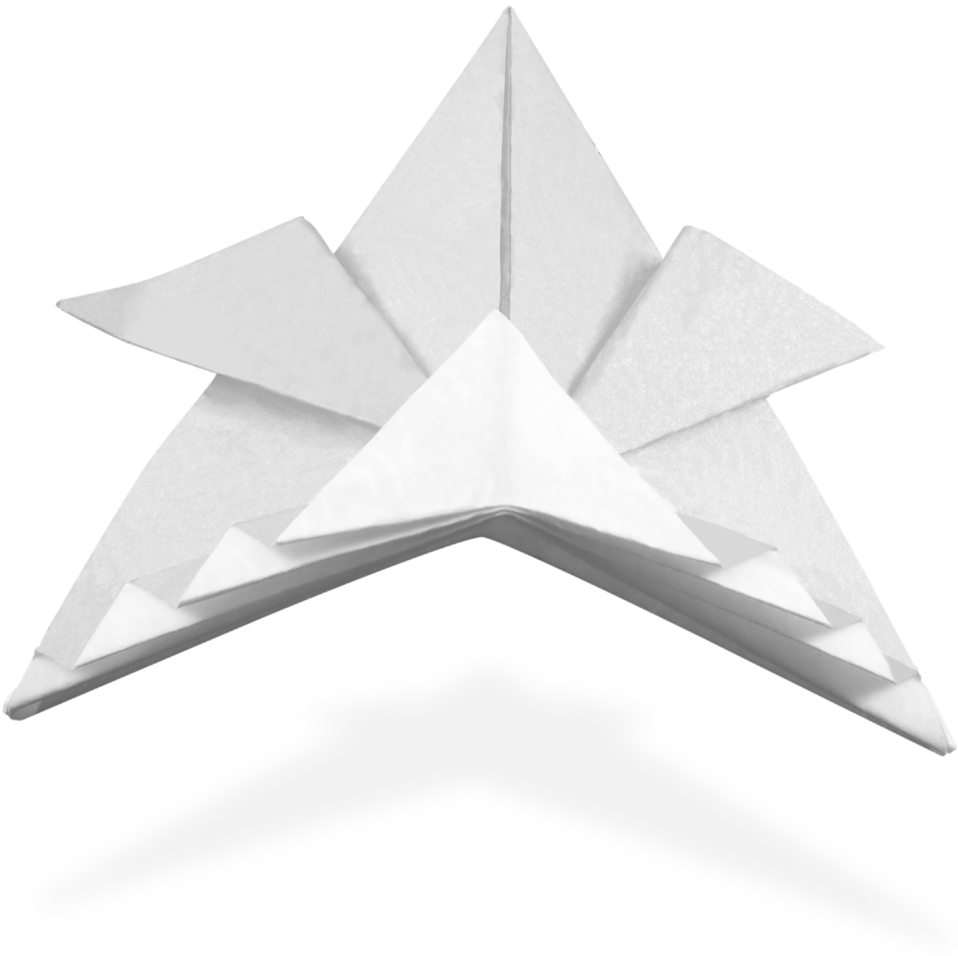

THE ACCREDITATION OF HIGHER EDUCATION PROGRAMMES

UK Standard for Professional Engineering Competence

Third edition

www.engc.org.uk

Engineering Council

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Operating under a Royal Charter, the Engineering Council is charged with regulating the engineering profession in the United Kingdom, setting the standard for the practice of engineering, and maintaining the registers of professional engineers and technicians. The Engineering Council is governed by a Board representing the professional engineering institutions in the UK, together with individuals drawn from industries and sectors with an interest in regulation of the engineering profession. The Engineering Council publishes the internationally recognised UK Standard for Professional Engineering Competence (UK-SPEC) on behalf of the profession. This Accreditation of Higher Education Programmes (AHEP) handbook sets out the learning outcomes that must be demonstrated for the award of Engineering Council Accredited Programme status, which are rooted in UK-SPEC. The searchable list of accredited HE programmes is published by the Engineering Council. First published in 2004, AHEP was developed in collaboration with the profession and is kept under review. It was most recently reviewed during 2013-2014.

FOREWORD

Engineering is concerned with the art and practice of changing the world we live in. Driven by the needs of society and business, engineers strive to find solutions to complex challenges. They work to achieve useful and beneficial outcomes that enhance the welfare, health and safety of all whilst paying due regard to the environment.

Whilst the objective of engineering professionalism is the public good, students choose engineering for a variety of reasons and a range of motivations. Whatever these might be, all students deserve an engineering education that is world-class and that develops industry-relevant skills. Accreditation of degree programmes helps to ensure that UK engineering education meets these needs as well as drawing students towards a career in the engineering profession. It demonstrates both nationally and internationally the high standard of UK engineering education and provides a basis for educational establishments to review their programmes and to develop excellence in delivery and content.

This accreditation handbook was first published by the Engineering Council in 2004 and since then has been widely used by engineering education providers, individual academics and professional engineering institutions. It has been welcomed for its clarity, brevity and emphasis on learning outcomes rather than inputs, which have been developed in consultation with the profession and include input from employers. It has enabled the development of diverse provision, without losing sight of the required skills, knowledge and understanding that tomorrow's engineers will need.

The criteria and process of accreditation are regularly reviewed internationally. The Engineering Council is a full member of the Sydney and Washington Accords, demonstrating that its accreditation process is compatible with the standards of the International Engineering Alliance (IEA) and that the learning outcomes meet or exceed the thresholds for graduate attributes published by the IEA. Alignment has also been demonstrated with the European Network for Accreditation of Engineering Education's EUR-ACE® framework, resulting in the Engineering Council being authorised to award the EUR-ACE® label to engineering programmes accredited for Chartered Engineer registration. Further details about international recognition for accredited degrees can be found on page 8.

This updated version of the accreditation handbook does not introduce any changes to the required overall standard for the award of accredited status, though there are modifications to some learning outcomes, and it remains rooted in the UK Standard for Professional Engineering Competence (UK-SPEC). It refers to the Engineering Accreditation Board (EAB), the forum for all the professional engineering institutions that hold a licence from the Engineering Council to accredit degrees. Since its establishment in 2006, EAB has endeavoured to ensure consistently applied and rigorous standards and the sharing of good accreditation practice between the accrediting institutions, and will continue to do so. This accreditation handbook continues to be the framework within which the accrediting institutions can establish the standard of degree programmes put forward for accreditation, and demonstrate nationally and internationally just what it is that accredited courses deliver.

GETTING AN ENGINEERING OR TECHNOLOGY DEGREE PROGRAMME ACCREDITED

Why seek accreditation?

Accreditation of degree programmes by recognised professional and statutory bodies is a mark of assurance that the programmes meet the standards set by a profession. In the UK, the Engineering Council sets and maintains the standards for the engineering profession and sets the overall requirements for accreditation. The Engineering Council licenses over 20 professional engineering institutions to undertake accreditation within these requirements – interpreting them as appropriate for their own sector of the profession – and maintains the database of accredited degree programmes. Accrediting institutions use the accreditation process to assess whether specific educational programmes provide some or all of the underpinning knowledge, understanding and skills for eventual professional engineer registration in a particular category.

Accreditation is an accepted and rigorous process that commands respect both in the UK and internationally. It helps students, their parents and advisers to choose degree programmes of the standard recognised by the engineering profession. It confers market advantage to graduates from accredited programmes both when they are seeking employment and also when, in due course, they seek professional registration as an Incorporated Engineer (IEng) or a Chartered Engineer (CEng). Some employers require graduation from an accredited programme as a minimum qualification.

The accreditation process gives educational institutions a structured mechanism to assess, evaluate and improve the quality of their programmes. Accreditation is a developmental process. It offers the opportunity for a continuing dialogue between professional engineering institutions and educational institutions, rather than placing all the emphasis on the periodic accreditation exercise. An important development in 2006 was the adoption by the UK Quality Assurance Agency for Higher Education (QAA) of the Engineering Council's standards for accredited engineering degrees as the subject benchmark statement for engineering. This alignment was strongly supported by the academic community and further strengthens the case for accreditation as well as assisting in reducing the regulatory burden on the higher education sector.

Increasingly the advantages of professional accreditation are being recognised internationally. The UK engineering profession participates in several major international accords, within and outside Europe, which establish the equivalence of engineering and technology degrees. In each case the system of accreditation applied in the UK is fundamental to the acceptance of UK degrees elsewhere. With increasing globalisation, such accords and frameworks (described in more detail on page 8) are assuming growing importance with employers as a means by which they can be confident in the skills and professionalism of the engineers involved. An accredited programme also has a market advantage for educational institutions wishing to attract international students to the UK.

