MSc with Qualifying Year
Guidelines for MSc programmes that enable a graduate with a science or mathematics degree to become chartered though the academic route

Introduction

These guidelines have been written for universities who are developing MSc programmes. The aim is demonstrate the many ways that MSc programmes can be part of the pathway to become a Chartered Engineer.

1. A graduate with an UK accredited BEng (Hons) that is recognised as part of the educational base to become a Chartered Engineer completes an accredited MSc programme. This is a standard route.
2. A graduate with a degree that is accredited as the educational base for an IEng (e.g. BSc) or someone who has completed the educational base to become an IEng (e.g. FD + FL) completes a technical MSc programme in engineering will have to submit to the Individual Case Procedure even if the MSc programme is accredited.. This pathway is a recommended pathway
3. A graduate with a degree in civil (or structural or transport) engineering which is not accredited (e.g. overseas) completes an MSc programme in engineering will have to submit to the Individual Case Procedure even if the MSc programme is accredited. This pathway is a recommended pathway.
4. A graduate with a cognate degree in science or mathematics completes an MSc programme in civil, structural or transport engineering. They would have to submit to the Individual Case Procedure even if the MSc programme is accredited. This is recommended pathway.
5. A graduate with a cognate degree in science or mathematics completes an accredited MSc programme in engineering with a prequalifying year in civil, structural or transport engineering. This pathway is a recommended pathway.

These guidelines cover the recommended pathway (5). Pathways 1 – 4 listed above are covered by separate guidelines.

The Recommended Model

The guidelines were developed from the guidelines for the MEng programme. There are three distinct features of the proposed programme that apply to the graduate with a cognate degree:-

- Graduates will have completed the outcome requirements for the underlying science and mathematics principles and normally their degree would be at least an upper second class honours
- Graduates will have achieved the general learning outcomes
- The focus of the accredited programme has to be on engineering

While it is recognised that it is possible for a graduate with a cognate degree to complete an accredited MSc programme and become Chartered this is can only take place if the initial professional development matches the educational base and therefore has to be assessed on an individual basis.
.
In general, most accredited degree programmes develop from the underlying scientific principles through the engineering principles to engineering practice. It is proposed that an accredited MSc programme that meets these guidelines would be typically:-

- a two year programme of technical education (as opposed to broadening);
- include engineering modules from years two and three (three and four in Scotland) of a JBM accredited programme in the first year of the MSc programme;

- and the second year is an accredited MSc technically deepening programme (see guidelines for technical and non technical MSc).

Academic Requirements

The essence of an educational base incorporating a cognate science or mathematics degree is to ensure that the education of students to an appropriate depth of understanding and breadth of knowledge needed to work within and, eventually, to lead and manage inter-disciplinary teams; that is it must meet the principles of the ‘gold standard’ educational base the MEng.

While the educational base is assessed on the outcomes the degree programme has to be designed for a certain standard of entry. It suggests that graduates with cognate degree should have achieved the equivalent of an upper second class honours degree or a lower second class honours degree with industrial experience.

Since the programme will be designed for students with high academic ability and motivation, the course needs to make provision for:[1]

- Sufficient time to cover the underlying engineering principles
- *Sufficient time to achieve the additional standards of the educational base for a Chartered Engineer.*
- *Analytical treatment, comparable in depth intellectually, to the highest standards for undergraduates.*
- *Both depth and breadth of coverage to meet the needs of industry in technical subjects, management and business topics and personal skills.*
- *A foundation for a wide range of subsequent study and the development of a positive attitude and motivation towards lifelong learning.*

The need to incorporate 50% of the programme covering the underlying engineering sciences (mathematics, physics and chemistry) is not necessary since they will have exceeded the requirements in their first, cognate degree.

The engineering content of the programme should be constructed around at least five core subjects from those listed below that are appropriate to the Institutions concerned in the accreditation of civil and structural engineering programmes. These core subjects should reflect the aims of the degree programme, and they should embrace theory, analysis, design and engineering practice. They should also provide an appropriate integration of the engineering sciences, mathematics, mechanics and materials. The JBM would expect to see degree programmes that contain the three core subjects of structures, materials and geotechnics, with a choice of at least two others from fluid mechanics (hydraulics), surveying (geomatics and measurement) and, for example, transport infrastructure engineering, public health, construction management, environmental engineering and architectural technology. The chosen core subjects should be developed to a depth where the time spent on them represents at least one third of the total curriculum. If fluid mechanics and surveying are not included within the core subjects then the JBM would expect to see the fundamentals of these subjects covered elsewhere in the degree programmes. It is anticipated that programmes would cover at least introductory aspects of most of the subjects listed above that are not included in a core selection.

The engineering subjects should be taught in the context of design (see Annex B – Design in Degree Programmes), with appropriate account of issues of sustainability (see Annex C – Sustainable Development in Degree Programmes) and construction, so that each forms a continuous and integrating thread running through the programme. Programmes should expose students to a thorough mixture of analysis, synthesis and conceptual design, and – through contact with other issues – they should be stretched to ensure development of their capabilities to operate at a high intellectual level, including the exercise of judgement.

There is no need to include mathematics as an identifiable discipline since the graduate with an appropriate cognate degree will have already have achieved the necessary outcomes at the right

[1] The text in italics is taken from the JBM guidelines for MEng programmes

standard. However, e*lements involving calculation, experiment, observation and deduction, must form a significant part of the programme.*

Experimental work is important and should extend beyond routine classical testing and experiments in the laboratory. Field courses in subjects such as surveying, geology and environmental issues are also important, particularly where these subjects form an integral part of the programme.

