APPENDIX B
MASTERS DEGREES OTHER THAN THE INTEGRATED MASTERS, AND ENGD LEARNING OUTCOMES.

Institution of MECHANICAL ENGINEERS

Output Standards for Accredited Programmes based on The Accreditation of Higher Education Programmes (AHEP) 3rd Edition

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

Masters degrees (other than the Integrated Masters) accredited as further learning to Masters Level for the purposes of registration with the Engineering Council vary in nature and purpose. Some offer the chance to study in greater depth particular aspects or applications of a broader discipline in which the graduate holds an Honours degree at Bachelors level. Others bring together different engineering disciplines or subdisciplines in the study of a particular topic, or engineering application, while a further category may be truly multidisciplinary. Masters programmes also provide an opportunity to integrate the technical and non-technical aspects of engineering and to develop a commitment to professional and social responsibility and ethical codes.

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

The Engineering Doctorate (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. 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.

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.

Learning outcomes specified in AHEP for Masters degrees (other than the Integrated Masters) accredited as further learning to CEng level, and for Engineering Doctorates (EngD) accredited as further learning to CEng level.

INTERPRETATION

In the tables below the following terms are used with the meanings stated:

Understanding is the capacity to use concepts creatively, for example, in problem solving, design, explanations and diagnosis.	**Knowledge** is information that can be recalled.	**Know-how** is the ability to apply learned knowledge and skills to perform operations intuitively, efficiently and correctly.
Skills are acquired and learned attributes that can be applied almost automatically.	**Awareness** is general familiarity, albeit bounded by the needs of the specific discipline.	**Complex** implies engineering problems, artefacts or systems that involve dealing simultaneously with a sizeable number of factors that interact and require deep understanding, including knowledge at the forefront of the discipline, to analyse or deal with.

Numbers follow on from numbering given for Bachelors and integrated Masters degree learning outcomes, with a capital M to distinguish from integrated Masters (MEng) learning outcomes where there are differences. Where a learning outcome is described in identical language to that for integrated Masters degrees it is numbered identically in Annex A. Note the numbering is only for the purpose of enabling a matrix for EAB submissions.

SCIENCE AND MATHEMATICS (SM)	
Engineering is underpinned by science and mathematics, and other associated disciplines. The main science and mathematical abilities will have been developed in an accredited engineering undergraduate programme. Masters graduates will therefore need additionally:	
SM7M	A comprehensive understanding of the relevant scientific principles of the specialisation
SM8M	A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation
SM9M	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

ENGINEERING ANALYSIS (EA)	
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:	
EA5m	Ability to use fundamental knowledge to investigate new and emerging technologies
EA6M	Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations
EA7M	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

DESIGN (D)	
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:	
D9M	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
D10M	Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations
D11M	Ability to generate an innovative design for products, systems, components or processes to fulfil new needs

ECONOMIC, LEGAL, SOCIAL, ETHICAL AND ENVIRONMENTAL CONTEXT (EL)	
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:	
EL8M	Awareness of the need for a high level of professional and ethical conduct in engineering
EL9M	Awareness that engineers need to take account of the commercial and social contexts in which they operate
EL10M	Knowledge and understanding of management and business practices, their limitations, and how these may be applied in the context of the particular specialisation
EL11M	Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate
EL12M	Awareness of relevant regulatory requirements governing engineering activities in the context of the particular specialisation
EL13M	Awareness of and ability to make general evaluations of risk issues in the context of the particular specialisation, including health & safety, environmental and commercial risk

ENGINEERING PRACTICE (P)	
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:	
P9m	A thorough understanding of current practice and its limitations, and some appreciation of likely new developments
P10m	Ability to apply engineering techniques, taking account of a range of commercial and industrial constraints
P11m	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
P12M	Advanced level knowledge and understanding of a wide range of engineering materials and components

ADDITIONAL GENERAL SKILLS (G)	
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:	
G1	Apply their skills in problem solving, communication, information retrieval, working with others, and the effective use of general IT facilities
G2	Plan self-learning and improve performance, as the foundation for lifelong learning/CPD
G3m	Monitor and adjust a personal programme of work on an on-going basis
G4	Exercise initiative and personal responsibility, which may be as a team member or leader

Other reference points are:

- QAA's Framework for HE Qualifications in England, Wales and Northern Ireland: **http://www.qaa.ac.uk/assuring-standards-and-quality/the-quality-code/qualifications**
- The Scottish Credit and Qualifications Framework: **www.scqf.org.uk**
- 'Doctoral degree characteristics' published by the QAA in September 2011: **www.qaa.ac.uk/en/Publications/Documents/Doctoral_Characteristics.pdf**
- The UK-SPEC standard of competence and commitment for CEng: **www.engc.org.uk/ukspec**