Accreditation of HE Programmes (AHEP): Collated learning outcomes for six areas of learning

Science and mathematics			
Programmes accredited for IEng	**Programmes accredited for CEng**		
Bachelors Degrees and Bachelors (Honours)	**Bachelors (Honours) Degrees accredited as partly meeting the educational requirement for CEng** ***(Further learning to Masters level will be required)***	**Integrated Masters (MEng) Degrees**	**Masters Degrees[1] other than the Integrated Masters (MEng) (Accredited as further learning to Masters level, partly meeting the educational requirement for CEng)**
Engineering is underpinned by science and mathematics, and other associated disciplines, as defined by the relevant professional engineering institution(s). Graduates will need:	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:	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:	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:
• Knowledge and understanding of the scientific principles underpinning relevant current technologies, and their evolution	• 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	• 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	• A comprehensive understanding of the relevant scientific principles of the specialisation
• Knowledge and understanding of mathematics and an awareness of statistical methods necessary to support application of key engineering principles.	• 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	• 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.	• 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 critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the 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.	• 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.

[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).

Engineering analysis			
Programmes accredited for IEng	**Programmes accredited for CEng**		
Bachelors Degrees and Bachelors (Honours)	**Bachelors (Honours) Degrees accredited as partly 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, partly meeting the educational requirement for CEng)**
Engineering analysis involves the application of engineering concepts and tools to the solution of engineering problems. Graduates will need:	Engineering analysis involves the application of engineering concepts and tools to the solution of engineering problems. Graduates will need:	Engineering analysis involves the application of engineering concepts and tools to the solution of engineering problems. Graduates will need:	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 to monitor, interpret and apply the results of analysis and modelling in order to bring about continuous improvement	• Understanding of engineering principles and the ability to apply them to analyse key engineering processes	• Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes	
• Ability to apply quantitative methods in order to understand the performance of systems and components	• Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques	• Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques	
• Ability to use the results of engineering analysis to solve engineering problems and to recommend appropriate action	• Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action	• 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	• Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations
• Ability to apply an integrated or systems approach to engineering problems through know-how of the relevant technologies and their application.	• Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems.	• 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 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.	• 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			
Programmes accredited for IEng	**Programmes accredited for CEng**		
Bachelors Degrees and Bachelors (Honours)	**Bachelors (Honours) Degrees accredited as partly 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, partly meeting the educational requirement for CEng)**
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:	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:	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:	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:
• Be aware of business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics	• Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics	• Understand and evaluate 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	• 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	• 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 be aware that this may affect the design	• Work with information that may be incomplete or uncertain and quantify the effect of this on the design	• 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, 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
• Apply problem-solving skills, technical knowledge and understanding to create or adapt design solutions that are fit for purpose including operation, maintenance, reliability etc	• 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	• 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	
• Manage the design process, including cost drivers, and evaluate outcomes	• Plan and manage the design process, including cost drivers, and evaluate outcomes	• Plan and manage the design process, including cost drivers, and evaluate outcomes	
• Communicate their work to technical and non-technical audiences.	• Communicate their work to technical and non-technical audiences.	• 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	• 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.	• Ability to generate an innovative design for products, systems, components or processes to fulfil new needs.

