THE ACCREDITATION OF HIGHER EDUCATION PROGRAMMES

UK Standard for Professional Engineering Competence

www.engc.org.uk

Engineering Council

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FOREWORD

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Engineering is a broad church that is concerned with the art and practice of changing the world we live in. Driven by the needs of business and society, 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 teaches them industry-relevant skills. Accreditation 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 praised for its clarity, its brevity and its emphasis on learning outcomes rather than inputs. It has enabled the development of a variety 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 have been reviewed internationally and deemed to be of a sufficiently high standard for the Engineering Council to be licensed to award the European Network for Accreditation of Engineering Education's EUR-ACE label to UK accredited engineering programmes. Programmes that carry the EUR-ACE label are recognised as being of international standing and aligning with European qualifications frameworks; perhaps most importantly they are recognised as first or second cycle degrees consistent with the Bologna process. 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.

This updated version of the accreditation handbook does not introduce any changes to the learning outcomes and it remains rooted in the UK Standard for Professional Engineering Competence (UK-SPEC). It has been updated to address issues arising since 2004, to reflect changes in qualifications frameworks and to recognize the establishment in 2006 of the Engineering Accreditation Board (EAB). EAB has worked hard to ensure consistently applied and rigorous standards and the sharing of good accreditation practice between professional engineering institutions, and will continue to do so. The accreditation handbook continues to be the framework within which professional engineering institutions that are licensed to accredit by the Engineering Council can establish the acceptability of degree programmes for accreditation and demonstrate nationally and internationally just what it is that accredited courses deliver.

Bob Cryan

PART ONE

GETTING YOUR 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 professional engineering institutions (Licensed Members) to undertake the accreditation within these requirements – interpreting them as appropriate for their own sector of the profession – and maintains the registers of accredited or approved programmes. Licensed Members use the accreditation process to assess whether specific educational programmes provide some or all of the underpinning knowledge, understanding and skills for eventual 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 choose quality degree programmes. It also confers market advantage to graduates from accredited programmes both when they are seeking employment and also when in due course they decide to seek professional qualification. 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 more of a continuing dialogue between Licensed Members and educational institutions, rather than placing all the emphasis on the periodic accreditation exercise. In an important development, the UK Quality Assurance Agency for Higher Education (QAA) has since 2006 adopted the standards in UK-SPEC 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 'tradeability' of engineering and technology degrees. In each case the system of accreditation applied in the UK is fundamental to the acceptance of UK degrees. With increasing globalisation, such accords and frameworks (described in more detail on page 7) 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 education providers wishing to attract international students to the UK.

What is Involved?

The accreditation process is essentially one of peer review; it is applied to individual programmes not to the department or institution overall. An educational establishment seeking accreditation for an engineering or technology programme should approach the relevant Licensed Member listed at **www.engc.org.uk** Accreditation is typically the responsibility of their education or qualifications department. There may be a charge for the process, especially for visits outside of the UK. Further advice is available from the relevant Licensed Member. There will inevitably be some costs to the institution seeking accreditation, mainly but not wholly in staff time. The Engineering Council supports the principles for better regulation of higher education promoted by the 'HE Better Regulation Group' (HEBRG)[1] and encourages Licensed Members to embrace these principles in relation to quality assurance and data collection. Engineering programme accreditation compares very favourably with other professions in this respect. Joint visits from two or more Licensed Members are an option and can reduce the overall costs of accreditation. These can be organised through the auspices of the Engineering Accreditation Board (EAB) and further details are given below.

Each Licensed Member will have 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 resources involved – including human, physical and material
- Its internal regulations regarding compensation for underperformance
- Quality assurance arrangements
- Entry to the programme and how cohort entry extremes will be supported
- How previous accreditation recommendations and requirements have been dealt with

Some Licensed Members request an initial brief 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 Licensed Member 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 the requirements for accreditation. The visit typically takes place over a two or three day period. The panel will expect to meet staff and students, and some panels meet 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.

1 The HEBRG was established in 2010 as the successor to the Higher Education Regulation Review Group.

Where programmes are offered collaboratively with other educational establishments, or on a franchised basis, the accrediting institution will normally expect to visit all partners involved in delivering the programme, although this requirement may be waived in certain circumstances.