What does accreditation involve?

The accreditation process is essentially one of peer review; it is applied to individual programmes, not to the department or institution overall. An educational institution seeking accreditation for an engineering or technology programme should contact the relevant professional engineering institution listed at: **www.engc.org.uk/courses** for advice on the procedure and the requirements for their sector of the engineering profession. There may be a charge for the process, especially for visits outside the UK, and further advice is available from the institution. There will inevitably be some costs to the institution seeking accreditation, mainly but not wholly in staff time.

Each professional engineering institution has its own published process for accreditation. Typically the educational institution will make a submission in advance of a visit that includes the following information:

- The learning outcomes of the programme(s)
- The teaching and learning processes
- The assessment strategies employed
- The human, physical and material resources involved
- Professional registration of its staff
- Its internal regulations regarding progression and the award of degrees
- Quality assurance arrangements
- Evidence that the programme is at the appropriate level of the relevant framework for HE qualifications in England, Wales and Northern Ireland or in Scotland
- Entry to the programme and how cohort entry extremes will be supported
- How previous accreditation recommendations and requirements have been dealt with.

The Engineering Council and the professional engineering institutions are committed to minimising the bureaucratic burden of accreditation, for example by using data collected by the educational institution for other purposes. Engineering programme accreditation compares very favourably with other professions in this respect.

Some professional engineering institutions request a brief initial submission covering basic details that is used to determine if the programme is likely to meet its requirements for accreditation. Once satisfied of this, the institution will appoint an accreditation panel and make arrangements for the visit. Every effort will be made to align requirements with those that a department would normally have to meet for internal management and quality assurance purposes.

The panel will include academic and industrial members trained in the principles of accreditation and conversant with its requirements. The visit typically takes place over two or three days. The panel will expect to meet staff and students, and some panels meet representatives from the Industrial Advisory Board. During the visit, they will expect to see laboratory and other teaching space and be provided with examples of student project work, examination scripts, marking strategies and external examiner reports. The internal QA systems will be reviewed.

Where programmes are offered collaboratively, or on a franchised basis, the accrediting institution will normally expect to visit all partners involved in delivering the programme.

Each professional engineering institution has a committee or board that takes the decision about whether or not a programme will be accredited, on the basis of the report from the accreditation panel. Programmes may be accredited as fully or partially meeting the educational requirement for registration as either Incorporated Engineer (IEng) or Chartered Engineer (CEng). **All Honours degrees accredited since 1999 as partially meeting the educational requirement for CEng also fully meet the educational requirement for IEng registration.**

Qualifying phrases such as 'provisional accreditation' and 'partial accreditation' are not used.

Following accreditation, the educational institution must notify the accrediting institution about any major changes made to an accredited programme.

Users of this accreditation handbook are encouraged to refer to the Guidance Note on Academic Accreditation available on the Engineering Council website page: **www.engc.org.uk/ukspec**

Output Standards

The standards that must be met for an educational programme to be accredited are set out in the following sections of this handbook and are derived from UK-SPEC. UK-SPEC describes the competence and commitment requirements that have to be met for professional registration; accredited programmes provide some or all of the educational element for eventual registration as IEng or CEng.

The decision about whether or not to accredit a programme will be made on the basis of the programme delivering the learning outcomes which the professional engineering institution has specified. These are derived from the generic output standards that apply to all accredited engineering degree programmes, set out in this handbook. Innovative provision can be accommodated within the framework of learning outcomes and examples are here:
www.engc.org.uk/accreditation-of-innovative-provision

How to apply

An educational provider that believes it has a programme that would benefit from accreditation by the Engineering Council should approach the relevant institution holding a licence to accredit. A summary of licences is at:
www.engc.org.uk/courses The decision about which institution to contact will normally be straightforward and obvious, dictated by the programme's specialism or underlying content.

Sometimes the programme's novelty or its breadth may mean that it could be accredited by a number of institutions. Joint accreditation visits are an option and can reduce the overall costs of accreditation. Visits from two or more professional engineering institutions can be organised by the Engineering Accreditation Board (EAB) which acts as a single point of contact. EAB-organised visits are appropriate when accreditation is sought from a number of professional engineering institutions, for either mixed discipline degrees or engineering courses with commonality. The Engineering Council provides the Secretariat for EAB and further information is available at: **www.engab.org.uk**

What happens once accreditation is granted?

Once accredited, a programme appears in the full list of accredited degrees maintained by the Engineering Council, available at: **www.engc.org.uk/courses** Additionally, accredited qualifications will normally appear in the UK section of the FEANI Index of recognised European qualifications: **www.feani.org**

An accredited programme may also provide the basis for professional recognition by other professional engineering institutions.

Once a programme is accredited, it normally retains accreditation for five years. However, accreditation may be for a shorter period, especially in the case of new programmes where it is necessary to monitor outputs. Re-accreditation is normally undertaken using the same processes as the original accreditation.

Educational institutions are encouraged to use the 'Engineering Council accredited degree' logo alongside the name of all degree programmes that have been accredited by a professional engineering institution. The logo may be downloaded at: **www.engc.org.uk/AccreditedDegreeLogo**

English version

Engineering Council accredited degree

Welsh version

Engineering Council gradd achrededig

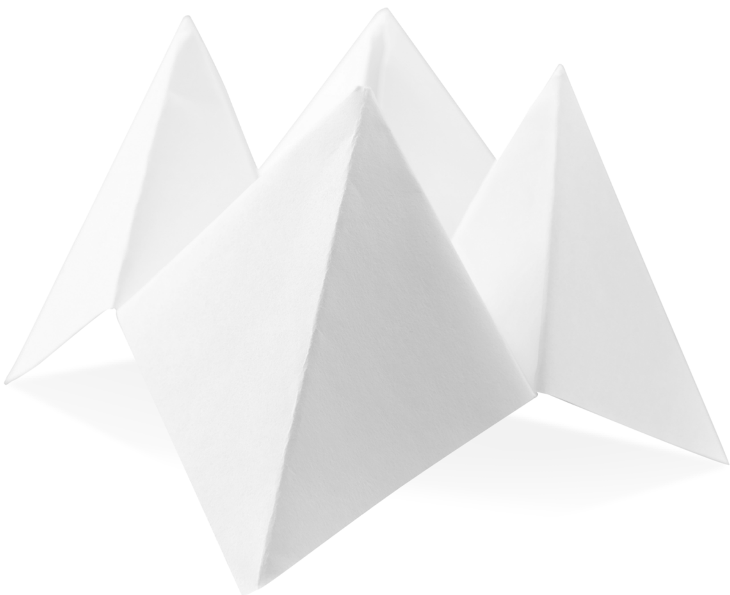
Educational institutions in the UK should ensure that they submit accurate information about accredited status for the 'Key Information Set' about a degree programme, and that their own publicity materials accurately reflect the accreditation status of their programmes and the relationship to registration as IEng or CEng.

International recognition

The Engineering Council is a signatory to the Washington and Sydney Accords, both of which provide a mechanism for mutual recognition by signatory countries of accreditation processes – and, by extension, of accredited degrees – for CEng and IEng degrees respectively. The number of countries that are signatories to these accords is increasing. For details, see: **www.engc.org.uk/international**

Within Europe, the EUR-ACE® framework, administered by the European Network for Accreditation of Engineering Education (ENAEE), allows educational institutions with accredited degrees to demonstrate the international standing of these awards.

The Engineering Council has been authorised to award the EUR-ACE® label to UK engineering degrees accredited since November 2006 as meeting in part or in full the academic requirement for CEng registration, on payment of a fee by the educational institution. Programmes that carry the EUR-ACE® label are recognised as being of international standing and align with the HE qualification framework agreed as part of the Bologna process. Award of the EUR-ACE® label shows that a programme is recognised by ENAEE as a first cycle degree (Bachelors with Honours degrees) or second cycle degree (Integrated Masters (MEng), MSc, etc). For further details see: **www.engc.org.uk/eurace** In an increasingly global market for engineering education, the opportunity of having a EUR-ACE® label brings huge potential benefits for UK providers of accredited programmes.



OUTPUT STANDARDS FOR ACCREDITED PROGRAMMES

Introduction

Accredited engineering and technology programmes provide the exemplifying levels of understanding, knowledge and skills for professional competence.

