posters and associated marking sheets and criteria
- detailing the investigative work undertaken throughout the programmes
- highlighting where students have developed the skills to undertake open-ended work
- evidence of consistent marking that does not result in wide disparities between markers

Substantial is considered to be of at least 30 CATS in integrated Master's degrees and 45 CATS in MSc programmes. Physics-based problem can be interpreted as widely as that described under KE 9.

It is expected that most Master's level projects will be conducted individually. However, it is possible to meet this key expectation through work undertaken in a group or paired project providing there is a significant element of individual work that can be evidenced.

Assessment outcomes must be in a form that is auditable. There must be some way for the IOP to evaluate in some depth the extent of the work carried out by the student.

Projects assess a student's ability to undertake the project as well as communicate their findings and the two should be marked independently. The project supervisor may contribute marks for the progress of the project but must not mark the final project report which must be marked by at least two independent markers.

KE11	Students can demonstrate the ability to formulate and tackle problems in physics	BSc, IM and MSc
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Universities must ensure that:

- students are required to identify what to do in order to solve problems by making appropriate assumptions, simplifying where necessary, identifying relevant factors
- problem solving required of students goes beyond purely deductive solution of closed problems
- strategies and tactics are used for enabling students to become confident and competent in forming and attempting to solve such problems
- students can apply the skills of computer programming in order to use computers as a general problem-solving tool and not rely entirely on pre-written software

Examples of ways to demonstrate this KE include:

- assessing students on their problem-solving ability through a variety of methods throughout the programmes
- requiring students to generate a code solution to a problem

KE12	Programmes must provide training in a broad range of transferable skills and their use should be demonstrated throughout the programmes	BSc and IM
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Universities must ensure that:

- the skills listed in the QAA Benchmark Statement are included within all programmes
- these skills are taught, developed, built upon and assessed
- sufficient time is given to skills coverage and that this is appropriately reflected in assessment weightings

Examples of ways to demonstrate this KE include:

- having a coherent skills strategy or skills map that details where students are taught or introduced to these skills, how they develop these skills throughout their studies and how and where they are assessed
- ensuring there are multiple opportunities to practise skills throughout the programme
- students keeping a personal development portfolio where they identify and reflect on the knowledge, understanding and skills taught and developed during their study
- ensuring a wide variety of types of communication from technical communication through to communicating to a non-specialist audience is included in the curriculum
- individual and group work is included throughout the curriculum
- provision of additional skills that may be degree specific, such as business awareness, intellectual property, digital media, and entrepreneurship

It is strongly recommended that skills are fully embedded within the physics curriculum and be as authentic as possible rather than taught exclusively in standalone skills modules. Students need to see the relevance of the skills they are obtaining to physics and integrating skills coverage into physics modules can be very effective.

It is recommended that skills are assessed in as authentic manner as possible. Few skills can be adequately assessed via examination.

There should be coverage of all types of communication skills which would normally include verbal presentations, poster presentations, technical report writing and communicating to a non-specialist audience verbally and/or in writing. The underlying competence standard is being able to communicate science effectively. Therefore, reasonable adjustments can be made, for example for socially anxious students that might find presenting to a large group too difficult, without affecting the achievement of this key expectation.

Individual and group work must be undertaken. By group work, the Institute means work in groups of four or more, toward a substantial shared goal with assignment of interdependent responsibilities and regular checks on progress. The underlying competence here is being able to work collaboratively within a team and as such all students must undertake group work. However, reasonable adjustments can and should be made for those that find such activity difficult. This might include adapting the group work so that there is reduced need to have face to face contact or ensuring students requiring reasonable adjustments have specific activities allocated to them by a staff facilitator rather than by other students who may not be aware of individual needs.

KE13	Students can demonstrate appropriate professional skills	BSc and IM
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Universities must ensure that:

- good scientific practice and culture is emphasised, and professional ethics and professional conduct is actively communicated to students
- students have a good understanding of equality, diversity and inclusion, including an awareness of bias, and how to report problems in this area to the university
- students are aware of appropriate behaviour and what the university expects from them, the university policies around bullying, harassment and misconduct, and how to report issues
- what constitutes unethical scientific conduct, including the falsification or selective recording or reporting of data, is communicated to all students
- the importance of academic integrity is communicated to students, covering plagiarism and collusion, and that academic misconduct will not be tolerated
- programmes develop students' independent learning ability, enabling self-directed learning and creative thinking
- graduates are prepared for employment and are provided with good career literacy throughout
- the importance of continuing professional development is emphasised and the value of progressing towards professional registration
- students should gain an awareness of the importance of sustainability and the environment, the role of science in society, ethical or moral considerations in scientific research and how science can be used and misused in society or the media

Examples of ways to demonstrate this KE include:

- provision of specific training covering both academic integrity and good scientific practice
- effective policies and procedures in academic integrity with evidence that they are used
- policies and procedures in EDI that are clearly signposted to students
- describing how the department supports student learning to increase confidence and self-reliance and showing how the demands on students change as they progress through the programme
- good career support from the university and the department covering a wide range of possible careers
- actively encouraging students to document the skills they are obtaining and to identify areas of improvement

It is appreciated that the majority of the requirements under this key expectation do not lend themselves easily to assessment. It is expected that the department will be able to demonstrate that this key expectation is met through provision of documentation and from student feedback.

The Institute of Physics (IOP) is the professional body and learned society for physics in the UK and Ireland, with an active role in promoting co-operation in physics around the world. We strive to make physics accessible to people from all backgrounds.

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