Each Licensed Member will have a committee or board which will take the decision on 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 should be regarded as fully meeting the educational requirement for IEng registration.

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

The accrediting institution must be notified 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

Under the United Kingdom Standard for Professional Engineering Competence (UK-SPEC), the decision about whether to accredit a programme will be made on the basis of the programme delivering the learning outcomes which the Licensed Member has specified. These outcomes are derived from the generic output standards for accredited degree programmes adopted by the Engineering Council and set out in part two of this document.

How to Apply

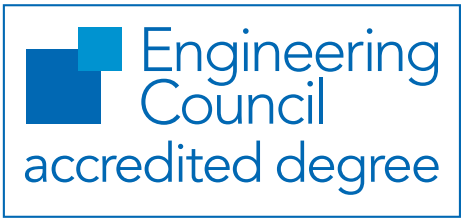
When an educational establishment believes it has a programme that would benefit from accreditation by the Engineering Council it should approach the relevant professional body that holds a licence to accredit and is listed at **www.engc.org.uk/institutions.** The decision about which body to contact 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 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 Licensed Members 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**

It is rare that a degree programme that embraces the principles of engineering cannot be accredited. Although a programme may be accredited by a particular Licensed Member, once accredited it appears in the full list of accredited degrees maintained by the Engineering Council, available at **www.engc.org.uk/acadsearch.** 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. Licensed Members may however accredit 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 should ensure that their own publicity materials accurately reflect the accreditation status of their programmes and the relationship to registration as IEng or CEng. In addition, they are encouraged to use the 'Engineering Council accredited degree' logo alongside the name of all degree programmes that have been accredited by a licensed professional engineering institution. The logo is available for downloading at **http://www.engc.org.uk/AccreditedDegreeLogo**



International Recognition

The Washington and Sydney Accords, to both of which the Engineering Council is a party, provide a mechanism for mutual recognition by signatory countries of accreditation processes – and by extension of accredited degrees – for CEng and IEng degrees respectively. An increasing number of countries are signatories to these accords. 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 universities with accredited degrees to demonstrate the international standing of these awards. The Engineering Council has been granted the right to license the award of the EUR-ACE label to UK engineering degrees accredited since November 2006, on payment of a fee by the university. A significant aspect of the EUR-ACE framework is that it aligns with the HE qualification framework agreed as part of the Bologna process. Award of the EUR-ACE label will show that a programme is recognised by ENAEE as a first cycle degree (Bachelors and honours degrees) or second cycle degree (MEng, MSc etc). For further details see **www.engc.org.uk/eurace**

PART TWO

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 need therefore to be read in the context of the generic statements of competence and commitment for Chartered Engineers and Incorporated Engineers as set out in the United Kingdom Standard for Professional Engineering Competence (UK-SPEC).

The output standards for accredited engineering programmes will encompass two different categories of learning outcomes that are inter-related. One category will be general in nature, and will apply to all types of programme. The second category will be more specific. The general learning outcomes describe the overall nature of the programme; delivery of the specific outcomes should contribute to a greater or lesser extent to the delivery of the general ones.

CEng

The following qualifications exemplify the required knowledge and understanding for:

Chartered Engineer (CEng):

- **either** an accredited Bachelors degree with honours in engineering or technology, plus either
  - An appropriate Masters degree or Engineering Doctorate (EngD) accredited by a Licensed Member
  - Or appropriate further learning to Masters level
- **or** an accredited integrated MEng degree.

Postgraduate Diplomas are not exemplifying qualifications under UK-SPEC, though they may be accepted on an individual basis as meeting part or all of the further learning requirements (ref Engineering Council's Guidance Note on Academic Accreditation, found at **www.engc.org.uk/ukspec**).

IEng

The following qualifications exemplify the required knowledge and understanding for:

Incorporated Engineer (IEng):

- **either** an accredited Bachelors or honours degree in engineering or technology
- **or** an accredited HNC or HND in engineering or technology (for programmes started before September 1999)
- **or** or an HNC or HND started after September 1999 (but before September 2010 in the case of the HNC) or a Foundation Degree in engineering or technology, plus appropriate further learning to degree level
- **or** an NVQ4 or SVQ4 which has been approved for the purpose by a licensed engineering institution.