The output standards set out here therefore need to be read in the context of the generic statements of competence and commitment for Incorporated Engineers and Chartered Engineers in UK-SPEC: **www.engc.org.uk/ukspec**

The following qualifications exemplify the required knowledge and understanding for:

Incorporated Engineer (IEng)

- An accredited Bachelors or Honours degree in engineering or technology
- **or** a Higher National Diploma or a Foundation Degree in engineering or technology, plus appropriate further learning to degree level*
- **or** an NVQ4 or SVQ4 which has been approved by a licensed professional engineering institution, plus appropriate further learning to degree level*.

Chartered Engineer (CEng)

- An accredited Bachelors degree with Honours in engineering or technology, plus either an appropriate Masters degree or Engineering Doctorate (EngD) accredited by a licensed professional engineering institution, or appropriate further learning to Masters level*
- **or** an accredited integrated MEng degree.

Types of degree

This handbook sets out the output standards expected from each of the four types of degree:

- Bachelors and Bachelors (Hons) degrees accredited as meeting in full the educational/knowledge and understanding requirement for IEng registration[1]

- Bachelors (Hons) degrees accredited as partially meeting the educational/ knowledge and understanding requirement for CEng registration

- Integrated Masters (MEng) degrees accredited as meeting in full the educational/ knowledge and understanding requirement for CEng registration

- Other Masters degrees accredited as partially meeting the educational/ knowledge and understanding requirement for CEng registration.

For the accreditation of EngDs, key principles and reference points are provided on page 25.

*see **www.qaa.ac.uk** for HE reference points

[1]Similar learning outcomes will apply to accredited Foundation Degree programmes, with particular strengths emphasised in any further learning undertaken to satisfy the academic requirements for IEng registration.

It is important to note that the listing of different learning outcomes does not imply a compartmentalised or linear approach to learning and teaching. Throughout each programme, a number of different learning outcomes are likely to be delivered concurrently, through, for example, project work. The process of accreditation will include an assessment of whether graduates are achieving these outcomes.

Each type of accredited degree provides a solid foundation in the principles of engineering relevant to the discipline specialism. What were previously referred to as 'general learning outcomes' have mostly been integrated within the five engineering-specific areas of learning, except for some that are listed as 'additional general skills'. The six key areas of learning are:

- Science and mathematics
- Engineering analysis
- Design
- Economic, legal, social, ethical and environmental context
- Engineering practice
- Additional general skills

The different types of accredited engineering programmes provide the exemplifying levels of understanding, knowledge and skills for specific registrant titles. To reflect this, there are some important differences between the degrees. Each type of degree is described in these terms in a preamble immediately before the learning outcomes for each specific degree. For ease of comparison, the preambles for the four types of accredited degree are presented together as a matrix in Annex A.

Interpretation

Within this document, the following terms are used with the meanings stated:

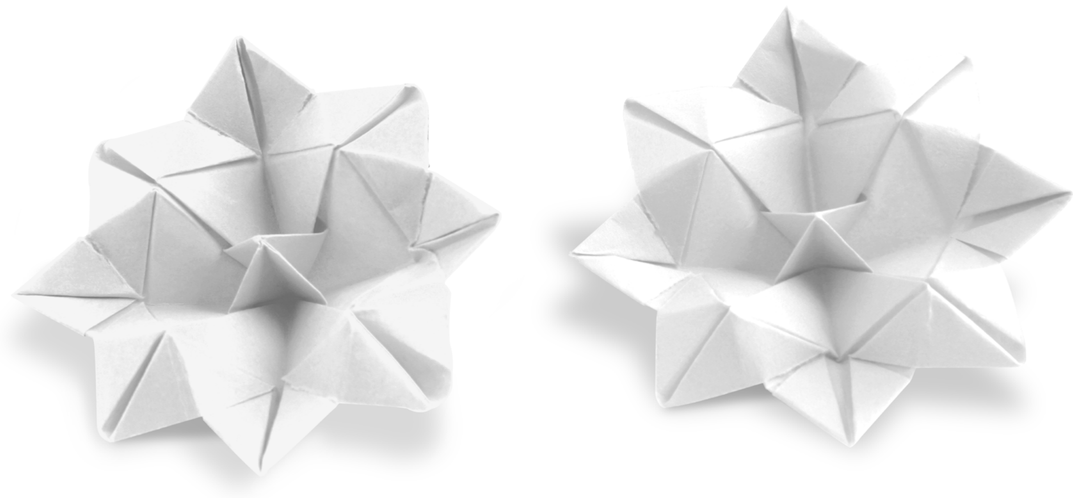
- **Understanding** is the capacity to use concepts creatively, for example, in problem solving, design, explanations and diagnosis
- **Knowledge** is information that can be recalled
- **Know-how** is the ability to apply learned knowledge and skills to perform operations intuitively, efficiently and correctly
- **Skills** are acquired and learned attributes that can be applied almost automatically

- **Awareness** is general familiarity, albeit bounded by the needs of the specific discipline

- **Complex** implies engineering problems, artefacts or systems that involve dealing simultaneously with a sizeable number of factors that interact and require deep understanding, including knowledge at the forefront of the discipline, to analyse or deal with

The level at which these outputs will be delivered is that expected from the relevant qualifications as they are described in the QAA's Framework for HE Qualifications in England, Wales and Northern Ireland **(www.qaa.ac.uk)** and in the Scottish Credit and Qualifications Framework **(www.scqf.org.uk)**. Both frameworks include qualification descriptors for Bachelors and Masters degrees, which are included as Annex B of this handbook.

A glossary of terms is included on pages 27-28.



Bachelors Degrees and Bachelors (Honours) Degrees accredited for IEng registration

Bachelors degrees and Bachelors (Honours) degrees accredited for the purpose of IEng registration will have an emphasis on development and attainment of the know-how necessary to apply technology to engineering problems and processes, and to maintain and manage current technology, sometimes within a multidisciplinary engineering environment.

Graduates from accredited Bachelors or Bachelors (Honours) degree programmes must achieve the learning outcomes described below. The breadth and depth of underpinning scientific and mathematical knowledge, understanding and skills will be provided in the most appropriate manner to enable the application of engineering principles within existing technology to future engineering problems and processes. Graduates are likely to have acquired some of this ability through involvement in individual and/or group design projects.

Programmes will develop a knowledge and understanding of current engineering practice and processes, with less focus on analysis than in programmes accredited for CEng. Design will be a significant component, especially in integrating a range of knowledge and understanding to design products, systems and processes to meet defined needs using current technology.

The weighting given to the six broad areas of learning below will vary according to the nature and aims of each programme.

Science and mathematics

Engineering is underpinned by science and mathematics, and other associated disciplines, as defined by the relevant professional engineering institution(s). Graduates will need:

- Knowledge and understanding of the scientific principles underpinning relevant current technologies, and their evolution

- Knowledge and understanding of mathematics and an awareness of statistical methods necessary to support application of key engineering principles.

Engineering analysis

Engineering analysis involves the application of engineering concepts and tools to the solution of engineering problems. Graduates will need:

- Ability to monitor, interpret and apply the results of analysis and modelling in order to bring about continuous improvement

- Ability to apply quantitative methods in order to understand the performance of systems and components

- Ability to use the results of engineering analysis to solve engineering problems and to recommend appropriate action

- Ability to apply an integrated or systems approach to engineering problems through know-how of the relevant technologies and their application.

Design

Design at this level is the creation and development of an economically viable product, process or system to meet a defined need. It involves technical and intellectual challenges and can be used to integrate all engineering understanding, knowledge and skills to the solution of real problems. Graduates will need the knowledge, understanding and skills to:

- Be aware of business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics

- Define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards

- Work with information that may be incomplete or uncertain and be aware that this may affect the design

- Apply problem-solving skills, technical knowledge and understanding to create or adapt design solutions that are fit for purpose including operation, maintenance, reliability etc

- Manage the design process, including cost drivers, and evaluate outcomes

- Communicate their work to technical and non-technical audiences.

Economic, legal, social, ethical and environmental context

Engineering activity can have impacts on the environment, on commerce, on society and on individuals. Graduates therefore need the skills to manage their activities and to be aware of the various legal and ethical constraints under which they are expected to operate, including:

- Understanding of the need for a high level of professional and ethical conduct in engineering and a knowledge of professional codes of conduct

- Knowledge and understanding of the commercial, economic and social context of engineering processes

- Knowledge of management techniques that may be used to achieve engineering objectives

- Understanding of the requirement for engineering activities to promote sustainable development

- Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues

- Awareness of risk issues, including health & safety, environmental and commercial risk.