Economic, legal, social, ethical and environmental context			
Programmes accredited for IEng	**Programmes accredited for CEng**		
Bachelors Degrees and Bachelors (Honours)	**Bachelors (Honours) Degrees accredited as partly 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, partly meeting the educational requirement for CEng)**
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:	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:	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:	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	• Understanding of the need for a high level of professional and ethical conduct in engineering and a knowledge of professional codes of conduct	• 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	• Awareness of the need for a high level of professional and ethical conduct in engineering
• Knowledge and understanding of the commercial, economic and social context of engineering processes	• Knowledge and understanding of the commercial, economic and social context of engineering processes	• Knowledge and understanding of the commercial, economic and social context of engineering processes	• Awareness that engineers need to take account of the commercial and social contexts in which they operate
• Knowledge of management techniques that may be used to achieve engineering objectives	• Knowledge and understanding of management techniques, including project management, that may be used to achieve engineering objectives	• 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	• Knowledge and understanding of management and business practices, their limitations, and how these may be applied in the context of the particular specialisation
• Understanding of the requirement for engineering activities to promote sustainable development	• Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate	• Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate	• Awareness that engineering activities should 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	• Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues	• 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	• Awareness of relevant regulatory requirements governing engineering activities in the context of the particular specialisation
• Awareness of risk issues, including health & safety, environmental and commercial risk.	• Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, and of risk assessment and risk management techniques.	• 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	• 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.
		• Understanding of the key drivers for business success, including innovation, calculated commercial risks and customer satisfaction.	

Engineering practice			
Programmes accredited for IEng	**Programmes accredited for CEng**		
Bachelors Degrees and Bachelors (Honours)	**Bachelors (Honours) Degrees accredited as partly 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, partly meeting the educational requirement for CEng)**
This is the practical application of engineering skills, combining theory and experience, and use of other relevant knowledge and skills. This can include:	This is the practical application of engineering skills, combining theory and experience, and use of other relevant knowledge and skills. This can include:	This is the practical application of engineering skills, combining theory and experience, and use of other relevant knowledge and skills. This can include:	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:
• Knowledge of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc)	• Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc)	• Understanding 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 of characteristics of particular materials, equipment, processes, or products	• Knowledge of characteristics of particular equipment, processes, or products, with extensive knowledge and understanding of a wide range of engineering materials and components;	• Advanced level knowledge and understanding of a wide range of engineering materials and components
• Knowledge and understanding of workshop and laboratory practice	• Ability to apply relevant practical and laboratory skills	• Ability to apply relevant practical and laboratory skills	
• Ability to use and apply information from technical literature	• Understanding of the use of technical literature and other information sources	• Understanding of the use of technical literature and other information sources	
	• Knowledge of relevant legal and contractual issues	• Knowledge of relevant legal and contractual issues	
• Ability to use appropriate codes of practice and industry standards	• Understanding of appropriate codes of practice and industry standards	• Understanding of appropriate codes of practice and industry standards	
• Awareness of quality issues and their application to continuous improvement	• Awareness of quality issues and their application to continuous improvement	• Awareness of quality issues and their application to continuous improvement	
	• Ability to work with technical uncertainty	• Ability to work with technical uncertainty	
		• A thorough understanding of current practice and its limitations, and some appreciation of likely new developments	• 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	• Ability to apply engineering techniques taking account of a range of commercial and industrial constraints
• Awareness of team roles and the ability to work as a member of an engineering team.	• Understanding of, and the ability to work in, different roles within an engineering team.	• 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.	• 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			
Programmes accredited for IEng	**Programmes accredited for CEng**		
Bachelors Degrees and Bachelors (Honours)	**Bachelors (Honours) Degrees accredited as partly 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, partly meeting the educational requirement for CEng)**
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:	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:	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:	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	• Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities	• Apply their skills in problem solving, communication, working with others, information retrieval and the effective use of general IT facilities	• 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 self-learning and improve performance, as the foundation for lifelong learning/CPD	• Plan self-learning and improve performance, as the foundation for lifelong learning/CPD	• Plan self-learning and improve performance, as the foundation for lifelong learning/CPD
• Plan and carry out a personal programme of work	• Plan and carry out a personal programme of work, adjusting where appropriate	• Monitor and adjust a personal programme of work on an on-going basis	• Monitor and adjust a personal programme of work on an on-going basis
• Exercise personal responsibility, which may be as a team member.	• Exercise initiative and personal responsibility, which may be as a team member or leader.	• Exercise initiative and personal responsibility, which may be as a team member or leader.	• 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.eng.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