This document deals in the first instance with the output standards expected from a Bachelors (Honours) degree appropriate for CEng. The modifications to these for an accredited MEng degree, for degree programmes specifically for IEng accreditation and for other accredited Masters degrees then follow.

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. Accrediting institutions may judge that a certain level of achievement at graduation is necessary to secure the outcomes.

MEng degrees differ from Bachelors degrees in having a greater range of project work, usually including a group project. They also provide a greater range and depth of specialist knowledge, within a research and industrial environment, as well as a broader and more general educational base, to provide both a foundation for leadership, and a wider appreciation of the economic, social and environmental context of engineering.

IEng Bachelors degrees, Foundation degrees and Higher National Diplomas (HNDs) will have an emphasis on the application of developed technology and the attainment of know-how, sometimes within a multidisciplinary engineering environment. The breadth and depth of underpinning scientific and mathematical knowledge, understanding and skills is provided in the most appropriate manner to enable the application of engineering principles within existing technology to future engineering problems and processes.

Masters degrees other than the integrated MEng vary in nature and purpose. Some offer the chance to study a discipline in greater depth, others bring together different engineering disciplines or sub-disciplines, and some may be truly multi-disciplinary. They provide an opportunity to integrate technical and non-technical aspects of engineering and to develop a commitment to professional and social responsibility and ethical codes. Learning outcomes for such Masters degrees should be interpreted in the context of the particular discipline. The competence statements adopted by the relevant professional institution under UK-SPEC, may also provide useful reference points.

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, in design, in explanations and in 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 which can be applied almost automatically.

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

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 that includes descriptors for the different levels of qualification (**www.qaa.ac.uk**) and in the Scottish Credit and Qualifications Framework (**www.scqf.org.uk**).

The QAA's and SCQF Partnership's level descriptors for Bachelors and Masters degrees are included as Annex 1 of this handbook.

General Learning Outcomes

Graduates with the exemplifying qualifications, irrespective of registration category or qualification level, must satisfy the following criteria:

Knowledge and Understanding: they must be able to demonstrate their knowledge and understanding of essential facts, concepts, theories and principles of their engineering discipline, and its underpinning science and mathematics. They must have an appreciation of the wider multidisciplinary engineering context and its underlying principles. They must appreciate the social, environmental, ethical, economic and commercial considerations affecting the exercise of their engineering judgement.

Intellectual Abilities: they must be able to apply appropriate quantitative science and engineering tools to the analysis of problems. They must be able to demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs. They must be able to comprehend the broad picture and thus work with an appropriate level of detail.

Practical skills: they must possess practical engineering skills acquired through, for example, work carried out in laboratories and workshops; in industry through supervised work experience; in individual and group project work; in design work; and in the development and use of computer software in design, analysis and control. Evidence of group working and of participation in a major project is expected. However, individual professional bodies may require particular approaches to this requirement.

General transferable skills: they must have developed transferable skills that will be of value in a wide range of situations. These are exemplified by the Qualifications and Curriculum Authority Higher Level Key Skills and include problem solving, communication, and working with others, as well as the effective use of general IT facilities and information retrieval skills. They also include planning self-learning and improving performance, as the foundation for lifelong learning/CPD.

Output Standards for a Bachelors (Honours) Degree for CEng

Specific Learning Outcomes in Engineering

Graduates from accredited programmes must achieve the following five learning outcomes, defined by broad areas of learning. As set out here, the outcomes apply to accredited programmes at Bachelors (Honours) level leading to CEng registration. See pages 16, 18 and 20 for an explanation of how they might be applied to accredited MEng degrees, to accredited Bachelors degrees leading to IEng registration, and to accredited Masters degrees other than MEng respectively.

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

Underpinning science and mathematics, and associated engineering disciplines, as defined by the relevant engineering institution

- 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 historical, current, and future developments and technologies;

- Knowledge and understanding of mathematical principles necessary to underpin their education in their engineering discipline and to enable them to apply mathematical 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.

Engineering Analysis

- 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 methods and computer software relevant to their engineering discipline, in order to solve engineering problems;

- Understanding of and ability to apply a systems approach to engineering problems.