Engineering practice

This is the practical application of engineering skills, combining theory and experience, and use of other relevant knowledge and skills. This can include:

- Knowledge of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc)
- Understanding of and ability to use relevant materials, equipment, tools, processes, or products
- Knowledge and understanding of workshop and laboratory practice
- Ability to use and apply information from technical literature
- Ability to use appropriate codes of practice and industry standards
- Awareness of quality issues and their application to continuous improvement
- Awareness of team roles and the ability to work as a member of an engineering team.

Additional general skills

Graduates must have developed transferable skills, additional to those set out in the other learning outcomes, that will be of value in a wide range of situations, including the ability to:

- Apply their skills in problem solving, communication, information retrieval, working with others and the effective use of general IT facilities
- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD
- Plan and carry out a personal programme of work
- Exercise personal responsibility, which may be as a team member.

Bachelors (Honours) Degrees accredited as partially meeting the educational requirement for CEng[2]

(Further learning to Masters level will be required)

Bachelors (Honours) degrees accredited for the purpose of CEng registration develop the ability to apply a thorough understanding of relevant science and mathematics to the analysis and design of technical solutions to improve quality of life.

Graduates from accredited Bachelors (Honours) programmes must achieve a systematic understanding of the learning outcomes described below, including acquisition of coherent and detailed knowledge, much of which is at, or informed by, the forefront of defined aspects of the relevant engineering discipline. Crucially, they will have the ability to integrate their knowledge and understanding of mathematics; science; computer-based methods; design; the economic, legal, social, ethical and environmental context; and engineering practice to solve problems, some of a complex nature, in their chosen engineering discipline. They are likely to have acquired some of this ability through involvement in individual and/or group design projects.

The weighting given to the six broad areas of learning below will vary according to the nature and aims of each programme.

Science and mathematics

Engineering is underpinned by science and mathematics, and other associated disciplines, as defined by the relevant professional engineering institution(s). Graduates will need the following knowledge, understanding and abilities:

- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies

- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems

- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline.

[2]All Honours degrees accredited since 1999 as partially meeting the educational requirement for CEng also fully meet the educational requirement for IEng registration.

Engineering analysis

Engineering analysis involves the application of engineering concepts and tools to the solution of engineering problems. Graduates will need:

- Understanding of engineering principles and the ability to apply them to analyse key engineering processes

- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques

- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action

- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems.

Design

Design at this level is the creation and development of an economically viable product, process or system to meet a defined need. It involves significant technical and intellectual challenges and can be used to integrate all engineering understanding, knowledge and skills to the solution of real and complex problems. Graduates will therefore need the knowledge, understanding and skills to:

- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics

- Investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards

- Work with information that may be incomplete or uncertain and quantify the effect of this on the design

- Apply advanced problem-solving skills, technical knowledge and understanding, to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal

- Plan and manage the design process, including cost drivers, and evaluate outcomes

- Communicate their work to technical and non-technical audiences.

Economic, legal, social, ethical and environmental context

Engineering activity can have impacts on the environment, on commerce, on society and on individuals. Graduates therefore need the skills to manage their activities and to be aware of the various legal and ethical constraints under which they are expected to operate, including:

- Understanding of the need for a high level of professional and ethical conduct in engineering and a knowledge of professional codes of conduct

- Knowledge and understanding of the commercial, economic and social context of engineering processes

- Knowledge and understanding of management techniques, including project management, that may be used to achieve engineering objectives

- Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate

- Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues

- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, and of risk assessment and risk management techniques.

Engineering practice

This is the practical application of engineering skills, combining theory and experience, and use of other relevant knowledge and skills. This can include:

- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc)

- Knowledge of characteristics of particular materials, equipment, processes, or products

- Ability to apply relevant practical and laboratory skills

- Understanding of the use of technical literature and other information sources

- Knowledge of relevant legal and contractual issues

- Understanding of appropriate codes of practice and industry standards

- Awareness of quality issues and their application to continuous improvement

- Ability to work with technical uncertainty

- Understanding of, and the ability to work in, different roles within an engineering team.

Additional general skills

Graduates must have developed transferable skills, additional to those set out in the other learning outcomes, that will be of value in a wide range of situations, including the ability to:

- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities

- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD

- Plan and carry out a personal programme of work, adjusting where appropriate

- Exercise initiative and personal responsibility, which may be as a team member or leader.

Integrated Masters (MEng) Degrees

Integrated Masters (MEng) degrees accredited for CEng registration include the outcomes of accredited Bachelors (Honours) degrees and go beyond to provide a greater range and depth of specialist knowledge, within a research and industrial environment, as well as a broader and more general academic base. Such programmes should provide both a foundation for leadership and a wider appreciation of the economic, legal, social, ethical and environmental context of engineering.

Graduates from an accredited integrated Masters (MEng) degree must achieve a systematic understanding of the learning outcomes described below, including acquisition of coherent and detailed knowledge, most of which is at, or informed by, the forefront of defined aspects of the relevant engineering discipline. Some of the learning outcomes will be to levels deeper and broader than in a Bachelors programme, the balance of which will vary according to the nature and aims of each programme. Crucially, graduates will have the ability to integrate their knowledge and understanding of mathematics; science; computer-based methods; design; the economic, legal, social, ethical and environmental context; and engineering practice to solve a substantial range of engineering problems, some of them complex or novel. They will have acquired much of this ability through involvement in individual and group design projects. Ideally some of these projects would have industrial involvement or be practice-based.

The weighting given to the six broad areas of learning below will vary according to the nature and aims of each programme.

Science and mathematics

Engineering is underpinned by science and mathematics, and other associated disciplines, as defined by the relevant professional engineering institution(s). Graduates will need the following knowledge, understanding and abilities:

- A comprehensive knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies

- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems

- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively

- Awareness of developing technologies related to own specialisation

- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations

- Understanding of concepts from a range of areas, including some outside engineering, and the ability to evaluate them critically and to apply them effectively in engineering projects.

Engineering analysis

Engineering analysis involves the application of engineering concepts and tools to the solution of engineering problems. Graduates will need:

- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes

- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques

- Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and to implement appropriate action

- Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems

- Ability to use fundamental knowledge to investigate new and emerging technologies

- Ability to extract and evaluate pertinent data and to apply engineering analysis techniques in the solution of unfamiliar problems.

Design

Design at this level is the creation and development of an economically viable product, process or system to meet a defined need. It involves significant technical and intellectual challenges and can be used to integrate all engineering understanding, knowledge and skills to the solution of real and complex problems. Graduates will therefore need the knowledge, understanding and skills to:

- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics

- Investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards

- Work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies

- Apply advanced problem-solving skills, technical knowledge and understanding to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal

- Plan and manage the design process, including cost drivers, and evaluate outcomes

- Communicate their work to technical and non-technical audiences

- Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations

- Demonstrate the ability to generate an innovative design for products, systems, components or processes to fulfil new needs.

Economic, legal, social, ethical and environmental context

Engineering activity can have impacts on the environment, on commerce, on society and on individuals. Graduates therefore need the skills to manage their activities and to be aware of the various legal and ethical constraints under which they are expected to operate, including:

- Understanding of the need for a high level of professional and ethical conduct in engineering, a knowledge of professional codes of conduct and how ethical dilemmas can arise

- Knowledge and understanding of the commercial, economic and social context of engineering processes

- Knowledge and understanding of management techniques, including project and change management, that may be used to achieve engineering objectives, their limitations and how they may be applied appropriately

- Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate

- Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues, and an awareness that these may differ internationally

- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk

- Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction.

Engineering practice

This is the practical application of engineering skills, combining theory and experience, and use of other relevant knowledge and skills. This can include:

- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc)

- Knowledge of characteristics of particular equipment, processes, or products, with extensive knowledge and understanding of a wide range of engineering materials and components;

- Ability to apply relevant practical and laboratory skills

- Understanding of the use of technical literature and other information sources

- Knowledge of relevant legal and contractual issues

- Understanding of appropriate codes of practice and industry standards

- Awareness of quality issues and their application to continuous improvement

- Ability to work with technical uncertainty

- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments

- Ability to apply engineering techniques taking account of a range of commercial and industrial constraints

- Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader.