Graduates with an appropriate cognate degree will have already covered subjects which could be classed as broadening. However there is a need to ensure that students following this programme should learn *to recognise and manage risk*. *This will involve the student in technical assessment and management (including project and budgetary control), and an understanding of environmental and occupational health and safety risks. An understanding of health and safety issues and the need to design and operate safe systems of work is mandatory for practising engineers; programmes must expose students to the wider social, commercial and legal contexts and engender an appreciation of the value of design and of good practice in the reduction of risk (see Annex D – Health and Safety Risk Management in Degree Programmes).*

Graduates with appropriate cognate degrees will have developed effective verbal and written communication skills for dealing with non-engineers, public speaking and presenting written material in clear and precise English. They should be encouraged to develop these skills further with a particular focus on communicating engineering concepts to engineers and non-engineers.

Graduates with appropriate cognate degrees will have developed competency in the use of computers and IT skills.

Sustainability issues in their broadest sense are of vital concern in professional engineering. It is important that graduates have an understanding of these and are able to take them into account in the design and construction processes. Wherever relevant, these issues should be woven into the separate subjects within the programme (see Annex C – Sustainable Development in Degree Programmes).

Programmes should introduce the concept of quality systems and the need for a quality approach to be intrinsic to all activities.

Graduates with an appropriate cognate degree are likely to have completed an investigative project but they should undertake a further, major investigative project in an engineering discipline to *provide scope for initiative, creative thinking, understanding the research method, and should be intellectually challenging and individually assessed*. *Additionally, students should be engaged in a group design project, which provides opportunities for integrating earlier modules, and will assist in the development of team working. Both forms of project should normally be linked to real problems.*

There should be strong, viable and visible links between departments and the profession. It is strongly recommended that local practising engineers should become involved with the education of students by, for example, giving appropriate lectures, internal talks, assisting with design projects, acting as industrial tutors, and enabling students to make site visits. Regular site visits should be seen as an important element within the programme. Industrial liaison groups should be established and should meet regularly to identify how local and national needs for graduate employment might influence programmes.

Programmes should not be overloaded and need to encourage the development of exploratory self-learning. Time should be available within the programmes to allow students to take advantage of a range of other opportunities.

Site visits and attendance at professional body/institution meetings are important elements of engineering education and the JBM actively encourages these activities. Direct links between universities and professional bodies are encouraged.

Appendix A Learning Outcomes

General Learning Outcomes

Learning Outcomes	Learning Outcomes to complete the educational base for a Chartered Engineer	Learning outcomes for Science Degrees (Gaps to be completed by the MSc with Qualifying Year)
Knowledge and Understanding	Knowledge and understanding of essential facts, concepts, theories and principles of their engineering discipline, and its underpinning science and mathematics	Knowledge and understanding of essential facts, concepts, theories and principles of the underpinning science and mathematics
	Appreciation of the wider multidisciplinary engineering context and its underlying principles.	
	Appreciate the social, environmental, ethical, economic and commercial considerations affecting the exercise of their engineering judgment.	Appreciate the social, environmental, ethical, economic and commercial considerations
Intellectual Abilities	Apply appropriate quantitative science and engineering tools to the analysis of problems.	Apply appropriate quantitative science tools to the analysis of problems.
	Demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs.	
	Able to comprehend the broad picture and thus work with an appropriate level of detail.	Able to comprehend the broad picture and thus work with an appropriate level of detail.
Practical Skills	Laboratories and workshops	Laboratories and workshops
	Work experience	
	Individual and group project work	Individual and group project work
	Design work	
	Development and use of computer software in design, analysis and control	Development and use of computer software in analysis
	Evidence of group working and of participation in a major project	
General Transferable Skills	Problem solving	Problem solving
	Communication	Communication
	Working with others	Working with others
	Use of general IT facilities	Use of general IT facilities
	Information retrieval skills	Information retrieval skills
	Planning self learning	Planning self learning
	Improving performance	Improving performance

Specific Learning Outcomes in Engineering

Learning Outcomes	Learning Outcomes to complete the educational base for a Chartered Engineer	Learning outcomes for Science Degrees
Underpinning science and mathematics, and associated engineering disciplines, as defined by the relevant engineering institution	Knowledge and understanding of scientific principles and methodology	Knowledge and understanding of scientific principles and methodology
	Enable appreciation of its scientific and engineering context	Enable appreciation of its scientific context
	Understanding of historical, current, and future developments and technologies	Understanding of historical, current, and future developments and technologies
	Knowledge and understanding of mathematical principles	Knowledge and understanding of mathematical principles
	Enable them to apply mathematical methods, tools and notations proficiently in the analysis and solution of engineering problems;	Enable them to apply mathematical methods, tools and notations proficiently in the analysis of engineering problems;
	Ability to apply and integrate knowledge and understanding of other engineering disciplines	
Engineering Analysis	Understanding of engineering principles and principles;	
	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 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;	Ability to apply quantitative methods and computer software
	Understanding of and ability to apply a systems approach to engineering problems.	
Design	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	Knowledge of characteristics of particular materials, equipment, processes, or products;	
	Workshop and laboratory skills;	Workshop and laboratory skills;
	Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology development, etc.);	
	Understanding use of technical literature and other information sources;	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.	