Design

Design 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 problems. Graduates will therefore need the knowledge, understanding and skills to:

- Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues;
- Understand customer and user needs and the importance of considerations such as aesthetics;
- Identify and manage cost drivers;
- Use creativity to establish innovative solutions;
- Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal;
- Manage the design process and evaluate outcomes.

Economic, social and environmental context

- Knowledge and understanding of commercial and economic context of engineering processes;
- Knowledge of management techniques which may be used to achieve engineering objectives within that context;
- Understanding of the requirement for engineering activities to promote sustainable development;
- Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues;
- Understanding of the need for a high level of professional and ethical conduct in engineering.

Engineering Practice

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

- Knowledge of characteristics of particular materials, equipment, processes, or products;
- Workshop and laboratory skills;
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, technology development, etc);
- Understanding use of technical literature and other information sources;
- Awareness of nature of intellectual property and contractual issues;
- Understanding of appropriate codes of practice and industry standards;
- Awareness of quality issues;
- Ability to work with technical uncertainty.

Applicability of Output Standards to MEng Degrees

Graduates from an accredited integrated MEng degree will have the general and specific learning outcomes described here and will have some of these to enhanced and extended levels. Crucially, they will have the ability to integrate their knowledge and understanding of mathematics, science, computer-based methods, design, the economic, social and environmental context, and engineering practice to solve a substantial range of engineering problems, some of a complex nature. They will have acquired much of this ability through involvement in individual and group design projects, which have had a greater degree of industrial involvement than those in Bachelors degree programmes.

General Learning Outcomes

The range of general learning outcomes described for graduates from Bachelors (Honours) programmes for CEng will also apply to graduates from MEng programmes. In respect of general transferable skills, the following enhanced outcomes should be expected of MEng graduates:

- The ability to develop, monitor and update a plan, to reflect a changing operating environment;
- The ability to monitor and adjust a personal programme of work on an on-going basis, and to learn independently;
- An understanding of different roles within a team, and the ability to exercise leadership;
- The ability to learn new theories, concepts, methods etc in unfamiliar situations.

Specific Learning Outcomes

In respect of the specific learning outcomes, MEng graduates will also be characterised by some or all of the following (the balance will vary according to the nature and aims of each programme):

Underpinning science and mathematics, and associated engineering disciplines, as defined by the relevant engineering institution

- A comprehensive understanding of the scientific principles of own specialisation and related disciplines;
- An awareness of developing technologies related to own specialisation;
- A comprehensive knowledge and understanding of mathematical and computer models relevant to the engineering discipline, and an appreciation of their limitations;
- An understanding of concepts from a range of areas including some outside engineering, and the ability to apply them effectively in engineering projects.

Engineering Analysis

- The ability to use fundamental knowledge to investigate new and emerging technologies;
- The ability to apply mathematical and computer-based models for solving problems in engineering, and the ability to assess the limitations of particular cases;
- The ability to extract data pertinent to an unfamiliar problem, and apply in its solution using computer based engineering tools when appropriate.

Design

- Wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations;
- The ability to generate an innovative design for products, systems, components or processes to fulfil new needs.

Economic, social and environmental context

- Extensive knowledge and understanding of management and business practices, and their limitations, and how these may be applied appropriately;
- The ability to make general evaluations of commercial risks through some understanding of the basis of such risks.

Engineering Practice

- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments;
- Extensive knowledge and understanding of a wide range of engineering materials and components;
- The ability to apply engineering techniques taking account of a range of commercial and industrial constraints.

Applicability of Output Standards to IEng Programmes

Programmes designed specifically for IEng accreditation will have an emphasis on developing and supporting the know-how necessary to apply technology to engineering problems and processes, and to maintain and manage current technology at peak efficiency.

A programme accredited for IEng will have the general learning outcomes described earlier in this document.

Specific Learning Outcomes

In relation to the specific learning outcomes, this focus on the application of developed technology and the attainment of know-how means that accredited Bachelors or honours degree programmes leading to Incorporated Engineer registration will have a different emphasis from those for intending Chartered Engineers. In particular, they are likely to give a greater weighting to developing a knowledge and understanding of engineering practice and processes, and to have less focus on analysis. Design will still be a significant component, especially in integrating a range of knowledge and understanding, but the emphasis will be on designing products, systems and processes to meet defined needs.