Additional general skills

Graduates must have developed transferable skills, additional to those set out in the other learning outcomes, that will be of value in a wide range of situations, including the ability to:

- Apply their skills in problem solving, communication, working with others, information retrieval and the effective use of general IT facilities

- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD

- Monitor and adjust a personal programme of work on an on-going basis

- Exercise initiative and personal responsibility, which may be as a team member or leader.

Masters Degrees other than the Integrated Masters (MEng)

(Accredited as further learning to Masters level, partially meeting the educational requirement for CEng)

Masters degrees[3] (other than the integrated Masters) accredited as further learning to Masters level for the purposes of registration with the Engineering Council vary in nature and purpose. Some offer the chance to study in greater depth particular aspects or applications of a broader discipline in which the graduate holds an Honours degree at Bachelors level. Others bring together different engineering disciplines or subdisciplines in the study of a particular topic, or engineering application, while a further category may be truly multidisciplinary.

Masters programmes also provide an opportunity to integrate the technical and non-technical aspects of engineering and to develop a commitment to professional and social responsibility and ethical codes.

Graduates from an accredited Masters degree must achieve a systematic understanding of the learning outcomes described below, including acquisition of coherent and detailed knowledge, most of which is at, or informed by, the forefront of defined aspects of the relevant engineering discipline. Some of the learning outcomes will be to enhanced and extended levels, the balance of which will vary according to the nature and aims of each programme. Crucially, graduates will have the ability to integrate their prior knowledge and understanding of the discipline and engineering practice with the development of advanced level knowledge and understanding, to solve a substantial range of engineering problems, some of them complex or novel. They will have acquired much of this ability through individual and/or group projects. Ideally some of these projects would have industrial involvement or be practice-based.

The weighting given to the six broad areas of learning below will vary according to the nature and aims of each programme.

Science and mathematics

Engineering is underpinned by science and mathematics, and other associated disciplines, as defined by the relevant professional engineering institution(s). The main science and mathematical abilities will have been developed in an accredited engineering undergraduate programme. Masters graduates will therefore need additionally:

- A comprehensive understanding of the relevant scientific principles of the specialisation

- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation

- Understanding of concepts relevant to the discipline, some from outside engineering, and the ability to evaluate them critically and to apply them effectively, including in engineering projects.

[3]The term 'Masters degree' is used to mean an engineering degree at Level 7 (Level 11 in Scotland) other than the integrated Masters degree (MEng).

Engineering analysis

Engineering analysis involves the application of engineering concepts and tools to the solution of engineering problems. The main engineering analysis abilities will have been developed in an accredited engineering undergraduate programme. Masters graduates will therefore need additionally:

- Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations

- Ability to use fundamental knowledge to investigate new and emerging technologies

- Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods.

Design

Design at this level is the creation and development of an economically viable product, process or system to meet a defined need. It involves significant technical and intellectual challenges and can be used to integrate all engineering understanding, knowledge and skills to the solution of real and complex problems. The main design abilities will have been developed in an accredited engineering undergraduate programme. Masters graduates will need additionally:

- Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies

- Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations

- Ability to generate an innovative design for products, systems, components or processes to fulfil new needs.

Economic, legal, social, ethical and environmental context

Engineering activity can have impacts on the environment, on commerce, on society and on individuals. Graduates therefore need the skills to manage their activities and to be aware of the various legal and ethical constraints under which they are expected to operate, including:

- Awareness of the need for a high level of professional and ethical conduct in engineering

- Awareness that engineers need to take account of the commercial and social contexts in which they operate

- Knowledge and understanding of management and business practices, their limitations, and how these may be applied in the context of the particular specialisation

- Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate

- Awareness of relevant regulatory requirements governing engineering activities in the context of the particular specialisation

- Awareness of and ability to make general evaluations of risk issues in the context of the particular specialisation, including health & safety, environmental and commercial risk.

Engineering practice

The main engineering practice abilities will have been developed in an accredited engineering undergraduate programme. Masters graduates will need to demonstrate application of these abilities where appropriate and additional engineering skills which can include:

- Advanced level knowledge and understanding of a wide range of engineering materials and components

- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments

- Ability to apply engineering techniques, taking account of a range of commercial and industrial constraints

- Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader.

Additional general skills

Graduates must have developed transferable skills, additional to those set out in the other learning outcomes, that will be of value in a wide range of situations, including the ability to:

- Apply their skills in problem solving, communication, information retrieval, working with others, and the effective use of general IT facilities

- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD

- Monitor and adjust a personal programme of work on an on-going basis

- Exercise initiative and personal responsibility, which may be as a team member or leader.

Engineering Doctorate accreditation

The Engineering Doctorate (EngD) was established in the UK in 1992 following the Parnaby Report's conclusion that an alternative was required that would be distinct from, and complementary to, the traditional existing PhD. The EngD is more vocationally focused and suited to the needs of industry. It is an alternative to the traditional PhD for students who want to pursue a career in industry.

The EngD was not included as an exemplifying qualification when UK-SPEC was first published. However, since then, professional engineering institutions' experience of accrediting Masters degrees and the publication in 2011 of learning outcomes for Masters degrees paved the way for the development of a process for accrediting the EngD.

An EngD may be considered as an exemplifying academic award for CEng for an individual holding an accredited Bachelors degree with honours in engineering or technology, sometimes referred to as 'accredited further learning'. This applies to an EngD that has been accredited since 1 March 2012.

Key principles and reference points

The EngD is at least equivalent to the intellectual challenge of a PhD (level 8 in the qualifications framework for England, Wales and Northern Ireland; level 12 in the framework for Scotland), but is enhanced by the provision of taught material in both management and technical areas.

When accrediting EngDs, the arrangements for the accreditation of HE programmes set out in the Engineering Council's Registration Code of Practice apply. Individual accrediting institutions will have their own detailed processes and requirements, to which the university should refer.

The principal reference point for the accreditation of the EngD is the set of learning outcomes for Masters degrees other than the MEng. Of particular note are the references in that preamble to the varying nature and purpose of such degrees, the opportunity to study in greater depth and the multidisciplinary nature of some degrees. These considerations also apply to the EngD.

Other reference points are:

- The Dublin Descriptor for third cycle qualifications:
  www.uni-due.de/imperia/md/content/bologna/dublin_descriptors.pdf

- 'Doctoral degree characteristics' published by the QAA in September 2011:
  www.qaa.ac.uk/Publications/InformationAndGuidance/Documents/Doctoral_Characteristics.pdf

- The UK-SPEC standard of competence and commitment for CEng :
  www.engc.org.uk/ukspec

When considering an EngD for accreditation as an academic award, the key assessment is whether or not the programme is delivering the knowledge and understanding that underpins the CEng standard. The EngD will need to deliver the engineering-specific learning outcomes and the additional general skills at the required level. EngDs are generally accepted to provide training and the opportunity for the development of competence; however these are not the focus of assessment during academic accreditation.

Particular attention is likely to be paid to the nature of the project, the balance between the management and more technical engineering content, the integration of learning with the research project objectives and application, supervision arrangements for the Research Engineer (RE), and systems for ensuring that the RE is allowed sufficient time to undertake any university modules and prepare for exams.

In line with normal accreditation practice, there will be a meeting with REs and usually with some employers of REs.

Further information about accrediting the EngD as an integrated learning and development programme is available from accrediting professional engineering institutions.

