

## Underpinning Knowledge & Understanding Criteria for CEng Registration

### 1. Science and mathematics

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

UK&U Criteria	Examples
<p><b>1.1</b> - 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.</p>	<p>You need to demonstrate your knowledge and understanding of the mathematical, scientific and engineering principles that underpin your experience within your area of expertise/specialism within building services engineering and the built environment.</p> <p>Give examples to demonstrate where you have applied numerate and scientific approaches to problem solving on a project or range of projects in your career including how you would assess any limitations.</p>
<p><b>1.2</b> - 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</p>	<p>It is likely you will have gained your underpinning knowledge incrementally over your career and through a variety of methods. You should provide details, with examples, of how you have gained this knowledge, how you have kept up to date in terms of emerging technologies, as well as developing and building upon this knowledge over time. You may now be supervising or managing others and required to check the application of mathematical and computer modelling techniques (being knowledgeable of their limitations) used by junior members of the team.</p>
<p><b>1.3</b> - 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</p>	
<p><b>1.4</b> - Awareness of developing technologies related to own specialisation</p>	
<p><b>1.5</b> - A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations</p>	<p>Over your career you will have used your underpinning knowledge and understanding to undertake and apply engineering principles to problems as well as being able to implement engineering processes and technologies. You should provide examples of where you have applied mathematical and computational models effectively, relevant to the built environment, and show that you have an understanding and importantly an appreciation of their limitations.</p>
<p><b>1.6</b> - 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.</p>	

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	<p>You should be able to demonstrate, by giving examples from your career, how you have developed your ability to analyse and extract data pertinent to an unfamiliar problem you have faced.</p>
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### 2. Engineering analysis

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

UK&U Criteria	Examples
<b>2.1</b> - Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes	<p>You will need to demonstrate you have a thorough understanding of current engineering principles as well as their limitations. Throughout your career you will have examples, and need to demonstrate, where you have used your knowledge to investigate new, innovative and/or emerging technologies to give solutions to problems faced.</p> <p>You may be able to provide examples of where you have used control systems or demonstrate control principles in relation to your building services engineering specialty. Consideration should also be given as to where your technical knowledge considers statutory and safety requirements.</p> <p>You should demonstrate how and when you have applied mathematical and computer based models for solving problems in unfamiliar situations during your career development. Examples may be drawn from when you have worked with different clients or on different projects. You should be able to show how you have evaluated your decisions when supervising others. Show how you question other people's decisions and results using your own underpinning knowledge and understanding.</p>
<b>2.2</b> - Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques	
<b>2.3</b> - 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	
<b>2.4</b> - Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems	
<b>2.5</b> - Ability to use fundamental knowledge to investigate new and emerging technologies	
<b>2.6</b> - Ability to extract and evaluate pertinent data and to apply engineering analysis techniques in the solution of unfamiliar problems.	

### 3. An Integrated approach to Building Services Engineering

*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. You will therefore need to demonstrate the knowledge, understanding and skills to:*

UK&U Criteria	Examples
<p><b>3.1</b> - Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics</p>	<p>Using your technical knowledge and understanding spanning across your career you should be able to give a variety of examples of how you have used processes and methodologies together with how you have adapted them, holistically, for the areas for which you have responsibility. These should be in particularly complex situations and demonstrate your ability to generate new and innovative solutions where due consideration has been given to their impact.</p> <p>Give examples of your structured, unstructured and on the job learning over the years and how you have built and developed your own learning to be able to apply your advanced problem solving skills and your underpinning technical knowledge in order to deliver engineering solutions relating to aspects of design, products, operation and maintenance of the built environment.</p> <p>You should be able to demonstrate a high degree of lateral thinking in the analysis, resolution and integration of engineering unfamiliar problems and how they have been applied, to the satisfaction of others, to projects for which you have had responsibility.</p> <p>Career development will have, by necessity, involved others for which you have had responsibility. You will need to demonstrate a progressive skillset of staff development and interpersonal skills together with the ability to communicate to both technical and non-technical colleagues a reasoned engineering argument that satisfies their expectations.</p>
<p><b>3.2</b> - 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</p>	
<p><b>3.3</b> - Work with information that may be incomplete or uncertain, quantify the effect of this on the process and, where appropriate, use theory or experimental research to mitigate deficiencies.</p>	
<p><b>3.4</b> - 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</p>	
<p><b>3.5</b> - Plan and manage the process, including cost drivers, and evaluate outcomes</p>	
<p><b>3.6</b> - Communicate their work to technical and non- technical audiences</p>	
<p><b>3.7</b>- Demonstrate wide knowledge and comprehensive understanding of processes and methodologies and the ability to apply and adapt them in unfamiliar situations</p>	
<p><b>3.8</b>- Demonstrate the ability to generate an innovative solutions for products, systems, components or processes to fulfil new needs.</p>	