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.

Underpinning science and mathematics, and associated engineering disciplines, as defined by the relevant engineering institution

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

- Knowledge and understanding of mathematics necessary to support application of key engineering principles.

Engineering Analysis

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

- The ability to apply quantitative methods and computer software relevant to their engineering technology discipline(s), frequently within a multidisciplinary context;

- An ability to use the results of analysis to solve engineering problems, apply technology and implement engineering processes;

- The ability to apply a systems approach to engineering problems through know-how of the application of the relevant technologies.

Design

Graduates will need the knowledge, understanding and skills to:

- Define a problem and identify constraints;
- Design solutions according to customer and user needs;
- Use creativity and innovation in a practical context;
- Ensure fitness for purpose (including operation, maintenance, reliability etc);
- Adapt designs to meet their new purposes or applications.

Economic, social and environmental context

- Knowledge and understanding of commercial and economic context of engineering processes;
- Knowledge of management techniques which may be used to achieve engineering objectives within that context;
- An understanding of the requirement for engineering activities to promote sustainable development;
- An awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues;
- An understanding of the need for a high level of professional and ethical conduct in engineering.

Engineering Practice

- An understanding of and ability to use relevant materials, equipment, tools, processes, or products;
- Knowledge and understanding of workshop and laboratory practice;
- Knowledge of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology etc);
- The ability to use and apply information from technical literature;
- The ability to use appropriate codes of practice and industry standards;
- An understanding of the principles of managing engineering processes;
- An awareness of quality issues and their application to continuous improvement.

Applicability of Output Standards to Masters Degrees other than the Integrated MEng

Masters degrees[1] 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. Others bring together different engineering disciplines or sub-disciplines in the study of a particular topic, or engineering application, while a further category may be truly multi-disciplinary.

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.

The key factor in considering Masters degrees for accreditation is that they deliver the learning outcomes, which should be interpreted in the context of the particular discipline. The outcomes are designed to enable programme development and innovation.

Graduates from an accredited Masters degree will have the general and specific learning outcomes described here and will have some of these to enhanced and extended levels.

Crucially, they 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 a complex nature. They will have acquired much of this ability through individual and/or group projects. Ideally some of these projects would have included industrial involvement or be practice-based.

General Learning Outcomes

The range of general learning outcomes described for graduates from Bachelors programmes will also apply to graduates from Masters degree programmes. In respect of general transferable skills, the following enhanced outcomes should be expected of Masters degree graduates:

- The ability to develop, monitor and update a plan, to reflect a changing operating environment;
- The ability to monitor and adjust a personal programme of work on an on-going basis, and to learn independently;
- The ability to exercise initiative and personal responsibility, which may be as a team member or leader;
- The ability to learn new theories, concepts, methods etc and apply these in unfamiliar situations.

[1]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).

Specific Learning Outcomes

In respect of the specific learning outcomes, Masters degree graduates will also be characterised by some or all of the following (the balance will vary according to the nature and aims of each programme):

Underpinning science and mathematics, and associated engineering disciplines, as defined by the relevant engineering institution

- A comprehensive understanding of the relevant scientific principles of the specialisation;
- A critical awareness of current problems and/or new insights much of which is at, or informed by, the forefront of the specialisation;
- An understanding of concepts relevant to the discipline, some from outside engineering, and the ability to critically evaluate and apply them effectively.

Engineering Analysis

- The ability to use fundamental knowledge to investigate new and emerging technologies;
- The ability to apply appropriate models for solving problems in engineering, and the ability to assess the limitations of particular cases;
- The ability to collect and analyse research data and use appropriate engineering tools to tackle unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods.

Design

- The ability to apply original thought to the development of practical solutions for products, systems, components or processes.

Economic, social and environmental context

- Knowledge and understanding of management and business practices, and their limitations, and how these may be applied appropriately, in the context of the particular specialisation;
- The ability to make general evaluations of risks through some understanding of the basis of such risks.

Engineering Practice

- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments;
- Advanced level knowledge and understanding of a wide range of engineering materials and components;
- The ability to apply engineering techniques taking account of a range of commercial and industrial constraints.