Reference

The EPSRC Industrial Doctorate Centre Scheme: Good Practice Guidance:
www.epsrc.ac.uk/SiteCollectionDocuments/other/IDCGoodPracticeGuidelines.pdf

Glossary

Accreditation	A process of peer review of a degree programme against published learning outcomes. This usually involves a visit from a team of professional engineers nominated by professional engineering institutions to the degree awarding body.
Bologna Process	A non-statutory inter-governmental agreement, creating a coherent and cohesive European Higher Education Area (EHEA) and a Framework for Qualifications of the European Higher Education Area (FQ-EHEA) comprising first, second and third cycle degrees. The EHEA is a means of promoting mutual recognition of qualifications, demonstrating transparency of systems and easing the mobility of staff and students across higher education in Europe. **www.ehea.info** The UK has verified that its national frameworks for higher education qualifications in England, Wales and Northern Ireland and in Scotland are compatible with the FQ-EHEA: Bachelors and Bachelors (Hons) degrees as first cycle, the Integrated MEng and Masters degree as second cycle. **www.qaa.ac.uk/Publications/InformationAndGuidance/Documents/BolognaLeaflet.pdf**
Chartered Engineer (CEng)	One of the professional titles available to individuals who meet the required standard of competence and commitment. **www.engc.org.uk/ceng**
Competence	The ability to carry out a task to an effective standard. Its achievement requires the right level of knowledge, understanding and skill, as well as a professional attitude. It is part of the requirement (along with commitment) that must be demonstrated in order for an individual to be admitted to the Engineering Council's register at the relevant level.
Continuing Professional Development (CPD)	The systematic acquisition of knowledge and skills, and the development of personal qualities, to maintain and enhance professional competence. All members of professional engineering institutions have an obligation to undertake CPD, and to support the learning of others. **www.engc.org.uk/cpd**
Educational institution	Most UK Higher Education courses are taught by universities, but many are also taught at colleges and other specialist institutions. Some 'private providers' are entering the market, and the term 'Higher Education provider' is now also used. There are around 160 universities and colleges in the UK that are permitted to award degrees.
Engineering Accreditation Board (EAB)	Made up of all the professional engineering institutions that are licensed by the Engineering Council to accredit academic programmes for both Incorporated Engineer and Chartered Engineer status. The Engineering Council provides the secretariat for EAB. **www.engab.org.uk**
Engineering Council	The UK regulatory body for the engineering profession that sets and maintains internationally recognised standards of professional competence and ethics, and holds the UK register of professional engineers and technicians. **www.engc.org.uk**
EUR-ACE®	European quality label for engineering degree programmes at Bachelors and Masters level **www.enaee.eu/eur-ace-system** The Engineering Council is authorised to award the EUR-ACE® label.
Exemplifying qualification	An educational or vocational qualification that demonstrates the knowledge, understanding and skills to meet or partially meet the requirement for registration in a particular category. Other qualifications may be permitted if they achieve (or exceed) the same level.
FEANI	The European Federation of National Engineering Associations of which the Engineering Council is the UK partner. **www.feani.org**
Graduate Attribute	Graduate attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practise at the appropriate level. The graduate attributes are exemplars of the attributes expected of graduates from an accredited programme. Graduate attributes are clear, succinct statements of the expected capability, qualified if necessary by a range indication appropriate to the type of programme.
Higher Education (HE)	In the UK, this refers to education that is post-school and defined in the Qualifications and Credit Framework (QCF) as being at a level between 4 and 8. It includes: Certificate of Higher Education; Diploma of Higher Education; Bachelors degrees; Masters degrees; and doctoral degrees.
Incorporated Engineer (IEng)	One of the professional titles available to individuals who meet the required standard of competence and commitment. **www.engc.org.uk/ieng**
International Engineering Alliance (IEA)	Partnership of international organisations and responsible for the governance of the international accords such as the Dublin, Sydney and Washington Accords.
Key Information Set (KIS)	Publically available standard sets of information about undergraduate degrees which are designed to meet the needs of prospective students. **www.hefce.ac.uk https://unistats.direct.gov.uk**
Learning outcome	A statement of achievement expected of a graduate from an accredited programme.

Output standard	The overall standard that a programme, which comprises a level of qualification and a set of associated learning outcomes, must meet in order to secure accredited status.
Professional engineering institution	Membership organisation which is licensed by the Engineering Council to assess candidates for professional registration. Some institutions also have a licence to accredit degree programmes and/or company training schemes. For a list see: **www.engc.org.uk/institutions**
Professional registration	The process whereby an individual is admitted to the Engineering Council's Register based on the individual demonstrating, via a peer review process by a licensed professional engineering institution, that he/she has met the profession's standards of commitment and competence. Depending on the type of accredited degree, graduates will have achieved in full or in part the academic requirements for IEng or CEng. Award of the title permits use of the relevant post-nominal.
Programme	An academic programme comprising a set of courses of study that leads to the award of a degree or other Higher Education qualification.
QCF	Qualifications and Credit Framework: a framework that applies to degrees, diplomas, certificates and other academic awards (other than honorary degrees) granted by a Higher Education provider. For HE reference points see **www.qaa.ac.uk**
Quality Assurance Agency for Higher Education (QAA)	Safeguards standards and drives improvement in the quality of UK higher education across all subjects. The QAA works closely with the Engineering Council and professional engineering institutions to support the engineering disciplines. **www.qaa.ac.uk**
Royal Charter	A formal document issued by the Monarch granting rights and powers to an individual or an organisation.
SCQF	The Scottish Credit and Qualifications Framework: a framework that applies to degrees, diplomas, certificates and other academic awards (other than honorary degrees) granted by a Higher Education provider. For HE reference point see **www.scqf.org.uk**
Sydney Accord	Similar to the Washington Accord (see below), for Incorporated Engineers (in the UK) or Engineering Technologists. **www.ieagreements.com/sydney**
Threshold	The minimum standard that a programme must meet.
UK-SPEC: the UK Standard for Professional Engineering Competence	The UK standard which sets out the competence and commitment requirements for registration with the Engineering Council as an Engineering Technician, Incorporated Engineer or Chartered Engineer. **www.engc.org.uk/ukspec**
Washington Accord	An international agreement among bodies responsible for accrediting engineering degree programmes, recognising the substantial equivalence of such programmes for entry to the practice of engineering. In the UK this is at Chartered Engineer status. **www.ieagreements.com/washington-accord**

Annex A: Collated preambles for each degree

Programmes accredited for IEng	Programmes accredited for CEng		
Bachelors Degrees and Bachelors (Honours) Degrees	**Bachelors (Honours) Degrees accredited as partially meeting the educational requirement for CEng (Further learning to Masters level will be required)**	**Integrated Masters (MEng) Degrees**	**Masters Degrees other than the Integrated Masters (MEng) (Accredited as further learning to Masters level, partially meeting the educational requirement for CEng)**
Bachelors degrees and Bachelors (Honours) degrees accredited for the purpose of IEng registration will have an emphasis on development and attainment of the know-how necessary to apply technology to engineering problems and processes, and to maintain and manage current technology, sometimes within a multidisciplinary engineering environment. Graduates from accredited Bachelors or Bachelors (Honours) degree programmes must achieve the learning outcomes described on pages 12-14. The breadth and depth of underpinning scientific and mathematical knowledge, understanding and skills will be provided in the most appropriate manner to enable the application of engineering principles within existing technology to future engineering problems and processes. Graduates are likely to have acquired some of this ability through involvement in individual and/or group design projects. Programmes will develop a knowledge and understanding of current engineering practice and processes, with less focus on analysis than in programmes accredited for CEng. Design will be a significant component, especially in integrating a range of knowledge and understanding to design products, systems and processes to meet defined needs using current technology. The weighting given to the six broad areas of learning on pages 12-14 will vary according to the nature and aims of each programme.	Bachelors (Honours) degrees accredited for the purpose of CEng registration develop the ability to apply a thorough understanding of relevant science and mathematics to the analysis and design of technical solutions to improve quality of life. Graduates from accredited Bachelors (Honours) programmes must achieve a systematic understanding of the learning outcomes described on pages 15-17, including acquisition of coherent and detailed knowledge, much of which is at, or informed by, the forefront of defined aspects of the relevant engineering discipline. Crucially, they will have the ability to integrate their knowledge and understanding of mathematics; science; computer-based methods; design; the economic, legal, social, ethical and environmental context; and engineering practice to solve problems, some of a complex nature, in their chosen engineering discipline. They are likely to have acquired some of this ability through involvement in individual and/or group design projects. The weighting given to the six broad areas of learning on pages 15-17 will vary according to the nature and aims of each programme.	Integrated Masters (MEng) degrees accredited for CEng registration include the outcomes of accredited Bachelors (Honours) degrees and go beyond to provide a greater range and depth of specialist knowledge, within a research and industrial environment, as well as a broader and more general academic base. Such programmes should provide both a foundation for leadership and a wider appreciation of the economic, legal social, ethical and environmental context of engineering. Graduates from an accredited integrated Masters (MEng) degree must achieve a systematic understanding of the learning outcomes described on pages 18-21, including acquisition of coherent and detailed knowledge, most of which is at, or informed by, the forefront of defined aspects of the relevant engineering discipline. Some of the learning outcomes will be to levels deeper and broader than in a Bachelors programme, the balance of which will vary according to the nature and aims of each programme. Crucially, graduates will have the ability to integrate their knowledge and understanding of mathematics; science; computer-based methods; design; the economic, legal, social, ethical and environmental context; and engineering practice to solve a substantial range of engineering problems, some of them complex or novel. They will have acquired much of this ability through involvement in individual and group design projects. Ideally some of these projects would have industrial involvement or be practice-based. The weighting given to the six broad areas of learning on pages 18-21 will vary according to the nature and aims of each programme.	Masters degrees[4] (other than the integrated Masters) accredited as further learning to Masters level accredited for the purposes of registration with the Engineering Council vary in nature and purpose. Some offer the chance to study in greater depth particular aspects or applications of a broader discipline in which the graduate holds an Honours degree at Bachelors level. Others bring together different engineering disciplines or subdisciplines in the study of a particular topic, or engineering application, while a further category may be truly multidisciplinary. Masters programmes also provide an opportunity to integrate the technical and non-technical aspects of engineering and to develop a commitment to professional and social responsibility and ethical codes. Graduates from an accredited Masters degree must achieve a systematic understanding of the learning outcomes described on pages 22-24, including acquisition of coherent and detailed knowledge, most of which is at, or informed by, the forefront of defined aspects of the relevant engineering discipline. Some of the learning outcomes will be to enhanced and extended levels, the balance of which will vary according to the nature and aims of each programme. Crucially, graduates will have the ability to integrate their prior knowledge and understanding of the discipline and engineering practice with the development of advanced level knowledge and understanding, to solve a substantial range of engineering problems, some of them complex or novel. They will have acquired much of this ability through individual and/or group projects. Ideally some of these projects would have industrial involvement or be practice-based. The weighting given to the six broad areas of learning on pages 22-24 will vary according to the nature and aims of each programme.