ANNEX 1

LEVEL DESCRIPTORS

Quality Assurance Agency Level 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.

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.

The Framework for Higher Education Qualifications in England, Wales and Northern Ireland.

Scottish Credit and Qualifications Framework

The Scottish Bachelors Degree

SCQF Level 9
SCQF Credit Points

At least 360 credits of which a minimum of 60 are at SHE level 3

General

The Scottish Bachelors (non-Honours) degree is typically achieved after the equivalent of three years of full-time higher education. In the main, and depending on the subjects or professional area(s) studied, it is awarded either a Bachelor of Science (BSc), or a Bachelor of Arts (BA).

Design of qualification

Although all degrees will exhibit a balance of breadth and depth, some degrees will be highly focused while others will develop greater breadth of outcomes. The particular characteristics of each degree will be articulated in the programme specification. Many degrees which have a specific vocational focus carry recognition by the appropriate professional or statutory body. In a small number of universities, in some faculties, this qualification is titled 'MA'. The Scottish Bachelors degree is a recognised 'normal' entry requirement to a number of professions across the UK.

Typically, holders of the degree will be able to:

Demonstrate a broad and comparative knowledge of the general scope of the subject, its different areas and applications, and its interactions with related subjects;

Demonstrate a detailed knowledge of a defined subject or a more limited coverage of a specialist area balanced by a wider range of study. In each case, specialised study will be informed by current developments in the subject;

Use their knowledge, understanding and skills, in both identifying and analysing problems and issues and in formulating, evaluating and applying evidence-based solutions and arguments.

Show a critical understanding of the essential theories, principles and concepts of the subject(s) and of the ways in which these are developed through the main methods of enquiry in the subject;

Show an awareness of the provisional nature of knowledge;

Communicate the results of their studies and other work accurately and reliably in a range of different contexts using the main specialist concepts, constructs and techniques of the subject(s);

Gain familiarity with and competence in the use of routine materials, practices and skills; and gain familiarity with and competence in a few that are more specialised, advanced and complex; Identify and address their own learning needs including being able to draw on a range of current research, development and professional materials;

Obtain well developed skills for the gathering, evaluation, analysis and presentation of information, ideas, concepts and quantitative and/or qualitative data, drawing on a wide range of current sources. This will include the use of ICT as appropriate to the subject(s);

Apply their subject and transferable skills to contexts where criteria for decisions and the scope of the task may be well defined but where personal responsibility, initiative and decision-making is also required.

The Scottish Bachelors Degree with Honours

SCQF Level 10
SCQF Credit Points

At least 480 credits of which a minimum of 180 are at SHE levels 3 and H including a minimum of 90 at SHE level H

General information

The Scottish Bachelors degree with Honours is typically offered through the equivalent of four years of full-time higher education. It is awarded mainly as either a Bachelor of Science (BSc Hons), or a Bachelor of Arts (BA Hons).

Design of qualification

All Honours degrees will exhibit a balance of breadth and depth as will be clear from particular programme specifications. Many Honours degrees will have a specific vocational focus, and in some cases will carry recognition by the appropriate professional or statutory body. In a small number of universities, in some faculties, this qualification is titled 'MA (Hons)'. The Honours degree is the recognised 'normal' entry requirement to postgraduate study and to many professions across the UK.

Typically, holders of the degree with Honours will be able to:

Demonstrate a systematic, extensive and comparative knowledge and understanding of the subject(s) as a whole and its links to related subject(s);

Demonstrate a detailed knowledge of a few specialisms and developments, some of which are at, or informed by, the forefront of the subject;

Use their knowledge, understanding and skills in the systematic and critical assessment of a wide range of concepts, ideas, and data (that may be incomplete), and in identifying and analysing complex problems and issues; demonstrate some originality and creativity in formulating, evaluating and applying evidence-based solutions and arguments.

Show a critical understanding of the established theories, principles and concepts, and of a number of advanced and emerging issues at the forefront of the subject(s);

Show a comprehensive knowledge and familiarity with essential and advanced materials, techniques and skills including some at the forefront of the subject;

Communicate the results of their study and other work accurately and reliably using the full repertoire of the principal concepts and constructs of the subject(s).