[4]The term 'Masters degree' is used to mean an engineering degree at Level 7 (Level 11 in Scotland) other than the integrated Masters degree (MEng).

Annex B

QUALIFICATION DESCRIPTORS

Quality Assurance Agency Descriptors

Descriptor for a Higher Education Qualification at Level 6: Bachelor's Degree with Honours

The descriptor provided for this level of the FHEQ is for any Bachelor's degree with honours which should meet the descriptor in full. This qualification descriptor can also be used as a reference point for other level 6 qualifications, including Bachelor's degrees, graduate diplomas etc.

Bachelor's degrees with honours are awarded to students who have demonstrated:

- a systematic understanding of key aspects of their field of study, including acquisition of coherent and detailed knowledge, at least some of which is at, or informed by, the forefront of defined aspects of a discipline
- an ability to deploy accurately established techniques of analysis and enquiry within a discipline
- conceptual understanding that enables the student:
    - to devise and sustain arguments, and/or to solve problems, using ideas and techniques, some of which are at the forefront of a discipline
    - to describe and comment upon particular aspects of current research, or equivalent advanced scholarship, in the discipline
- an appreciation of the uncertainty, ambiguity and limits of knowledge
- the ability to manage their own learning, and to make use of scholarly reviews and primary sources (for example, refereed research articles and/or original materials appropriate to the discipline).

Typically, holders of the qualification will be able to:

- apply the methods and techniques that they have learned to review, consolidate, extend and apply their knowledge and understanding, and to initiate and carry out projects
- critically evaluate arguments, assumptions, abstract concepts and data (that may be incomplete), to make judgements, and to frame appropriate questions to achieve a solution - or identify a range of solutions - to a problem
- communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.

And holders will have:

- the qualities and transferable skills necessary for employment requiring:
    - the exercise of initiative and personal responsibility
    - decision-making in complex and unpredictable contexts
    - the learning ability needed to undertake appropriate further training of a professional or equivalent nature.

At the time of publication of this handbook, the QAA was reviewing its qualification descriptors. For the up-to-date version, refer to the QAA website: ***www.qaa.ac.uk***

Holders of a Bachelor's degree with honours will have developed an understanding of a complex body of knowledge, some of it at the current boundaries of an academic discipline. Through this, the holder will have developed analytical techniques and problem-solving skills that can be applied in many types of employment. The holder of such a qualification will be able to evaluate evidence, arguments and assumptions, to reach sound judgements and to communicate them effectively.

Holders of a Bachelor's degree with honours should have the qualities needed for employment in situations requiring the exercise of personal responsibility, and decision-making in complex and unpredictable circumstances.

Bachelor's degrees with honours form the largest group of higher education qualifications. Typically, learning outcomes for these programmes would be expected to be achieved on the basis of study equivalent to three full-time academic years and lead to awards with titles such as Bachelor of Arts, BA (Hons) or Bachelor of Science, BSc (Hons). In addition to Bachelor's degrees at this level are short courses and professional 'conversion' courses, based largely on undergraduate material, and taken usually by those who are already graduates in another discipline, leading to, for example, graduate certificates or graduate diplomas.

Descriptor for a Higher Education Qualification at Level 7: Master's Degree

The descriptor provided for this level of the framework is for any Master's degree which should meet the descriptor in full. This qualification descriptor can also be used as a reference point for other level 7 qualifications, including postgraduate certificates and postgraduate diplomas.

Master's degrees are awarded to students who have demonstrated:

- a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their academic discipline, field of study or area of professional practice
- a comprehensive understanding of techniques applicable to their own research or advanced scholarship
- originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline
- conceptual understanding that enables the student:
    - to evaluate critically current research and advanced scholarship in the discipline
    - to evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses.

Typically, holders of the qualification will be able to:

- deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences
- demonstrate self-direction and originality in tackling and solving problems, and act autonomously in planning and implementing tasks at a professional or equivalent level
- continue to advance their knowledge and understanding, and to develop new skills to a high level.

And holders will have:

- the qualities and transferable skills necessary for employment requiring:
  - the exercise of initiative and personal responsibility
  - decision-making in complex and unpredictable situations
  - the independent learning ability required for continuing professional development.

Much of the study undertaken for Master's degrees will have been at, or informed by, the forefront of an academic or professional discipline. Students will have shown originality in the application of knowledge, and they will understand how the boundaries of knowledge are advanced through research. They will be able to deal with complex issues both systematically and creatively, and they will show originality in tackling and solving problems. They will have the qualities needed for employment in circumstances requiring sound judgement, personal responsibility and initiative in complex and unpredictable professional environments.

Master's degrees are awarded after completion of taught courses, programmes of research or a mixture of both. Longer, research-based programmes may lead to the degree of MPhil. The learning outcomes of most Master's degree courses are achieved on the basis of study equivalent to at least one full-time calendar year and are taken by graduates with a Bachelor's degree with honours (or equivalent achievement).

Master's degrees are often distinguished from other qualifications at this level (for example, advanced short courses, which often form parts of continuing professional development programmes and lead to postgraduate certificates and/or postgraduate diplomas) by an increased intensity, complexity and density of study. Master's degrees – in comparison to postgraduate certificates and postgraduate diplomas – typically include planned intellectual progression that often includes a synoptic/research or scholarly activity.

Some Master's degrees, for example in science, engineering and mathematics, comprise an integrated programme of study spanning several levels where the outcomes are normally achieved through study equivalent to four full-time academic years. While the final outcomes of the qualifications themselves meet the expectations of the descriptor for a higher education qualification at level 7 in full, such qualifications are often termed 'integrated Master's' as an acknowledgement of the additional period of study at lower levels (which typically meets the expectations of the descriptor for a higher education qualification at level 6).

First degrees in medicine, dentistry and veterinary science comprise an integrated programme of study and professional practice spanning several levels. While the final outcomes of the qualifications themselves typically meet the expectations of the descriptor for a higher education qualification at level 7, these qualifications may often retain, for historical reasons, titles of Bachelor of Medicine, and Bachelor of Surgery, Bachelor of Dental Surgery, Bachelor of Veterinary Medicine or Bachelor of Veterinary Science, and are abbreviated to MBChB or BM BS, BDS, BVetMed and BVSc respectively.

Note

The Master of Arts (MA) granted by the University of Oxford and the University of Cambridge are not academic qualifications. The MA is normally granted, on application, to graduates of these universities with a Bachelor of Arts (BA). No further study or assessment is required, but the recipient may be required to pay a fee.

At the University of Oxford, the MA may be granted during or after the twenty-first term from matriculation and at the University of Cambridge, the MA may be granted six years after the end of the first term.