Show a critical understanding of the uncertainty and limits of knowledge and how it is developed and an ability to deploy established techniques of analysis and enquiry within the subject;

Systematically identify and address their own learning needs both in current and in new areas, making use of research, development and professional materials as appropriate, including those related to the forefront of developments.

Develop skills in identifying information needs, and in the systematic gathering, analysis and interpretation of ideas, concepts and qualitative and quantitative data and information from a range of evaluated sources including current research, scholarly, and/or professional literature;

Apply their subject-related and transferable skills in contexts of a professional or equivalent nature where there is a requirement for:

- the exercise of personal responsibility and initiative;
- decision-making in complex and unpredictable contexts;
- the ability to undertake further developments of a professional or equivalent nature.

Masters Degrees

SCQF Level 11
SCQF Credit Points

At least 180 credits of which a minimum of 150 are at SHE level M. For integrated Masters, at least 600 credits of which a minimum of 120 are at SHE level M. (Credit definitions do not normally apply to the MPhil)

General information

The Masters degree is available through several different routes: as a programme for graduates or equivalent, through at least one year of full-time postgraduate study or an equivalent period of part-time study; as a programme of typically the equivalent of five years' full-time study that integrates a period of undergraduate study with the Masters degree.

The first of these typically leads to award of Master of Science or Master of Arts, depending on the subject taken, but other titles are also used. Integrated programmes, frequently offered over the equivalent of five years' full-time study, typically lead to a subject-specific qualification title (e.g. MEng) and are often linked to professional/statutory body recognition.

Design of qualification

In the majority of cases, the Masters degree reflects a specialised knowledge and understanding of particular areas, applications or levels of expertise in particular subject or professional areas. In some professional areas, Masters degrees are linked to structures of continuing professional development.

Typically, holders of the qualification will be able to:

Demonstrate 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;

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.

Show a comprehensive understanding of techniques applicable to their own research or advanced scholarship;

Demonstrate self-direction and originality in tackling and solving problems, and act autonomously in planning and implementing tasks at a professional or equivalent level.

Demonstrate 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;

Continue to advance their knowledge and understanding, and develop new skills to a high level.

Show a conceptual understanding that enables the student:

- to evaluate critically current research and advanced scholarship in the discipline, and to evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses.
- to demonstrate the qualities and transferable skills necessary for employment requiring: the exercise of initiative and personal responsibility; decision-making in complex and unpredictable situations; and the independent learning ability required for continuing professional development.

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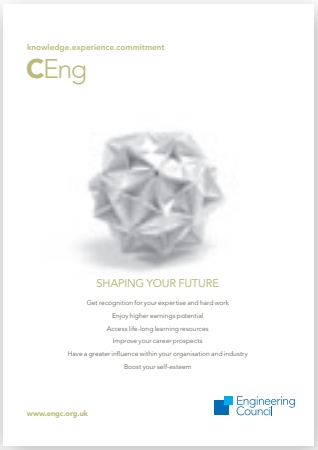

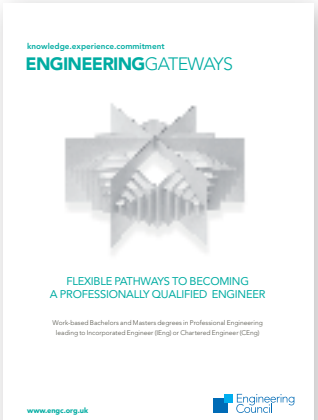

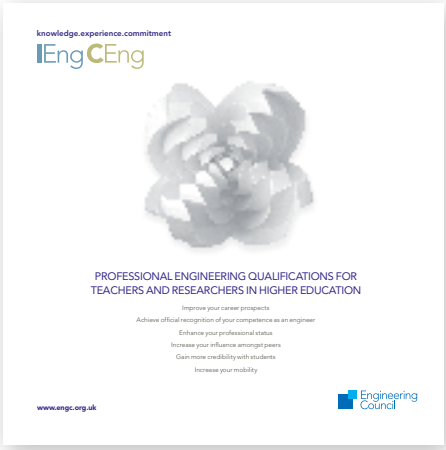

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