SCOTTISH CREDIT AND QUALIFICATIONS FRAMEWORK

The Scottish Credit and Qualifications Framework (SCQF)

The SCQF has 12 levels which provide an indication of the complexity of qualifications and learning programmes. SCQF levels are based on a single set of Level Descriptors that are the common reference points and definitions which provide a way of recognising learning that is outcome-based and quality-assured, irrespective of whether that learning is academic, vocational, non-formal or informal.

These revised Level Descriptors (August 2012) supersede all previous versions. More detailed information regarding the specific amendments that have been introduced can be accessed at: **www.scqf.org.uk** where it is possible to compare old and new versions to track the differences.

For each Characteristic, the following descriptions are for guidance only – it is not expected that every point will necessarily be covered.

Bachelors Degree SCQF Level 9
Bachelors Degree with Honours SCQF Level 10
Masters Degree SCQF Level 11

Characteristic 1: Knowledge and understanding		
Level 9	Level 10	Level 11
Demonstrate and/or work with: • An understanding of the scope and defining features of a subject/discipline/sector, and an integrated knowledge of its main areas and boundaries. • A critical understanding of a range of the principles, principal theories, concepts and terminology of the subject/discipline/sector. • Knowledge of one or more specialisms that is informed by forefront developments.	Demonstrate and/or work with: • Knowledge that covers and integrates most of the principal areas, features, boundaries, terminology and conventions of a subject/discipline/sector. • A critical understanding of the principal theories, concepts and principles. • Detailed knowledge and understanding in one or more specialisms, some of which is informed by, or at the forefront of, a subject/discipline/sector. • Knowledge and understanding of the ways in which the subject/discipline/sector is developed, including a range of established techniques of enquiry or research methodologies.	Demonstrate and/or work with: • Knowledge that covers and integrates most, if not all, of the main areas of the subject/discipline/sector – including their features, boundaries, terminology and conventions. • A critical understanding of the principal theories, concepts and principles. • A critical understanding of a range of specialised theories, concepts and principles. • Extensive, detailed and critical knowledge and understanding in one or more specialisms, much of which is at, or informed by, developments at the forefront. • A critical awareness of current issues in a subject/discipline/sector and one or more specialisms.

Characteristic 2: Practice: applied knowledge, skills and understanding		
Level 9	Level 10	Level 11
Apply knowledge, skills and understanding: • In using a range of the principal professional skills, techniques, practices and/or materials associated with the subject/discipline/sector. • In using a few skills, techniques, practices and/or materials that are specialised and/or advanced. • In practising routine methods of enquiry and/or research. • To practise in a range of professional level contexts that include a degree of unpredictability.	Apply knowledge, skills and understanding: • In using a wide range of the principal professional skills, techniques, practices and/or materials associated with the subject/discipline/sector. • In using a few skills, techniques, practices and/or materials that are specialised, advanced and/or at the forefront of a subject/discipline/sector. • In executing a defined project of research, development or investigation and in identifying and implementing relevant outcomes. • To practise in a range of professional level contexts that include a degree of unpredictability and/or specialism.	Apply knowledge, skills and understanding: • In using a significant range of the principal professional skills, techniques, practices and/or materials associated with the subject/discipline/sector. • In using a range of specialised skills, techniques, practices and/or materials that are at the forefront of, or informed by forefront developments. • In applying a range of standard and specialised research and/or equivalent instruments and techniques of enquiry. • In planning and executing a significant project of research, investigation or development. • In demonstrating originality and/or creativity, including in practices. • To practise in a wide and often unpredictable variety of professional level contexts.

Characteristic 3: Generic cognitive skills		
Level 9	Level 10	Level 11
• Undertake critical analysis, evaluation and/or synthesis of ideas, concepts, information and issues in a subject/discipline/sector. • Identify and analyse routine professional problems and issues. • Draw on a range of sources in making judgements.	• Critically identify, define, conceptualise and analyse complex/professional problems and issues. • Offer professional insights, interpretations and solutions to problems and issues. • Demonstrate some originality and creativity in dealing with professional issues. • Critically review and consolidate knowledge, skills, practices and thinking in a subject/discipline/sector. • Make judgements where data/information is limited or comes from a range of sources.	• Apply critical analysis, evaluation and synthesis to forefront issues, or issues that are informed by forefront developments in the subject/discipline/sector. • Identify, conceptualise and define new and abstract problems and issues. • Develop original and creative responses to problems and issues. • Critically review, consolidate and extend knowledge, skills, practices and thinking in a subject/discipline/sector. • Deal with complex issues and make informed judgements in situations in the absence of complete or consistent data/information.

Characteristic 4: Communication, ICT and numeracy skills		
Level 9	Level 10	Level 11
Use a wide range of routine skills and some advanced and specialised skills in support of established practices in a subject/discipline/ sector, for example: • Present or convey, formally and informally, information on standard/mainstream topics in the subject/discipline/sector to a range of audiences. • Use a range of ICT applications to support and enhance work. • Interpret, use and evaluate numerical and graphical data to achieve goals/targets.	Use a wide range of routine skills and some advanced and specialised skills in support of established practices in a subject/discipline/ sector, for example: • Present or convey, formally and informally, information about specialised topics to informed audiences. • Communicate with peers, senior colleagues and specialists on a professional level. • Use a range of ICT applications to support and enhance work at this level and adjust features to suit purpose. • Interpret, use and evaluate a wide range of numerical and graphical data to set and achieve goals/ targets.	Use a wide range of routine skills and a range of advanced and specialised skills as appropriate to a subject/discipline/sector, for example: • Communicate, using appropriate methods, to a range of audiences with different levels of knowledge/ expertise. • Communicate with peers, more senior colleagues and specialists. • Use a wide range of ICT applications to support and enhance work at this level and adjust features to suit purpose. • Undertake critical evaluations of a wide range of numerical and graphical data.

Characteristic 5: Autonomy, accountability and working with others		
Level 9	Level 10	Level 11
• Exercise autonomy and initiative in some activities at a professional level in practice or in a subject/ discipline/sector. • Exercise managerial responsibility for the work of others and for a range of resources. • Practise in ways that show awareness of own and others' roles and responsibilities. • Work, under guidance, with specialist practitioners. • Seeking guidance where appropriate, manage ethical and professional issues in accordance with current professional and/or ethical codes or practices.	• Exercise autonomy and initiative in professional/equivalent activities. • Exercise significant managerial responsibility for the work of others and for a range of resources. • Practise in ways that show awareness of own and others' roles and responsibilities. • Work, under guidance, in a peer relationship with specialist practitioners. • Work with others to bring about change, development and/or new thinking. • Manage complex ethical and professional issues in accordance with current professional and/or ethical codes or practices. • Recognise the limits of these codes and seek guidance where appropriate.	• Exercise substantial autonomy and initiative in professional and equivalent activities. • Take responsibility for own work and/or significant responsibility for the work of others. • Take significant responsibility for a range of resources. • Work in a peer relationship with specialist practitioners. • Demonstrate leadership and/or initiative and make an identifiable contribution to change and development and/or new thinking. • Practise in ways which draw on critical reflection on own and others' roles and responsibilities. • Manage complex ethical and professional issues and make informed judgements on issues not addressed by current professional and/or ethical codes or practices.

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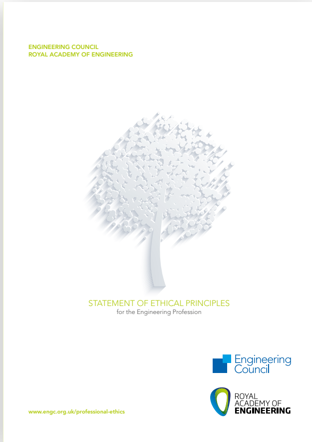

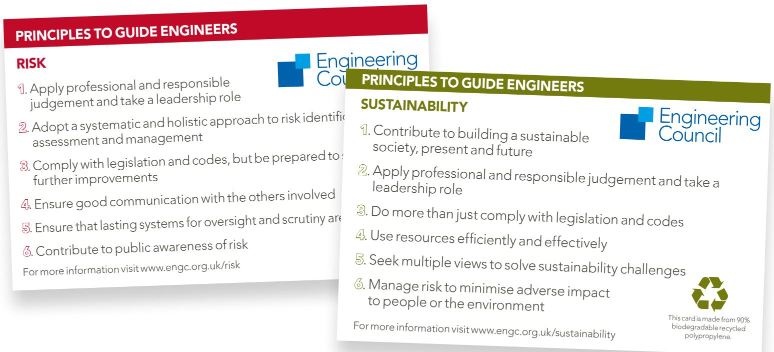

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